Research Synthesis
Discussion Paper | Water Sensitive Cities Institute

Ideas for a Waterwise Queens Park Regional Open Space

A sports pitch in the bush

Water Sensitive Cities Institute

Contributors
Jamie Ewert[1], Emma Yuen[1], Greg Ingleton[2], Jarrod Hill[3], Helen Brookes[4], Dr Josh Byrne[5], Paul Verity[5], Aaron Wong[6], Rachel Evans[7], Stephen Carter[8]
[1]Water Sensitive Cities Institute, [2]SA Water, [3]SportEng, [4]Urbaqua, [5]Josh Byrne and Associates, [6]Carabina Architects, [7]Emerge Associates, [8]CLE

The contribution of workshop participants is also gratefully acknowledged.

Publisher: Water Sensitive Cities Institute Ltd
Level 1, 8 Scenic Blvd, Bldg 74
Monash University
Clayton VIC 3800 Australia
p. +61 3 9902 4985
e. info@crcwsc.org.au
w. www.watersensitivecities.org.au

Date of publication: June 2020

An appropriate citation for this document is:
Water Sensitive Cities Institute (2020), Ideas for Queens Park Regional Open Space. Melbourne, Australia: Water Sensitive Cities Institute.

About this document

This report presents a series of ideas to maximise the value delivered through efficient use of water at the proposed Queens Park Regional Open Space (QPROS) and to make it a WaterWise Development.

This is a large open space renewal that will accommodate a mix of sporting facilities, natural vegetation areas and passive open space. It will attract users from across Perth and beyond, as well as being a major land use feature of the local community.

The project was initiated by Department of Local Government, Sport and Cultural Industries (DLGSC), together with the City of Canning (CoC). These organisations saw an opportunity for QPROS, where possible, to consider objectives of the WA Government's Waterwise Perth Action Plan.

The project also recognises the importance of water in creating quality public infrastructure. The QPROS is located in Canning and will be used by local residents, visiting community sports clubs and elite sports teams alike. To meet their needs, the facility must provide a variety of high quality environments and water security will be paramount to ensure this outcome.

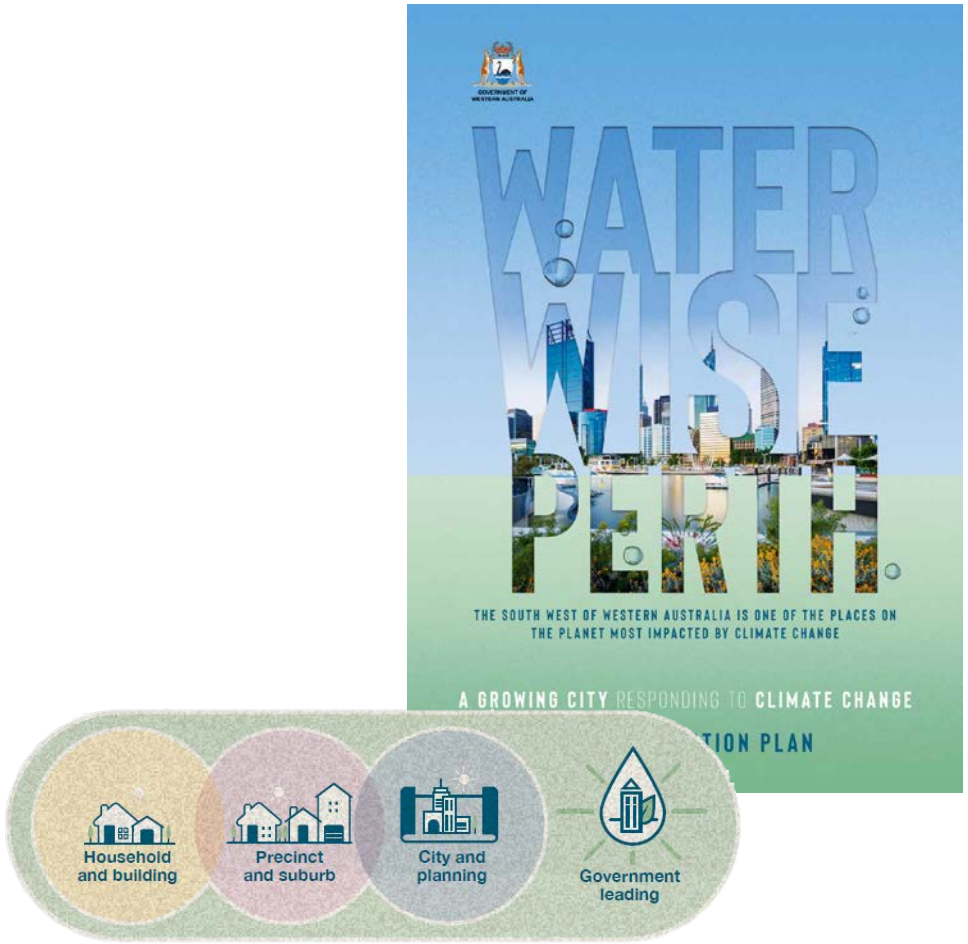
A key activity in the project was a stakeholder design workshop, held at CoC's Function Centre on 21 February 2020.

At this workshop, participants from Football West, DLGSC, City of Canning, Department of Water and Environmental Regulation, Department of Biodiversity and Conservation and Attractions and Water Corporation helped to identify the water issues for the QPROS and to shape ideas in response.

The ideas themselves can influence the next stages of planning for QPROS. At the time of the workshop, planning, sustainability, traffic and architecture consultants had just been appointed. A key task across this mix of consultants is the creation of the Development Project Brief. The ideas presented in this report provide:

- Innovations that can be further explored and developed by the individual consultant teams
- An integrating narrative to embed the Waterwise objectives in the next iteration of the master plan
- Points of discussion for further stakeholder engagement.

The ideas themselves are presented as options for further development. The workshop was focused on creation of ideas, rather than detailed evaluation. The ideas have no formal status and the participation of organisations in the workshop does not imply endorsement of the ideas.



Project approach

The project followed a rapid design process to develop ideas for QPROS. Over two days, it followed steps of understanding context, identifying key ‘problem(s)’ to be solved, using a mutli-disciplinary approach to develop initial ideas, and a stakeholder co-design workshop to test and refine these ideas.

Multi disciplinary

The project team comprised a mix of urban water planning disciplines across engineering and environmental science fields. This ensured that the ideas were not limited to water infrastructure and water saving opportunities, but also considered other aspects of site and urban design.

Site tour and initial stakeholder engagement

A key early step involved a field visit to build an understanding of context and to understand how each expert interpreted the site. A workshop with project sponsors from DLGSC, Football West and CoC followed the site visit and provided further exploration of the drivers for the project. This is an important step in defining the “shared problem” to be solved.

Idea development

The project team reflected upon the problem from a range of perspectives. Building on the insights gained from this, it then developed initial ideas and a narrative to show how these acted collectively to make QPROS more ‘waterwise’.

Stakeholder workshop

The workshop allowed the initial ideas to be socialised and refined. The workshop was designed to enhance collaboration between the major stakeholder organisations, and to foster relationships that will be maintained through following stages of the QPROS planning.

Stakeholders from internal teams in the sponsor organisations, and external stakeholders such as DWER and Water Corporation, were invited to contribute. The major output of the workshop was feedback on the initial ideas and suggestions for a second iteration.

The site tour included a visit to water sensitive urban design projects in Canning City Centre, including the innovate Wharf Street Wetland

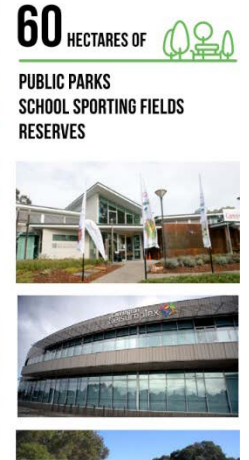
Project aims

- Provide ideas for a Waterwise QPROS
- Show what this could look like and what the benefits could be
- Identify which stakeholders need to come together to deliver these outcomes.

Context - The City of Canning

The City of Canning is committed to creating a vibrant City Centre for its diverse and multicultural population of almost 100,000 people. As such, the City Centre is currently undergoing a number of public realm transformations which underpin the delivery of 10,000 new homes for up to 25,000 new residents.

This project will support the creation of high quality local sporting facilities at Queens Park Regional Open Space (QPROS)



Context - QPROS

What is the QPROS?

QPROS is a 29 Ha park in the City of Canning. It is located along Welshpool Rd in the suburbs of Queens Park, Welshpool and East Cannington and contains remnant of Banksia/Marri bushland as well as open parkland areas.

QPROS is an important site for biodiversity. The bushland on the site has Bush Forever status to recognise the conservation value of the Southern River Vegetation Complex. Although formerly a dampland, a wetland has been constructed on the site from a Water Corporation drain, and is surrounded by degraded land. The drain lowers the local water table to enable the site to be used, while the wetland helps to manage stormwater runoff. The wetland also provides habitat for wetland animal species.

In 2017, the site was identified as a potential home for a State Football Centre for Western Australia. This would revitalise the site, whilst being sympathetic to existing ecological values. The redevelopment will expand the local sporting facilities and introduce several new playing fields, along with the construction of a sports club building and car parking.

What does ‘Waterwise” look like?

The Waterwise Perth Action Plan aims to find smarter ways to ensure that Perth remains a beautiful, green and liveable city in a changing climate where water is less secure. Its actions will be applied at a range of scales: from whole of city; to individual households; and by government, businesses and householders.

For QPROS, a waterwise approach will:

- Provide healthy trees for shade and biodiversity,
- Encourage citizens to connect with water and with Indigenous water values,
- Adopt green landscapes and playing fields that require less irrigation,
- Improve the sustainability of local groundwater aquifers and reduce stormwater pollution into the Canning River,
- Showcase water efficient buildings,
- Be a catalyst for action by others.

Context – Water

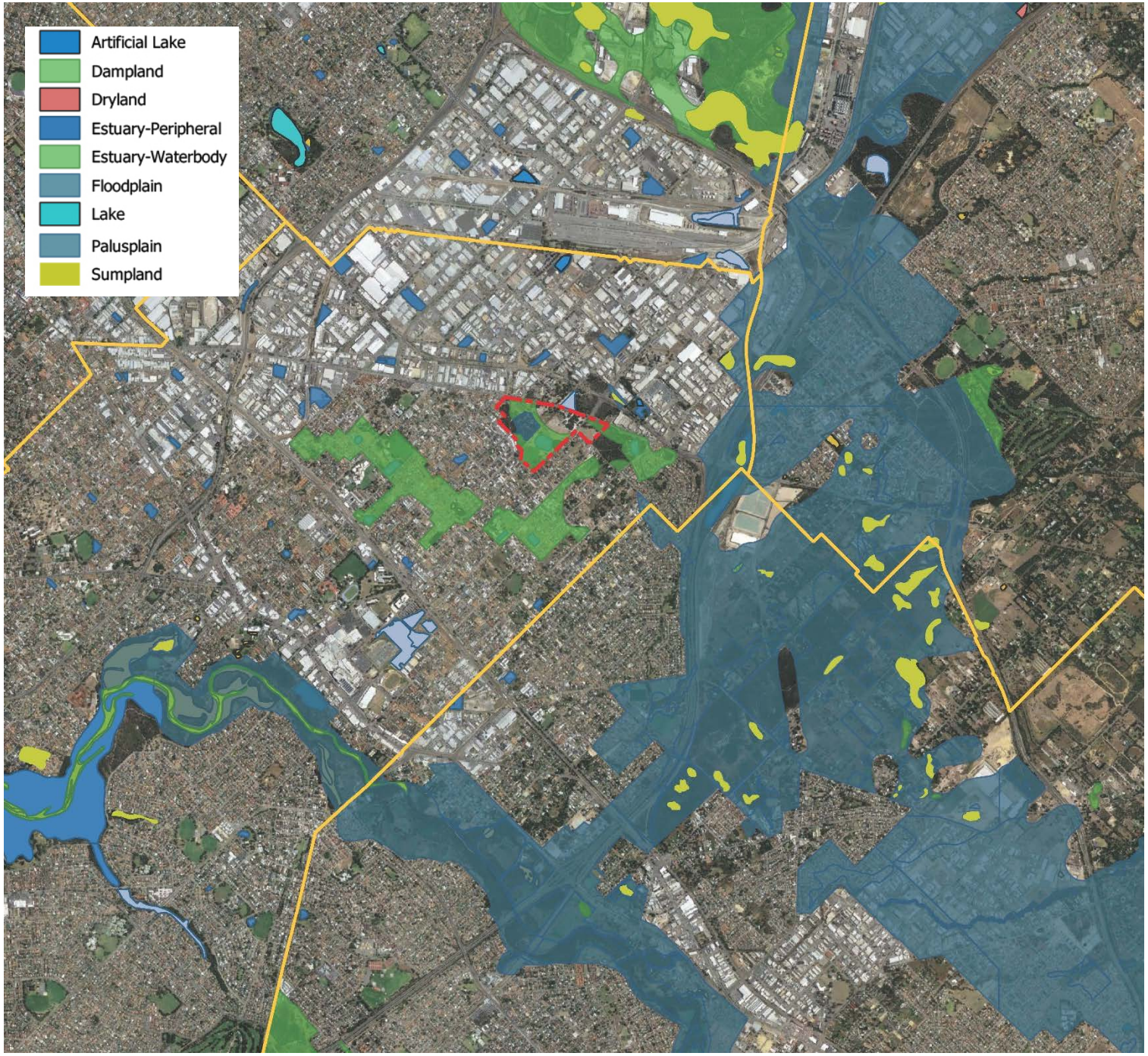
The land underlying Canning area is part of a much larger landscape linked by water catchments, subterranean and surface water features, plant and animal habitats, and people and animal movements.

The 1953 aerial photo shows a series of interconnected sump lands, palusplains and damp lands forming an extensive drainage network influenced by topography and groundwater levels.

The site is linked to Djarlgarra (The Canning River) via surface and groundwater movement. These ecological and cultural connections make it part of a much larger, interconnected system that adds to its significance.

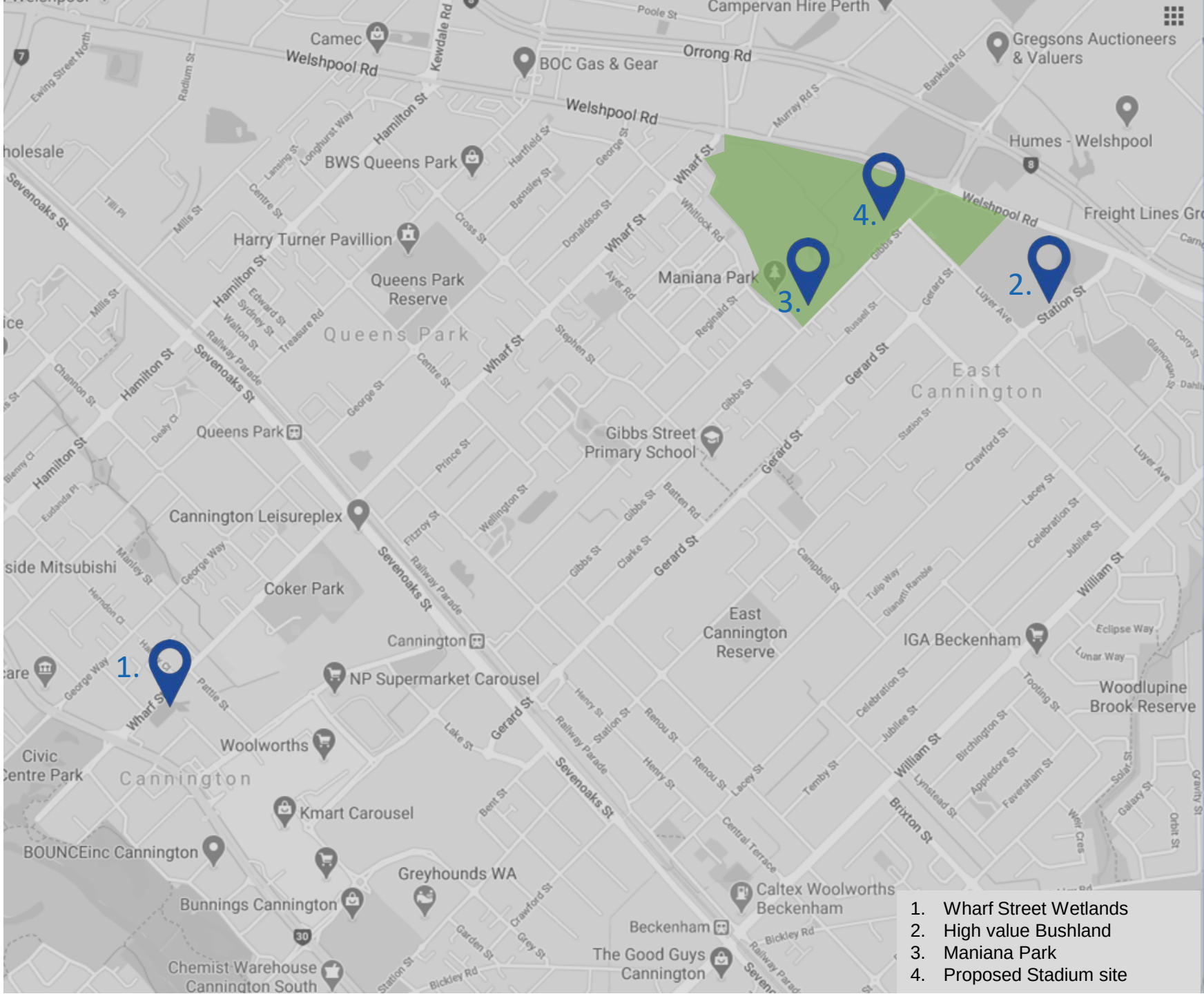
Djarlgarra (The Canning River) holds significant sites for Whadjuk Nyungar people. Water flow is intrinsically linked to the unique plants and animals of this area. In turn, they relate to the cultural and spiritual identity and stories of this area for the Whadjuk people.

Analysis of historical and existing land use and its interaction with the catchment stormwater system is important and can be used to understand current water quality levels within the system and influence long term educational strategies to reduce eutrophication and contamination with the area.
A Range of different wetland typologies are within the proximity of the project site and historically within the site itself.



Key Features

- There is a wider vision for a Riverine City for the Canning City Centre. The CoC and Water Corporation are upgrading local water infrastructure to deliver this. Despite these projects, developers are yet to fully embrace the benefits, and new development continues to turn its back on the blue and green infrastructure.
- QPROS presents a high value bushland reserve that is maintained by an active Friends group. In contrast, surrounding streets present a harsh climate, with few trees and limited sustainability practices or built form.
- City of Canning has existing groundwater allocations and bores near Queens Park. Bores are used to irrigate Maniana Park, providing a lush, green playing area. The groundwater allocation is not fully used.
- QPROS itself is hot and dry. It appears as a hot spot in local heat mapping, in contrast to Maniana Park. Whilst QPROS has open site boundaries, and there is an active Friends Group, there is little evidence of regular or active use of the site by the broader community.



Issues to be addressed

- Water supply and usage
- Drainage and groundwater
- Urban Heat Island
- Biodiversity
- Waterwise literacy and behaviours

Other issues raised

- Transport and parking
- Site safety
- Engaging the local community
- Supporting sports participation

Key Features

- There is strong community ownership of the natural environments at Queens Park, including connection to local Indigenous groups. The site is home to a number of valuable ecological assets.
- The streets immediately surrounding the park have limited tree canopy, poorer performing housing stock and do not encourage active transport.
- Queens Park itself contains several high value vegetation areas, but is otherwise a hot, dry and denuded landscape.
- Groundwater levels are naturally shallow across the site. A drainage channel traversing the site has a small base flow, but primarily functions to lower the water table rather than to convey stormwater from a wider catchment. The drainage system includes a wetland area that is periodically inundated and remains damp at other times. The site sits at the top of its catchment, with only a small external area contributing stormwater flows into Queens Park.
- Beyond the northern site boundary, a 200mm diameter Water Corporation rising main sewer follows Welshpool Road.

Success factors for a Waterwise QPROS

- The local community is engaged and can see the benefits of the QPROS redevelopment.
- High quality POS is not limited by water availability.
- Built form that integrates with natural assets.
- Increase in tree canopy.
- Best practice development, waterwise demonstration features and class leading open space.
- Enhancing and preserving bushland and biodiversity

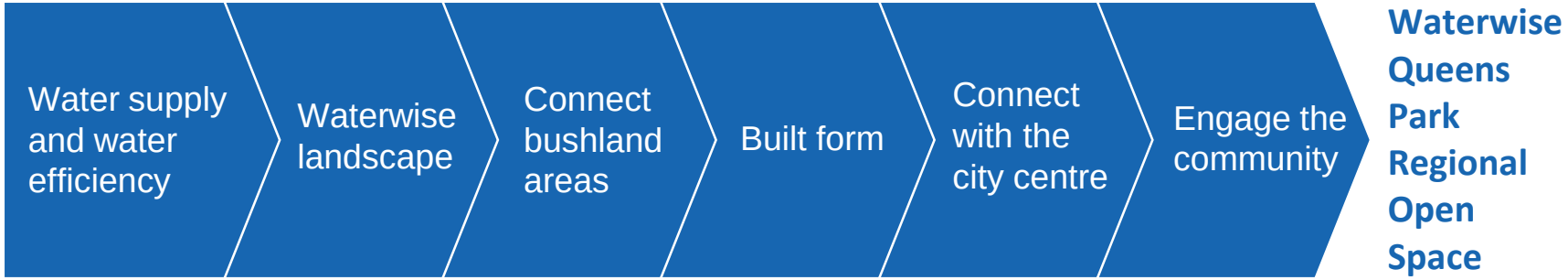
Six Waterwise ideas

There are six distinct things that can be done to make QPROS Waterwise. These are inspired by actions taken elsewhere in Perth and in other cities that are moving to become waterwise and water sensitive.

These ideas aim to:

- Make best use of water that is available locally, in preference to importing water that could be better used elsewhere,
- Being water efficient at every opportunity, considering build form and natural form across the site,
- Using water as a way to engage the local community and to welcome them into the site,
- Using water to regenerate local ecosystems and invigorate community health,
- Show what is possible to stimulate action by others elsewhere in Canning or Perth.

Water supply and water efficiency ideas form the base of these other ideas: without a secure water source for irrigation, the soccer playing fields and the vision for QPROS are unattainable. Yet this is not simply a matter of connecting to the Perth's water supply or the City of Canning's groundwater allocation.



In a Waterwise city, facilities like QPROS will create their own water security by making the best use of locally available water sources. They will also demonstrate best practice in water efficiency.

This theme extends to the broader **landscape** of the site. As it is redeveloped, there is an opportunity to adopt water-sensitive design principles. These aim to mimic the natural water cycle by allowing water that falls onto the site to soak into the ground and to recharge local groundwater, rather than being fed into drains and exported to local waterways.

When this is implemented, it will passively water vegetation on the site. This has two distinct benefits:

- A well watered landscape has been shown to reduce the urban heat island effect. Surface and air temperatures will be lower than in surrounding streets, and QPROS will offer local residents a cooler 'oasis' on hot days.
- Secondly, the long term viability of native bushland will be enhanced if the natural water balance can be retained.

If vegetation health can be secured into the future, the next big idea is to **re-connect the bushland** patches across the site. This can be achieved using Water Sensitive Urban Design principles, so the connections form a blue-green grid across the site to infiltrate rainfall, cleanse stormwater pollutants, provide shade from a distributed tree and allow dispersal of plants and animals over time.

Waterwise buildings and playing fields can then be merged into this landscape, and arranged to achieve the multiple sports, ecological and recreation objectives of the site. The built form should be an extension of the site's other Waterwise water practices, rather than a contradiction. The built form has a further opportunity to demonstrate sustainability in construction, energy use and renewable energy generation.

The first is using QPROS to mark the character of urban renewal in Queens Park and surrounding suburbs. It does this by presenting a bookend to the Riverine City approach being applied in the Canning City Centre. This approach uses sustainable water management as an urban design feature. The QPROS uses the same design principles, but is located at the top of the catchment. Over time, urban renewal using these same design elements principles can be used to **connect the city centre to QPROS**, to replace old urban design with this new approach to create a much larger, waterwise city precinct. To achieve this, it is important that the QPROS present itself as a good example of waterwise practice, and extend its waterwise features beyond its physical boundaries and into surrounding streets.

One way to do this is to encourage the local community to make use of QPROS as their de facto 'backyard'. This will generate community ownership of the site based on high quality open space, diversity of experiences, and other benefits such the aforementioned urban oasis effect on hot days.

Once on site, there is a further opportunity to **foster waterwise behaviours amongst visitors** – whether they are local community, sports participants or commercial vendors servicing the site. These behaviours might include water savings behaviours, bushland conservation, healthy lifestyles or cultural awareness fostered by promoting the Indigenous stories associated with the site.

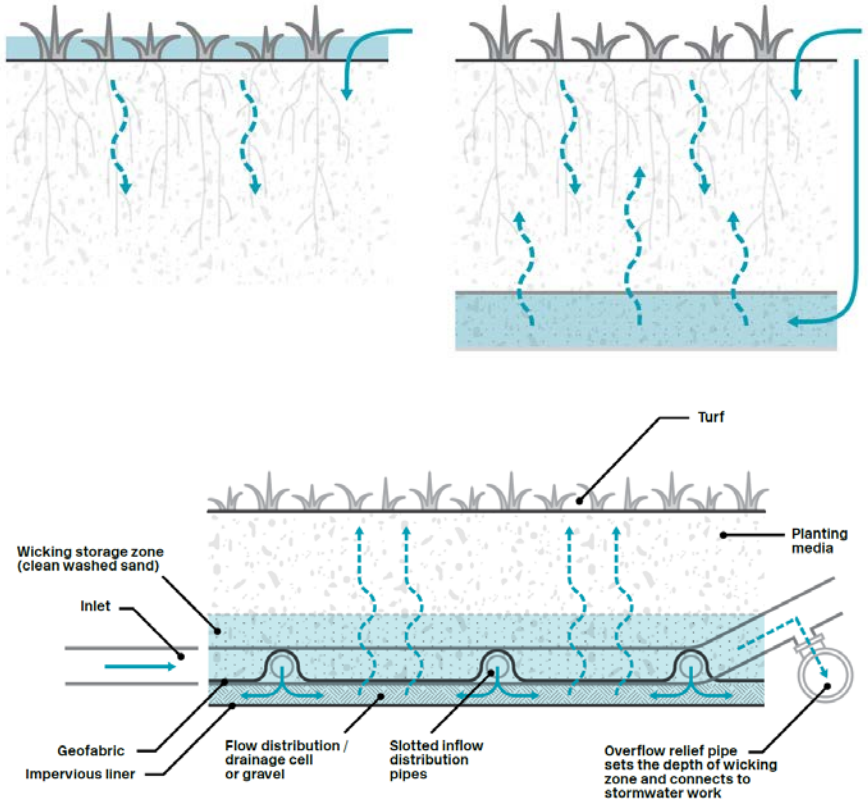
Water supply and water efficiency

In a changing climate where water is becoming scarce, there is an increasing need for newly created open space to be Waterwise. This requires consideration of where irrigation water will come from and how it will be used so that this new water demand does not burden existing supplies. By extension, there will likely be a public expectation that QPROS be self sufficient in its water supply, rather relying on groundwater that could otherwise be applied elsewhere in Canning.

The following ideas ensure that water availability is not a barrier to high quality playing fields and surfaces. The aim is to use water more efficiently for irrigation. Once this has been achieved, the next principle is to shift towards more sustainable water sources, particularly the benefits of using local water sources. The next consideration concerns the infrastructure for water, and how treatment, storage and distribution can be sustainably integrated into the site.

There is also demonstration value in a site like QPROS. It has a scale and a profile to reach thousands of people each year. If the behavior of these people can be influenced through educational and demonstration of Waterwise approaches, the investment in water infrastructure can be leveraged into larger water savings for Perth.

1. Wicking bed playing fields
The elite playing fields at QPROS can use wicking bed technology to water the turf. Wicking bed technology creates a perched water table in a sand layer, over a granular material that holds water. Surface tension between the sand and the granular that holds the water gives deep root growth and can be monitored at different sensors. By holding water in the soil profile, the turf roots are irrigated in the soil profile rather than from surface irrigation. This reduces evaporation and encourages deeper root growth.



(Top) Surface irrigation (left) uses gravity to allow water to infiltrate the soil while subsurface irrigation (right) also improves soil moisture through capillary rise
(Bottom) Subsurface irrigation can be used in a wicking application for high use turf areas
(Source: CRCWSC, 2020)

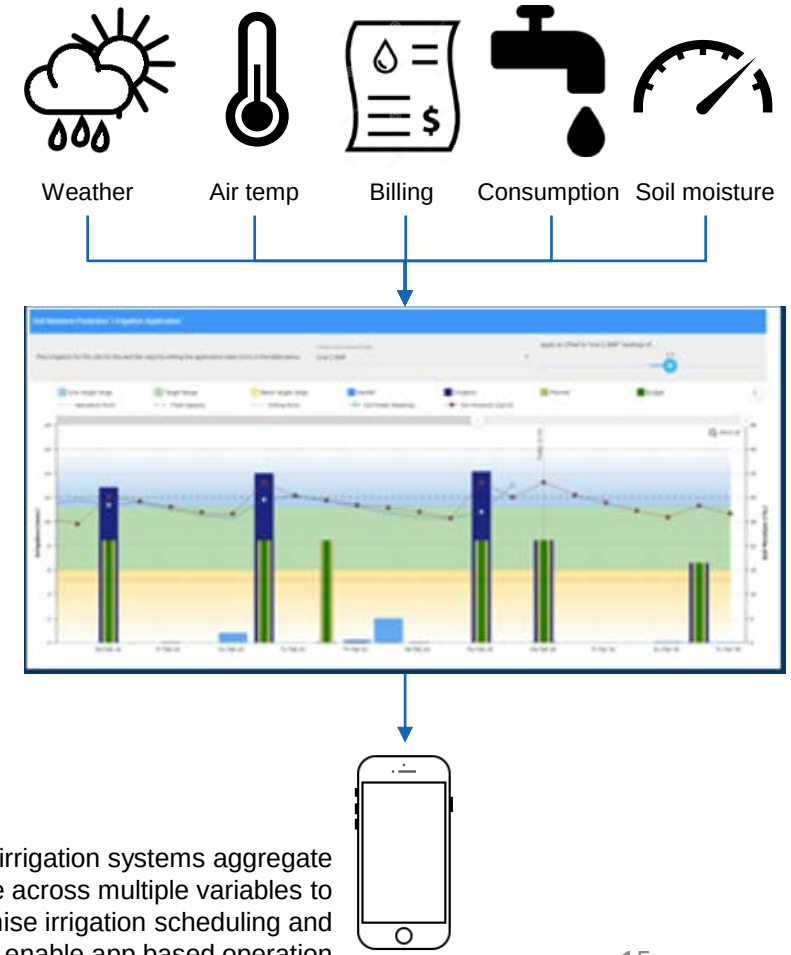
2 Waterwise turf
Turf design provides a way to minimise the water demand by promoting retention of water. When considering turf, a fit for purpose (pitch) approach is used. Three sporting pitch areas are proposed for the QPROS. One will be within a stadium that will host elite level matches. The other two playing fields will be used for training and local community use. Elite and community surfaces are often different things, but share a common need for water, water retention and drainage. Turf also requires nutrients to flourish, but the application of water and nutrients needs to be managed to avoid impact on surrounding ecological systems.

3 Smart irrigation
Irrigation is used to maintain the levels water in the soil profile. Smart irrigation systems are able to achieve this more precisely and are able to respond automatically to changes or predictions in weather. These systems monitor soil moisture, nutrients and weather profiles by looking ahead to the weather and anticipating water and nutrient requirements so that "if its going to rain tomorrow we don't irrigate today". Smart systems aggregate data from multiple sources to calculate the optimal time and volume to irrigate. This reduces wastage and can be adjusted to suit seasonal conditions and changes in allocation, such as real time water management responses to drought.

Water balance
There is a need for a further 45ML/year for irrigation at QPROS, based on the gap between current bore supply at the site and estimate of irrigation demand for playing fields.

The peak volumes are likely to be low because demand for the sporting facilities is lowest during peak summer periods. Turf irrigation during such periods is aimed at maintaining plant health rather than optimal playing condition: some water stress is beneficial to the turf.

Hydrozone	Area (m^2)	Irrigation demand (ML/ha)	Volume required ML/year
Playing surface - elite	17940	9.5	17
Playing surface - good	30104	6	18
Passive turf	30000	4	12
Landscape	30000	3	9
TOTAL			56



Smart irrigation systems aggregate date across multiple variables to optimise irrigation scheduling and enable app based operation (Images- SA Water)

4 Portfolio of water sources

Open space uses a lot of water, and in many council areas this comes from groundwater. This groundwater is a shared resource and should b used wisely. Irrigation is perceived as a low value water use and using Scheme water would likely be perceived as wasteful during periods of water scarcity.

The idea of a portfolio of water sources is based on QPROS irrigating from a variety of different sources to move away from a sole reliance on groundwater. This creates options to maintain supply during periods of scarcity, whilst also having control over costs when water is plentiful.

This portfolio approach is used in other fields as diverse as investment and transport planning to reduce dependence on any one source. A portfolio approach uses a mix of water resources to provide the total volume required.

To be successful, it is recommended that the individual water supply sources be as climate independent as possible. Sources for QPROS will likely include groundwater bores and potentially recycled wastewater. Given the characteristics of the site, stormwater harvesting is not recommended.

A portfolio approach allows the development and implementation of each source to be staged. For QPROS, it may be practical to establish the site using the existing CoC groundwater allocation, even though this is not a long term solution. Currently the City only uses 76.8% of its allocation, and may be willing to make the remaining allocation available for QPROS. As demand for the groundwater at other CoC parks grows over time, QPROS could introduce its own water supplies, such as recycled water if feasible. This staged approach allows a longer lead time to test feasibility, establish the approvals, governance and funding for options such as recycled water.

Where to locate a sewer mining plant at QPROS?

- Near the Welshpool Rd sewer for operational convenience
- In high profile locations for educational value

Examples of small scale sewer mining plants at the Melbourne Cricket Ground (this plant is below ground, with the green glass structure offering access and community information) and Geelong. (MCG image: https://www.caps.com.au)

5 Recycled water from a sewer mining plant
Central to the portfolio is recycled water, potentially sourced from a small sewer mining plant. Perth's Scheme water system is already transitioning to climate independent water sources using recycled water. The local solutions for QPROS can complement this transition by expanding the use of recycled water at a local scale, and reinforcing the value of this resource to the community.

This idea involves accessing sewer flows that are:

- **Regular in volume, and generally consistent in quality**, making them a good raw water source. This reduces the cost of water quality treatment. In contrast, stormwater quality depends on the storm event and the treatment needs constant adjusting.
- **Local**. There are two rising sewer mains along Welshpool Road.
- **Are available year round**, so less storage capacity is needed and this cost is avoided.
- **Growing over time**. Water Corporation has identified the need to upgrade the Richmond Road sewer pump station to address growth.
- **Well understood and regulated as a water supply**. Recycled water is widely used globally, and Australia has well developed guidelines outlining environmental and health requirements for its safe use.
- **Proven technology**. There are numerous technologies available for on-site sewer mining and numerous examples of sewer mining use for high profile open spaces.
- **Modular and can be expanded over time** as QPROS develops.
- **Maintains minimum operational flows downstream** so that the system doesn't block.

There are a number of examples of sewer mining in Australian. Examples include Geelong and at the Melbourne Cricket Ground. The Geelong case study is relevant because is accesses a similar size sewer (215mm diameter main) and has a small footprint for the treatment plant. This scheme generates 40ML/year of recycled water.

A sewer mining facility at QPROS could use a small membrane bioreactor package plant. These are compact, modular and odourless, and no set back is required. As the first of its type in Perth, the sewer mining facility would also have demonstration value which would encourage uptake elsewhere.

It is noted that this idea has high energy and operational costs, will require a footprint on the QPROS site for the treatment facility and balancing storage, and is likely to require an entity to own and operate this infrastructure asset.

The sewer mine will also require permission of Water Corporation to harvest sewer flows and to discharge returns back to the sewer as trade waste permeate. It should be noted that the feasibility of this option, is dependant on the availability of wastewater to maintain minimum operational flows downstream. This requirement must be met at the time of commissioning.

6 Groundwater
Groundwater from the CoC's existing allocation can contribute to this portfolio, especially in the early stages. The CoC has unused groundwater allocation for the shallow aquifer, as well as an existing bore at Maniana Park, that could be used to establish the QPROS.

In the short term (less than five years) it is unlikely that there will be any major need for the unused groundwater allocation for other uses. In the medium term, COC's groundwater allocation may be available for irrigation for QPROS, and will provide a cost effective water source that will lower the average costs of water used.

To facilitate this, consideration could be given to relocate the existing bore currently at Maniana Park to enable irrigation across both sites.

City of Canning's groundwater allocation
Annual groundwater allocation: 2,637,600kL
Current usage: 76.8% (2016-2018)
Available allocation: 23.2%
(CoC, 2019)

7 On site water storage
When using local water sources, storage is part of the infrastructure. This allows water to be harvested during periods of abundance (e.g. when pumping costs are lower) and to ensure supply is available when required.

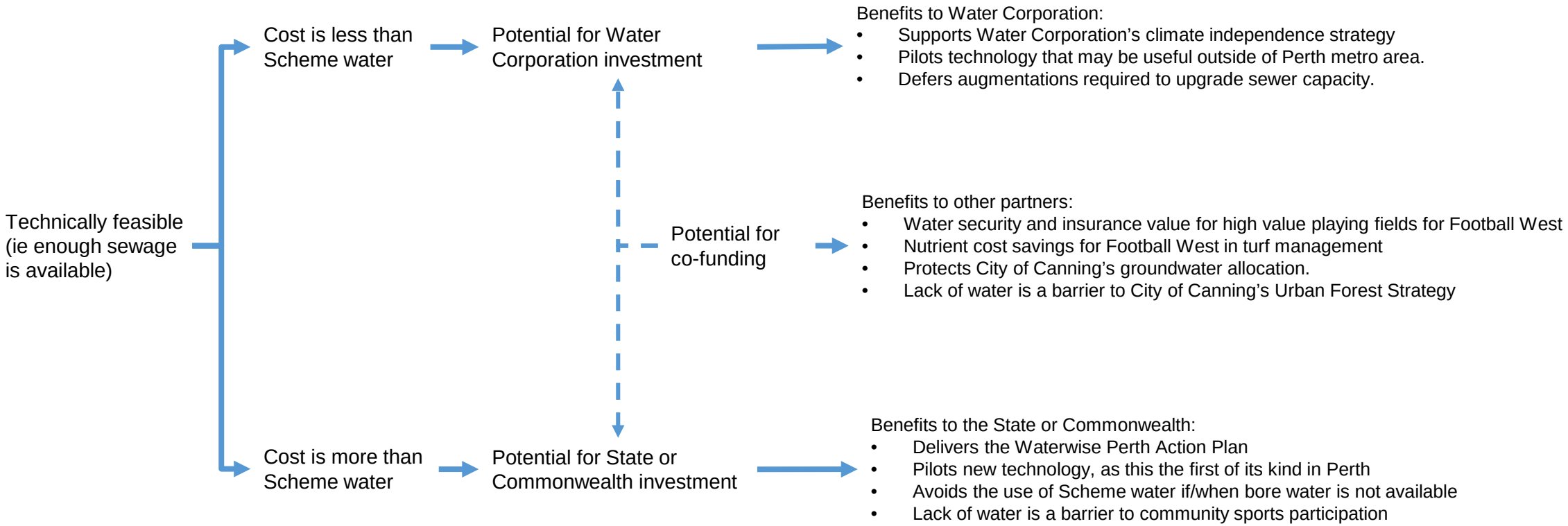
As a minimum, the system would include a balance tank to supply an irrigation session, as well as a temporary storage tank to cater for short term plant break down. The size of these tanks is a risk-based decision, considering the expected duration of an 'outage'. As the irrigation demand at QPROS is low, the storage does not need to be large.

Managed aquifer recharge (MAR) and surface water storage were both considered for QPROS. MAR makes use of available groundwater aquifers for storage. However the permeability of the aquifers at QPROS is poor and a MAR scheme would be cost prohibitive compared with tank-based storages.

Surface water storage (e.g. in the existing wetland) may provide an effective central collection and pumping point. For this to be effective, water quality would need to be actively managed to avoid algal blooms which would clog irrigation and wicking systems. Surface storages have other disadvantages in contributing to evaporation losses and, in the case of Queens Park, shifting the local ecology by introducing permanent water to the site.

8 Micro water grid
A water grid can be developed for QPROS that allows 'injection' and distribution of water from different sources. This allows connection to bores at Maniana Park, a sewer mining plant to the north of the site or other sources in the future as required. The grid is integral to the implementation of a water source portfolio as it enables switching between sources as required.

Overview of a business case for a sewer mine



Waterwise landscape

The park area surrounding the playing fields at QPROS will be designed to be Waterwise and to mimic natural systems. This will apply Water Sensitive Urban Design approaches widely across the site.

The Site formerly is a dampland (seasonally waterlogged) and sumpland (seasonally inundated). Historic aerials and soil data suggest that soils within the site are natural / unmodified.

The landscape can be enhanced to celebrate the particular natural history of the site and distil a defined ‘character.’ The design can Interpret the sites unique “water story” through vegetation selection and colour and texture selection.

What is Water Sensitive Urban Design?
Water sensitive urban design (WSUD) is an approach to urban planning that reuses stormwater by mimicking the natural water cycle as closely as possible. WSUD options include rainwater tanks, swales, biofilters/ raingardens and wetlands, amongst others.

Vegetation selection guide for Queens park

9 Disconnect from Water Corp drains
The big move is to disconnect the existing drain from the Water Corporation drainage system and raise the channel invert levels. This will retain more stormwater onsite, and increase infiltration to groundwater and reduce export of polluted stormwater downstream eventually entering to the Canning River. The Water Corporation system is easy to cut off for this catchment, as it is small with one piped outlet.

Overall, it is expected that the system will hold more groundwater and support local biodiversity as climate change impacts emerge. This increase in groundwater infiltration may also enable increased groundwater usage by the local government in the future.

10 Shallow groundwater recharge
The existing drain's structure can be redesigned to recharge the shallow aquifer. This could see the drain converted from a straight, trapezoidal earthen drain into a more diverse ephemeral creek that:

- Adopts a dry creek bed stream style that provides more amenity.
- Has a sandy base that recharges groundwater into the superficial aquifer
- Contain vegetation and drainage layers that improve water quality.

Consideration will need to be given to developing a diverse ecological community suitable for high levels of human interaction.

Water Corp drain (dotted blue line) and retention wetland adjacent to Maniana Park

Connect Queens Park to Canning City Centre

By default, spectators travelling to sporting events go by car. This creates traffic congestion, parking issues as well as having implications for greenhouse gas emissions and climate change. Meanwhile the residential areas surrounding Queens Park would benefit from improved walkability and livability through urban design that encourages, not discourages, active recreation. As an investment into urban greening, QPROS offers a way to initiate such change. These ideas relate to long term urban planning by the CoC, beginning at QPROS.

11 Riverine City Master Plan
The greening of QPROS can be the first step in transforming the streets of Queens Park. Consultation by CoC for the Queens Park Activation Project[1] shows a need to transform these areas, and similar consultation on the Draft Urban Forest Strategy (CoC, 2019) shows support for greening streets and verges.

A Riverine City Masterplan can be developed from two fronts: the City Centre and the QPROS. Both would pilot urban forest and Waterwise approaches that could be replicated and adopted more widely over time through urban renewal.

The Master Plan can be delivered over time through normal urban renewal and asset upgrade projects. Key to this delivery is advancing from two fronts: form the City Centre and from QPROS.

12 QPROS as an urban forest demonstration
As development front for the master plan, QPROS will be key in demonstrating proof of concept of urban forest and Waterwise approaches. Its high visitation numbers make it ideal for as a demonstration site. Specifically, QPROS can increase walkability across the site and showcase the cooling benefits of urban forest and Waterwise approaches.

In this way, QPROS will offer a template to demonstrate to local residents what green streets could look like and will provide opportunities to experience the benefits first hand.

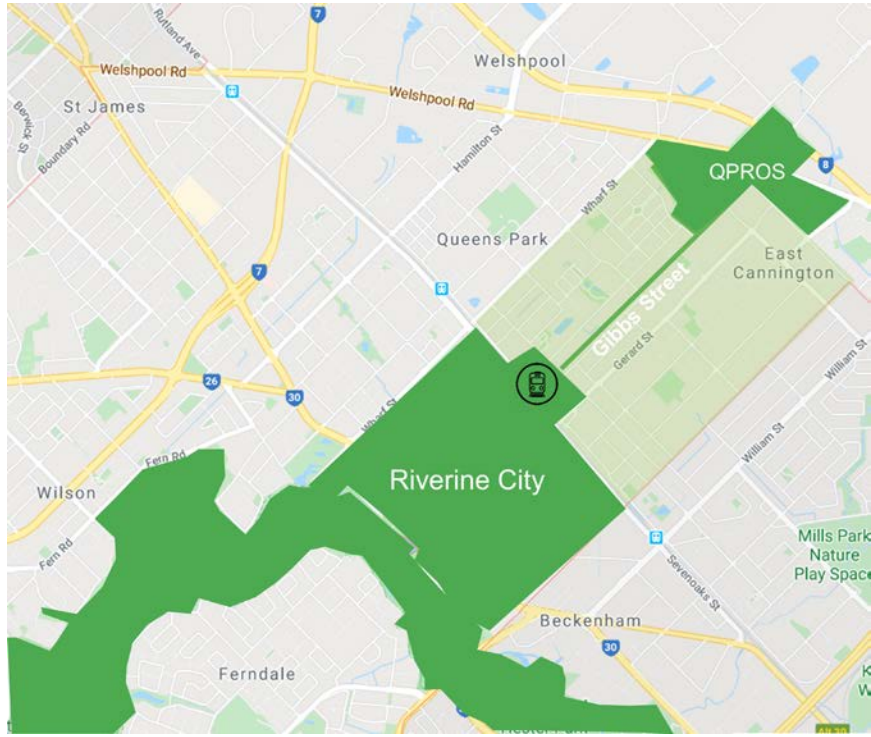
1. https://www.canning.wa.gov.au/our-community/grow-and-engage/city-activation/queens-park-activation-project

13 Gibbs Street as a green connector
Gibbs Street can be a green connector street to support active transport, provide a link between the train station and QPROS and to provide a tangible link between the urban forest nodes at the Riverine City Centre and QPROS.

The CoC has already developed the Gibb Street bike connector. This initiative can be extended to provide a high amenity street scape between the two locations by applying urban forest and Water Sensitive Urban Design approaches. This will create a cool linkage between the City Center, and QPROS to walk or cycle surrounded by shade trees and passively irrigated biofilters. Using stormwater runoff from paved areas provides not only a sustainable water source for these trees but also treats stormwater before it enters the Canning River.

Gibbs Street would form a spine connecting local green streets into a wider green grid network. This would improve safety and access for events visitors and encourages local residents to walk or ride within their local community. It also reinforces the brand of QPROS as a Waterwise facility.

Similar approaches could be used to connect Queens Park to the north, across Welshpool Road, to the industrial sites. This area could be temporarily repurposed during major events as car parking.



Gibbs Street can be a green connector street between the train station and QPROS

Engage the community

Canning is home to many diverse groups. QPROS can bring these groups together to demonstrate value of community participation in sport as a way to build community health and connectedness.

13 Highlight local stories
There are many stories that can be told through a water lens related to:

- Indigenous history and cultural values,
- Cooling and biodiversity benefits
- Sporting history.

Indigenous stories related to the site highlight connection to the land and the roles of plants and animals in our collective culture. Indigenous groups based at Queens Park could be invited to tell their stories through interpretive signage or being engaged to provide cultural experiences for visitors. Other cultural groups could also be invited to hold cultural celebrations at QPROS, especially where there is an overlap with water issues or healthy communities. For example, with a large local Indian community, QPROS could host the Hindu celebration of Ring Barse – the Festival of Colours.

14 Waterwise education
Environmental education based on existing ecological systems at QPROS and new Waterwise features is valuable for adults and children alike. New technologies such as a sewer mine or a green wall pilot can provide a mix of educational offerings for schools, TAFEs, community and industry capacity building.

Interpretive signage can also be used around the nature play areas, dry creek and sewer mining plant to reinforce the proven technology and value of recycled water and Water Sensitive Urban Design.

These education elements can build upon existing CoC communication initiatives at Wharf Street and in the city centre. (For example https://www.canning.wa.gov.au/about-us/our-future/major-projects/canning-city-centre/wharf-street-basin)

15 Use data to tell the water cycle story
The water story explains the benefit to the local community of a Waterwise QPROS: what's in it for them. These benefits include financial savings (if they try Waterwise ideas at home), amenity from a green suburb, cooling benefits from the QPROS's water features and the strengthening of local biodiversity. On top of this, the community will also benefit from high quality sports facilities.

One clear way to tell this story is with data. Messages around cooling benefits and biodiversity are somewhat difficult to appreciate. The water cycle story will benefit from locally sourced evidence, especially if this is matched with residents' personal experiences that validate the data.

Data will also support the demonstration value of the Waterwise initiatives. If they are to be scaled up across Perth, the pilots will need to be evaluated and the results shared.

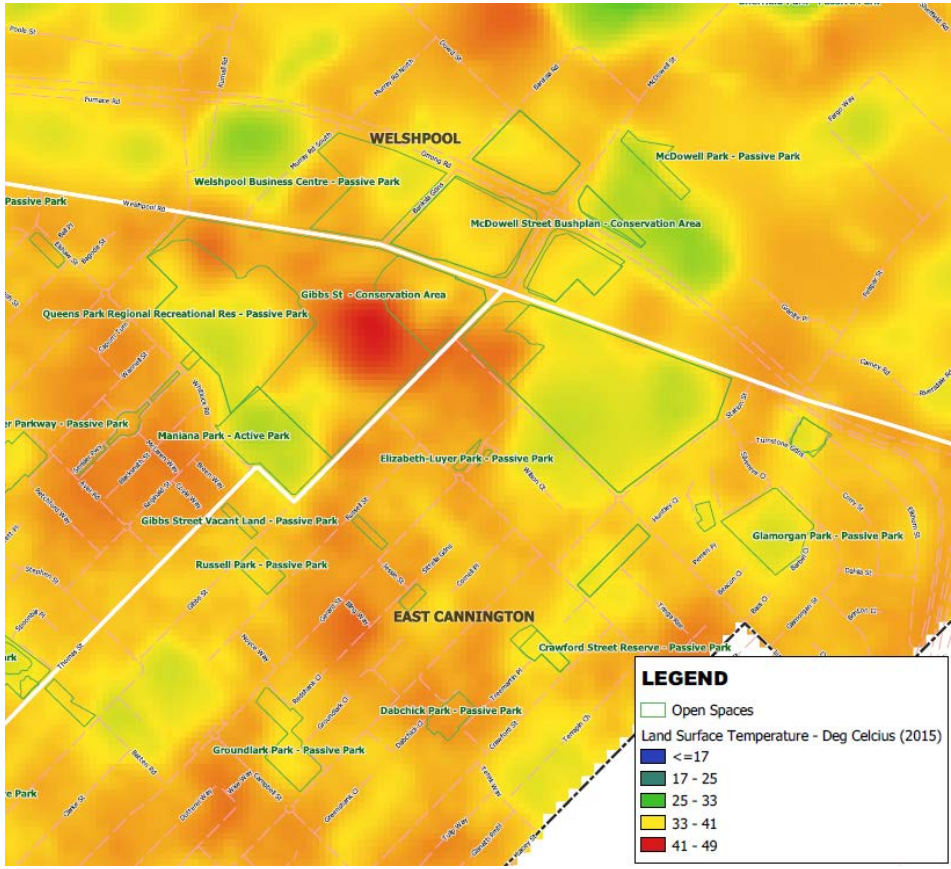
To be successful, the data will require pre and post project assessment of biophysical and community wellbeing outcomes. Monitoring current air temperature and biodiversity will provide a baseline for comparison as QPROS is redeveloped. This data can be progressively reported as the project takes shape to help local residents calibrate their experiences of the construction with the benefits that it will provide

The urban heat island
The urban heat island describes the temperature increase in cities compared to surrounding rural areas. This difference is caused when green spaces are replaced with hard city landscapes that retain heat from the sun, vehicles and other heat sources in cities.

Considerable research has been undertaken showing that replacing green spaces in cities can help to turn the heat island effect around, and that combining green spaces with water is even more effective in reducing temperatures on hot days. This cooling is achieved through shade and evapotranspiration.

This effect is already evident in Queens Park. Surface temperature data from City of Canning (CoC, 2019) identifies Maniana Park as a cool area next to the adjacent QPROS site which is dry and much hotter. The research described above shows that dry grass and bare earth is as hot as a road on a hot day.

The heat map also shows heat from QPROS 'bleeding' over into the adjacent residential area. Making QPROS a greener and cooler environment will reduce this heat sink effect.



Land surface temperature map highlighting the heat signature differences between Maniana Park (green; cool) and the existing QPROS site (red; hot). (Image – City of Canning)

Connect bushland areas across the site

QPROS needs to be inviting and safe to enter but should also ensure that the objective of “elite sport in the bush” is anchored by the bush context of the current Queens Park. There are two ways to approach this: regeneration and enhancement. Both contribute to a net positive outcome in ecological function and increased resilience to future shocks including those driven by climate change. The ‘net positive’ concept is understood in terms of energy, and can be extended here in terms of net positive ecosystem function.

The bushland covers approximately 36 hectares in total, broken up into blocks of various sizes. 7.8 hectares of the bushland abuts the selected site.

Connect bushland areas across the site

16 Bushland corridors
The site has a number of potential Threatened Ecological Communities to protect, but some areas are degraded. In addition to enhancing these bushland areas, the redevelopment can connect these patches by establishing new bushland corridors and linkages across the site. This will enable species migration and promote healthy ecosystems.

Raingardens, landscaping and natural play areas can be designed with this ecological function as an objective.
This can be achieved by using the vegetation complexes and the current ecological narrative of the site as a design template. For instance this may mean working within the constraints of not having any permanent or standing water on the site, and instead embracing ephemeral systems and vegetation.

The Friends of Queens Park Bushland (FQPB) is a community group of volunteers. Their aim is to help the community connect with nature through protecting, regenerating and revegetating the bushland where the suburbs of Queens Park, East Cannington and Welshpool intersect.

17 Dry creek bed
Drainage channels on the site can move away from an engineered form and towards a winter wet depressions or ephemeral damp land. These become the type of landscape feature that are expected on a site such as Queens Park Regional Open Space.

The existing drainage can be transformed into a dry creek bed with seasonal pooling of water rather than a permanent flow. Flattening the slope of the existing banks will achieve necessary safety standards to permit controlled access to the creek bed, providing a place for play and sense of engagement with the water cycle for the site.

Visitor safety
Safety was an issue that arose during workshop discussions and in post-workshop surveys. Potential issues include risk associated with fire, animals such as snakes, and from bushland inadvertently creating spaces in which the community does not feel safe to visit.

New bushland areas and corridors can be designed to ensure sufficient visibility and activation to ensure people are safe to use these spaces at different times of the day.

Fire, urban heat and undesirable fauna will all need to be managed in an integrated and transparent way to ensure comfort amongst the local community.

18 No fences strategy

Although the main pitch which requires physical barriers for major events, the QPROS could adopt a minimal fencing objective by using natural barriers wherever possible.

In this approach, natural landscape features, such as the dry stream, raingardens and swales, can be located and designed to influence where people move and go across the site.

This approach could be used as an alternative to fencing to separate visitors from the more sensitive bushland areas.

Waterwise built form

Structures at QPROS could blend into the landscape through sensitive positioning, careful material selection and high performance design. However, structures could also provide a useful function through capturing fit for purpose water source for reuse within the stadium.

19 Buildings that disappear into the landscape
This idea promotes the having the landscape and bushland as the main feature people see at QPROS, with buildings taking a second place.

Buildings such as the stadium, sewer mine plant and other facilities could be partially covered with earth mounds or green walls to enable them to blend with the surrounding landscape. The recycled water plant could be built underground while the elite stadium could be lower compared to surrounding areas so that it stands out less and provides cool and shaded areas from where to watch events.

While some of the upper levels of the stadium could be used to create a function area overlooking the bush and available at all times, other areas of the site could host food trucks that are able to converge onto well designed ‘pop up’ food areas that disappear soon after the last visitor.

Recreation and play areas could also integrate with the landscape. This includes a soft transition from formal play areas to nature play area, Amphitheatres could blend into the landscape, and youth appropriate recreation facilities such as pump tracks could provide social and physical outlets for local community.

Render of the Victorian desalination plant, highlighting its integration into the coastal dune landscape. (Image -Thiess Degremont accessed at www.water-technology.net/projects/wonthaggidesalinatio/)

20 Waterwise and low carbon buildings
QPROS could adopt an objective and target to reduce the heat through good design of hardstand areas. This would create cooler places to observe events and would promote recreation year round.

For the stadium, existing Waterwise approaches could be widely adopted. This could include rainwater tanks to capture runoff from roofs for use in toilet flushing, hot water systems or other suitable uses. These are not large volumes of water in comparison to volumes for maintaining the playing surfaces, but this project could present a good example if done well, reducing running costs for Football West.

Efficiency will extend to energy, including making the buildings as close to net zero energy in their operation as possible. A key to this will be using on site renewable energy generation where possible. Further net zero energy opportunities lie in innovation in building materials such as cross laminated timber construction.

Water sensitive building demonstration site, Kunshan, China

Benefit Cost Analysis

This section presents an economic analysis of the ideas. For this step, workshop participants contributed to a rapid evaluation of the costs and benefits of each of the major ideas.

About benefit cost analysis
Benefit cost analysis (BCA) is an important tool in decision making. It identifies the net benefits to the community of an action. It differs from financial analysis which considers the financial feasibility of a project based on its cash flows.

The Rough Benefit Cost Analysis process can be found here: https://watersensitivecities.org.au/content/inffews-rough-bca-tool/

BCA now regularly considers a range of environmental, social and economic benefits. This is part of the shift in economic assessment from a focus on the lowest cost options to those that provide the best value. To achieve this, a BCA can include:
• Different types of costs and benefits (including non-market values)
• Benefits that are locally specific as well as those that benefit the City of Canning (or Perth) more broadly

Method for this project
The economic assessment used in this project adopted a rapid BCA process developed by the CRCWSC (CRCWSC 2020b).

The CRCWSC has developed a BCA tool tailored to water sensitive city investments. A 'rough' version of this tool has also been developed using a simplified spreadsheet and guidelines.

This Rough BCA was circulated via an online survey to workshop participants. The survey listed several potential benefits and costs of the major ideas, derived from the stakeholder workshop (Appendix 1).

Survey respondents were asked to rate these benefits, costs, risks and to consider lags in delivery of benefits for the six major ideas. Assessments were qualitative using a 1-5 rating scale (Appendix 2). The average and mode for each variable of the Rough BCA were determined, and a single benefit cost ratio (BCR) was calculated for each idea.

A 2.5% discount rate was used, based on the ten year Commonwealth bond rate.

Pilot survey
To develop the data collection method for this BCA, a pilot survey was tested with the QPROS project team.

Based on the results, modifications were made to the collection of risk and time lag data.

In calculating the time lags, survey participants were asked to estimate a time lag in years. The pilot results varied greatly. Respondents said they lacked experience to estimate lags for all ideas, and so guessed their scores. In calculating risks, respondents were confused by the definition of risk and this variation in interpretation was reflected in the scores.

The final survey included a modified risk question, and changed the time lag question to ask about things that would influence the lag between delivery of an idea, and observation of its benefits. The translation of these suggestions into years was performed post-hoc by DLCSC and CRCWSC using expert knowledge.

Results
The BCA results ranged between 0.8 and 1.9.

A score of at least 1 indicates a positive sentiment for the project warranting more detailed analysis.

Several ideas scored highly. These ideas include the waterwise landscape, connecting bushland areas, connecting QPROS to the city centre and developing a waterwise built form (the benefits are almost double the costs).

It is interesting to observe that the City of Canning is the main beneficiary of these ideas: the ideas themselves relate to the park areas surrounding the new stadium, the streets and ecosystems which are (or will be) managed by City of Caning. The BCA shows that the City has much to gain from the QPROS project.

Where ratios were less than 1, it was found that the estimation of costs was not the sole reason; the results were also sensitive to the risk and time lag ratings associated with the benefits (Appendix 3).

For instance, the benefits of novel water supply and water efficiency are generally experienced in the future, when drought limits the availability of water. However the major capital and planning costs are experienced up front.

If ways can be found to reduce risk and time lag, these ideas may prove to be economically viable. For example, the sewer mine provides substantial benefits even though it has large construction and operational costs. But the likelihood of regulatory and governance risk acts to pull its BCR down. To pursue the sewer mine idea, stakeholders could collaborate to identify ways of reducing approval time, perhaps by framing the scheme as a pilot.

	Benefits	Costs	Risks	Time lag	BCR
Water supply and water efficiency	4	4	3	5 yrs	0.8
Waterwise landscape	4	3	2	5 yrs	1.3
Connect Queens Park to Canning City Centre	4	3	3	5 yrs	1.06
Built form	4	4	3	7 yrs	0.76
Connect bushland areas	4	3	2	7 yrs	1.23
Engage the community	4	2	2	5 yrs	1.94

Results of the rough benefit cost analysis of ideas for QPROS.

References

CoC, ND, Canning City Centre A Riverine City, City of Canning

CoC, 2019, Draft City of Canning Urban Forest Strategy, City of Canning, accessed at file:///C:/Users/jewert/Downloads/Draft_Urban_Forest_Strategy%20(2).pdf

CRCWSC, 2020a, Designing for a cool city– Guidelines for passively irrigated landscapes. Melbourne, Victoria: Cooperative Research Centre for Water Sensitive Cities

CRCWSC, 2020b, Rough BCA Tool, accessed at https://watersensitivecities.org.au/content/inffews-rough-bca-tool/

Government of Western Australia 2019. Waterwise Perth, accessed at https://dwer.wa.gov.au/sites/default/files/Waterwise%20Perth%20Action%20Plan.pdf

Appendix 1 - Benefits, costs and risk listed in the BCA survey

Idea theme 1: Water supply and water efficiency
During the workshop the following **benefits** were mentioned:
- Water security now and into the future.
- Lower costs through efficiency of water and nutrient application.
- Demonstrates a commitment to sustainability.

During the workshop the following **costs** were mentioned:
- Increased planning and communications resources for pitch, water treatment and irrigation design.
- Capital and maintenance costs of a package treatment plant and irrigation infrastructure.
- Will have a higher energy and carbon footprint compared with bore water use.
- Compliance/ monitoring and legal/ administrative costs, especially to manage any public health risks.

What is the **likelihood** that the intended benefits are not delivered?
Some of the potential reasons for project failure discussed during the workshop included:
- The small wastewater plant can't be established because there is no third-party provider to service and maintain the sewer mining system and associated infrastructure.
- Small wastewater plant can't be used because it fails to deliver the appropriate quality or breaks down causing a nuisance for surrounding residents.

Idea theme 2: Waterwise landscape
During the workshop the following **benefits** were mentioned:
- More groundwater recharge of the superficial aquifer
- More sustainable and healthy ecosystem

During the workshop the following **costs** were mentioned:
- Less water is available for use in WSUD in Canning city centre despite volumes from the site being low.
- Provide more habitat for undesirable flora and fauna (e.g. snakes).
- Increased planning resources for WSUD
- Cost of earth works and rehabilitation of the dry creek system.
- Increased ongoing legal and administrative costs especially related to public safety

What is the **likelihood** that the intended benefits are not delivered?
Some of the potential reasons for project failure discussed during the workshop included:
- Despite reduced rainfall through climate change, and increased holding capacity of the dry creek system, the site floods during heavy rainfall events.
- Access to the living stream is restricted for safety reasons.

Idea theme 3: Connect bushland areas
During the workshop the following **benefits** were mentioned:
- Improved ecosystem function
- Improved ecological resilience
- Protection of areas whilst allowing interaction between bushland areas

During the workshop the following **costs** were mentioned:
- Increase the numbers of undesirable species (e.g. snakes).
- Bushfire risk and fire management costs
- Reduced developable area for sports playing fields
- Increased planning resources when designing holistically for the site
- Capital and maintenance costs of revegetation, weed or pest management.
- Increased ongoing legal and administrative costs related to public safety.

What is the **likelihood** that the intended benefits are not delivered?
Some of the potential reasons for project failure discussed during the workshop included:
- Landscape features don't offer sufficient natural barriers and fences are required anyway.
- Fires harm people, infrastructure and biodviersity.

Idea theme 4: Connect to Caning City Centre
During the workshop the following **benefits** were mentioned:
- Safe, active and engaged communities.
- Local walkability and liveability.
- Reduced heat and urban greening.
- Encourages public transport to events.
- Reduced car congestion during events.
- Treats stormwater from local streets.

During the workshop the following **costs** were mentioned:
- Increased planning resources for planning the connector pathway.
- Capital and maintenance costs of street redevelopment and greening.
- Capital cost of changes to road kerbing and alignment.
- Publicity and communications so people are aware of the best travel options
- Antisocial behaviour in and around the sporting facilities or vandalism

What is the **likelihood** that the intended benefits are not delivered?
Some of the potential reasons for project failure discussed during the workshop included:
- The distance to the city centre may be too far to walk and no one uses the improved access paths.

Idea theme 5: Waterwise built form
During the workshop the following **benefits** were mentioned:
- Demonstrate leadership.
- Low running costs as resources are sourced locally

During the workshop the following **costs** were mentioned:
- Increased planning resources for design.
- Capital costs for earth works should stadiums be set into the ground.
- Maintenance costs to fix vandalism.
- Maintenance costs of landscape features (eg green walls).
- Increased ongoing legal and administrative costs..
- Capital cost of water harvesting infrastructure including treatment and storage on buildings
- Sporting Arenas and other facilities may be less visible from the street leading to more antisocial behaviour and or vandalism

What is the **likelihood** that the intended benefits are not delivered?
Some of the potential reasons for project failure discussed during the workshop included:
- Potential for the structural integrity of the building to are compromised by increased vegetation or use of an untested design.
- Potential for a contaminant in the water captured from buildings makes recycled water unsafe to use.

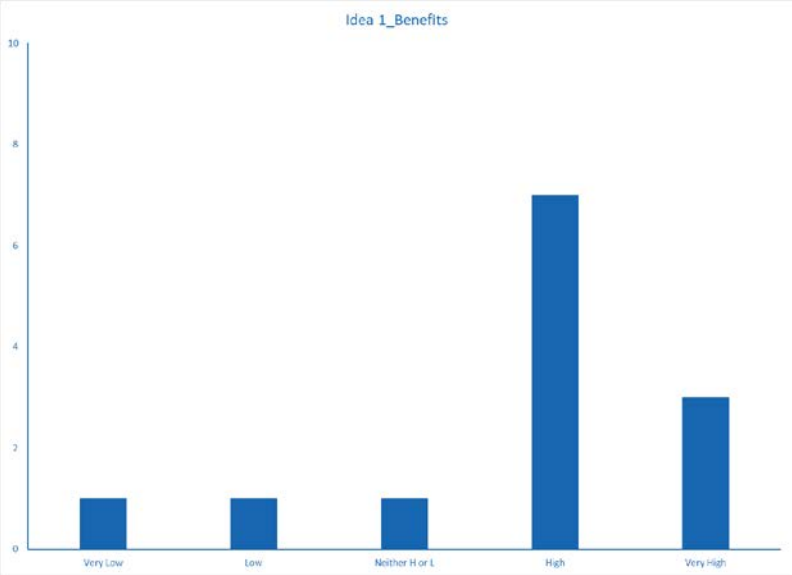
Idea theme 6: Engage the community
During the workshop the following **benefits** were mentioned:
- Community have sense of ownership.
- Local parks are placed in the context of the broader facility.
- Promoting health and wellbeing.to families
- Integration of groups across a diverse community.
- Increase understanding of Nyoongar culture and Indigenous history.
- Build on existing city initiatives at Wharf Street and in the city centre.

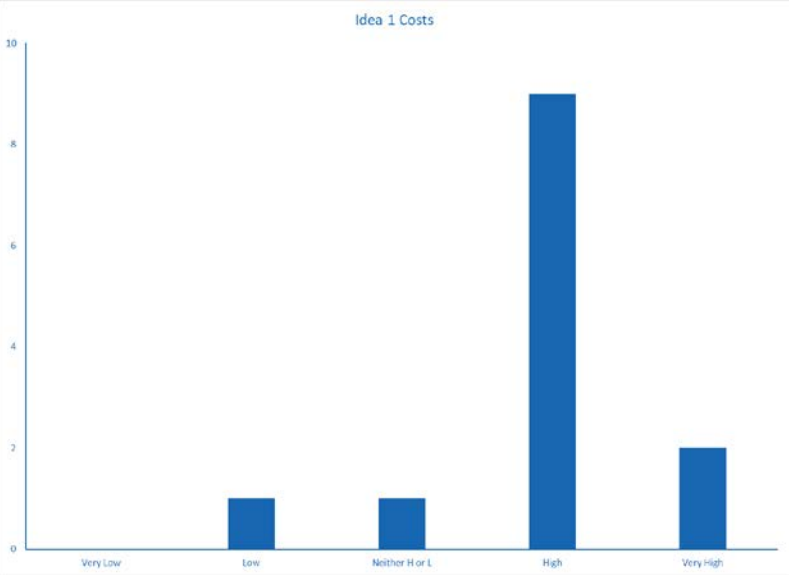
During the workshop the following **costs** were mentioned:
- Increased planning resources to develop and curate the story.
- Capital and maintenance costs of signage etc.
- Such a strong connection is formed that some groups want to exclude other groups and will not allow changes to the site

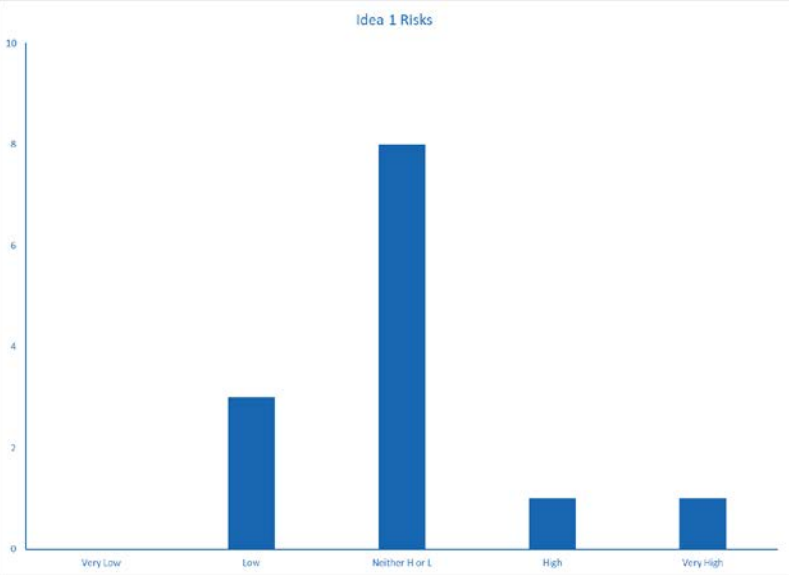
What is the **likelihood** that the intended benefits are not delivered?:
- Speakers of languages other than English may not understand the signs.
- Signs are regularly vandalised.
- No one reads the signs

Appendix 2 - BCA Survey results

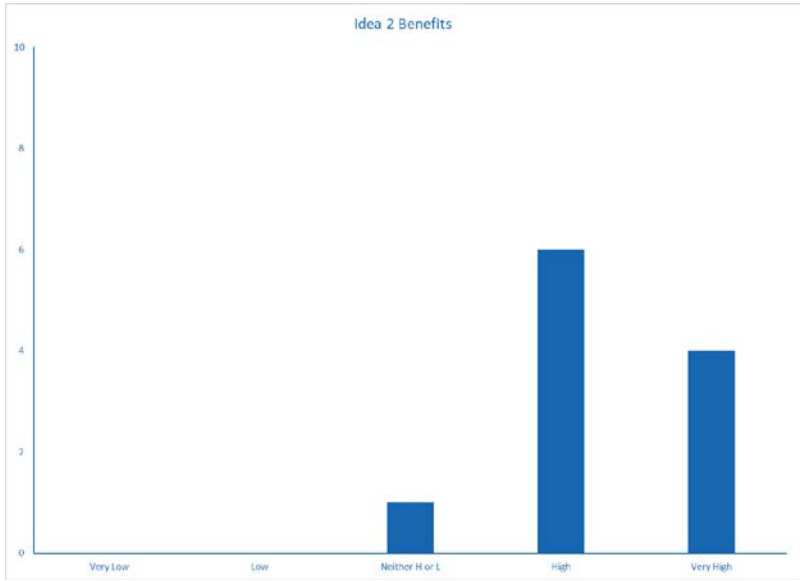
Idea 1 Water supply and water efficiency

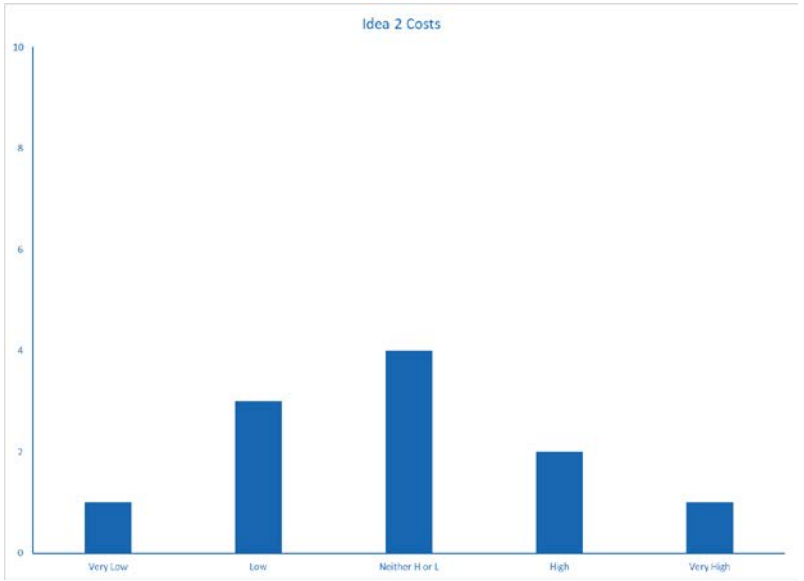


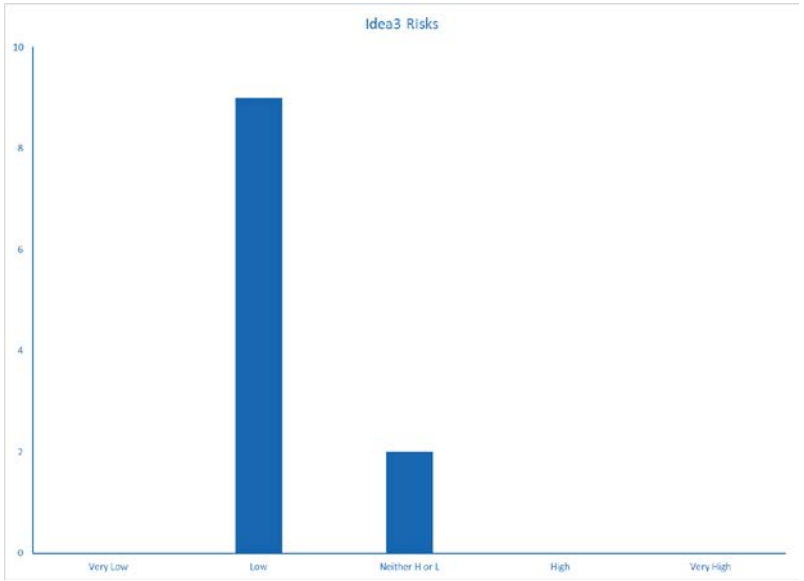




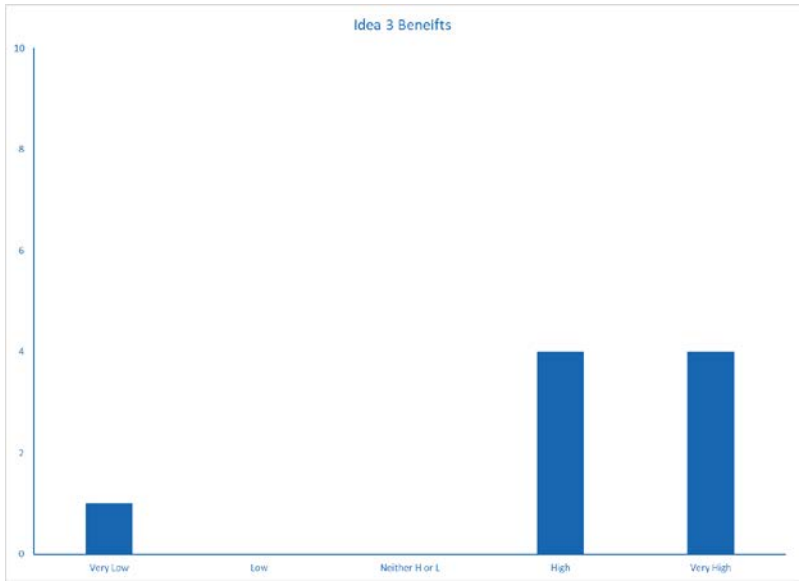
Idea 2 Waterwise landscape

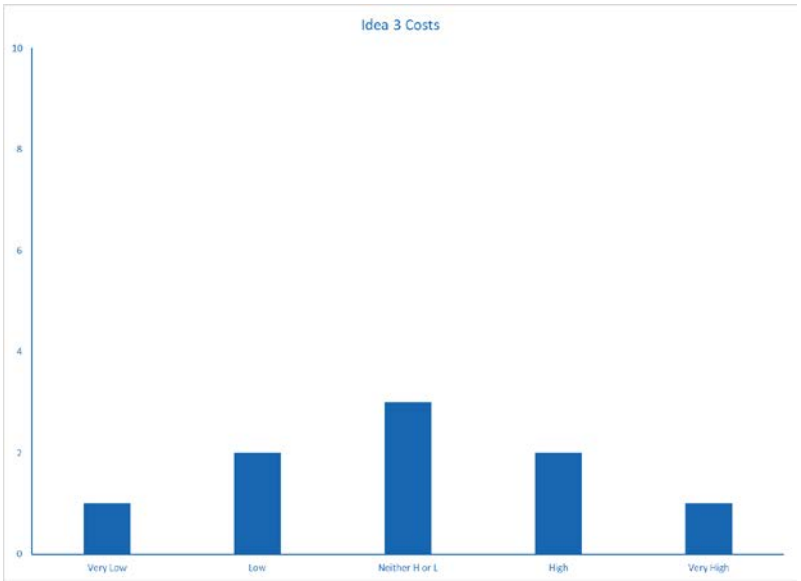


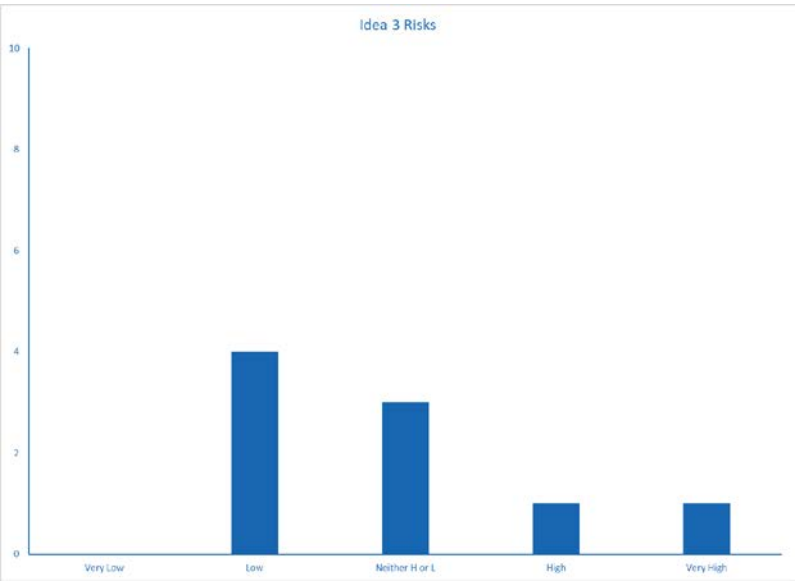




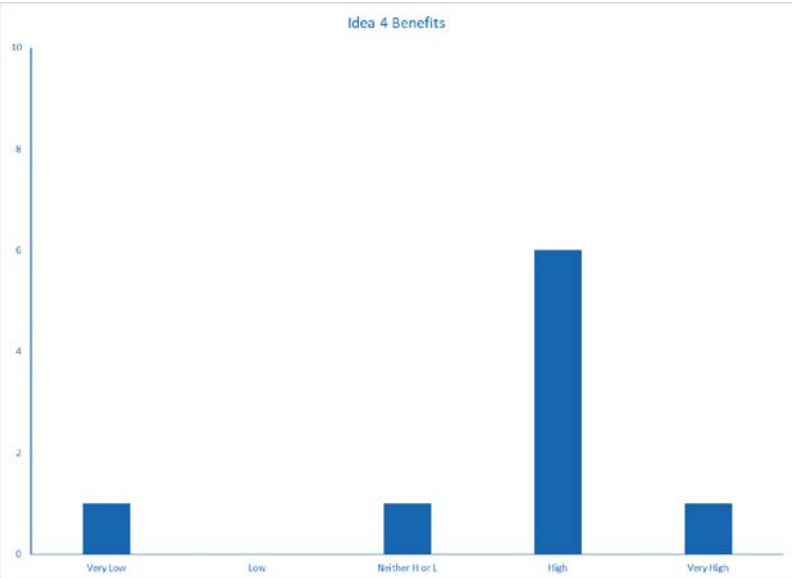
Idea 3 Connect Queens Park to Canning City Centre

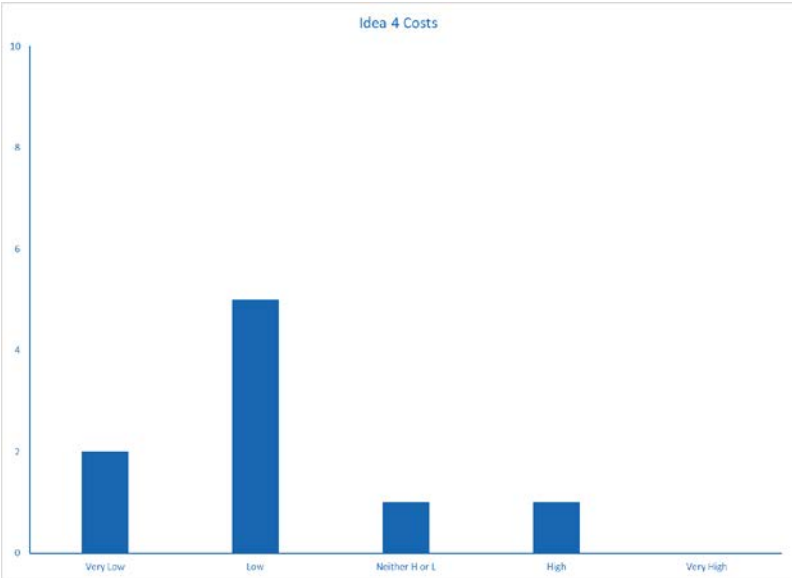


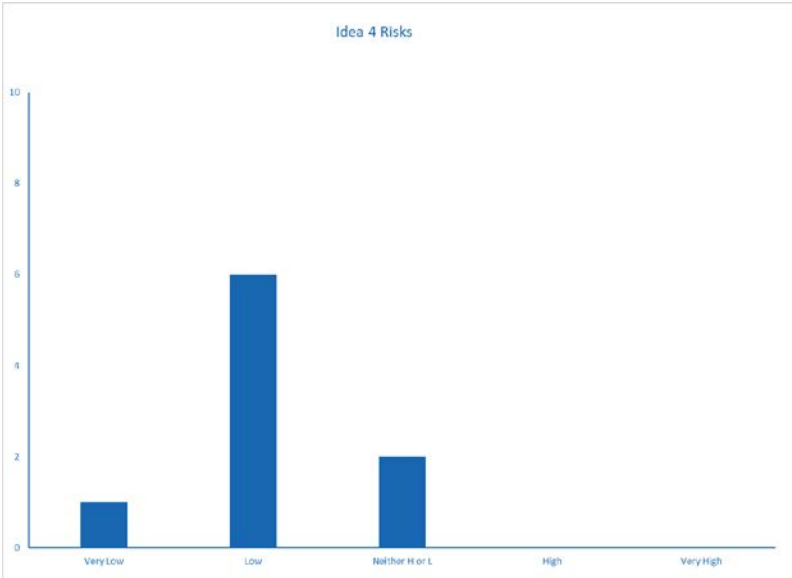




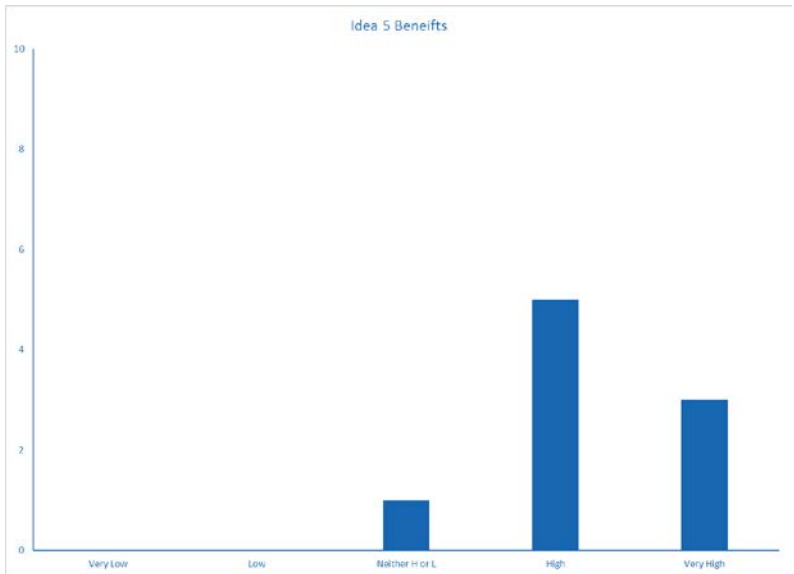
Idea 4 Built form

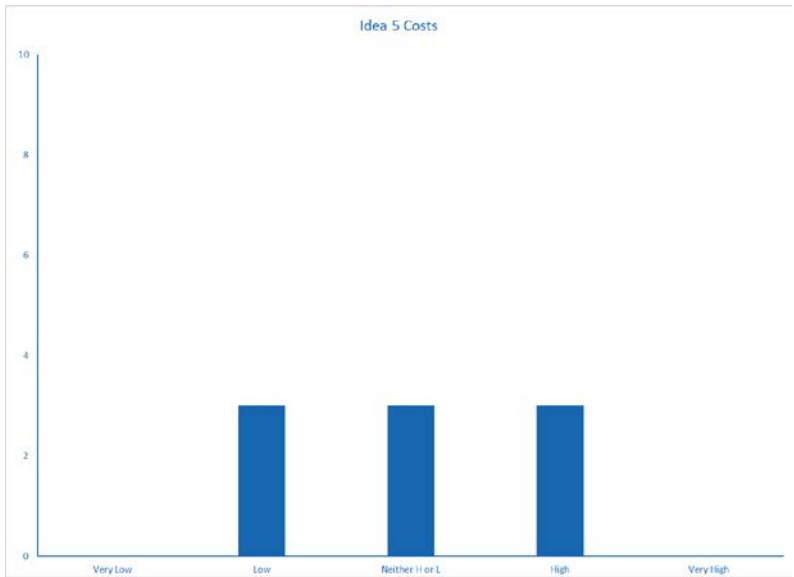


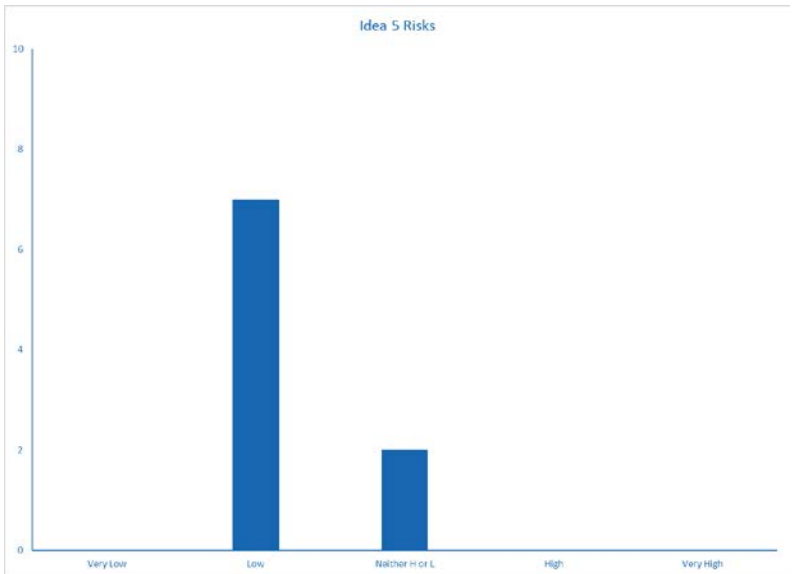




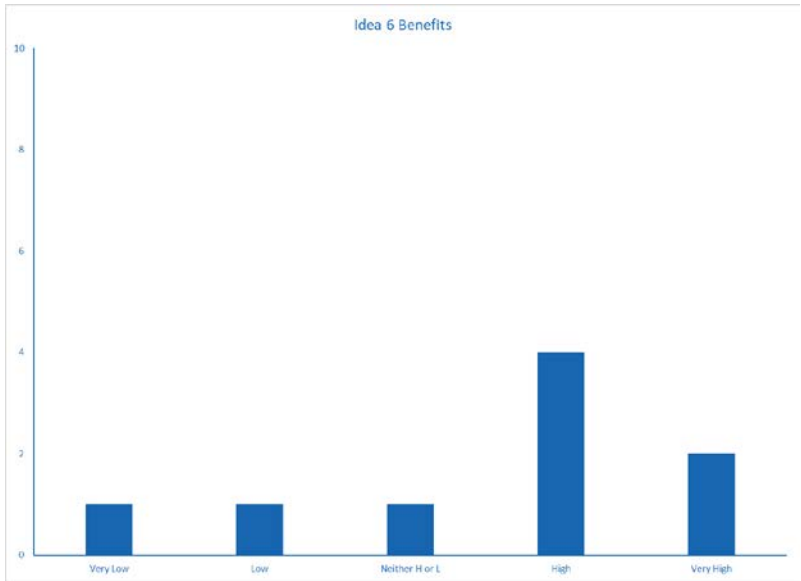
Idea 5 Connect bushland areas

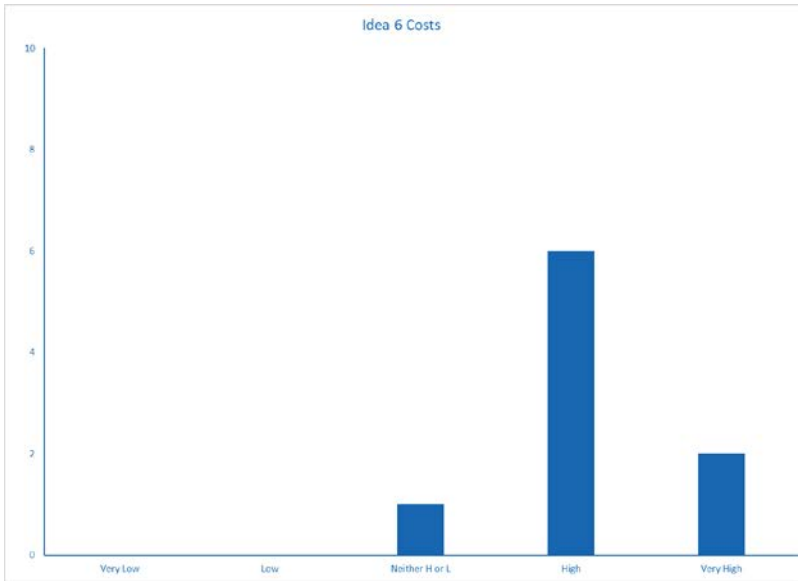


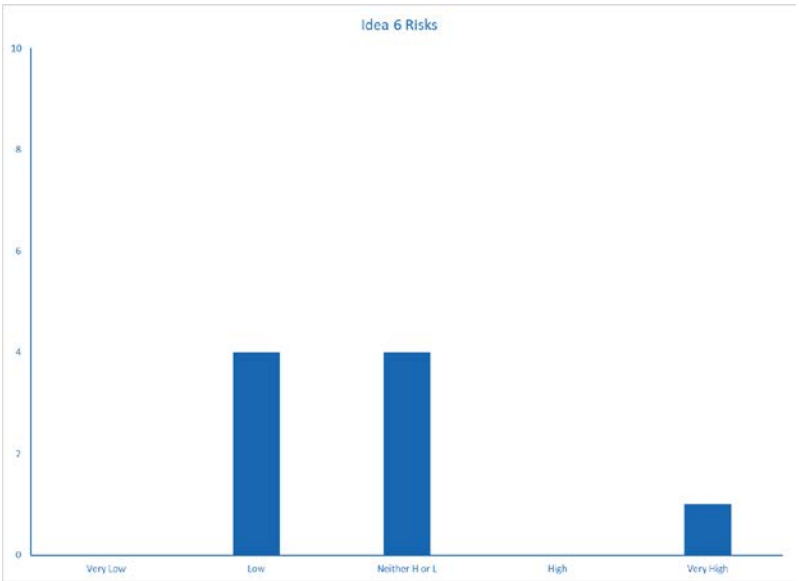




Idea 6 Engage the community







Appendix 3 - BCA Sensitivity analysis

Sensitivity analysis is used to understand which uncertainties in a calculation are most influencing the result. To do this, individual parameter values are modified to observe the effect on the overall result.

In this project, sensitivity analysis concentrated on the benefit costs ratio of the two 'unfavourable' ideas (Water supply and water efficiency and Engaging the community).

In this assessment, the risk rating emerged as an important variable. The table presented here shows the effect of reducing risk to "1" (very low risk) for each idea to illustrate this point.

Given that the ideas themselves often relate to novel solutions (e.g. site scale sewer mining), it is reasonable to expect that there is a higher risk compared with conventional approaches or technologies. Notwithstanding this, if risk is the major barrier to uptake of these ideas, it should be further investigated. This is especially true in a project such as QPROS which aims to showcase new Waterwise outcomes.

The conclusion from this assessment is that the focus on developing these ideas is not only on reducing costs; it is also on managing risk in pilot projects.

	Benefits	Costs	Risks	Time lag	BCR
Water supply and water efficiency	4	4	1	5 yrs	**1.15**
Waterwise landscape	4	3	2	5 yrs	1.3
Connect Queens Park to Canning City Centre	4	3	3	5 yrs	1.06
Built form	4	4	1	7 yrs	1.09
Connect bushland areas	4	3	2	7 yrs	1.23
Engage the community	4	2	2	5 yrs	**1.94**

Benefit Cost Ratio (BCR) sensitivity table showing the effect of lowering the risk rating of ideas 1 and 4 (dark blue cells). In this example, all ideas are now BCR>1.