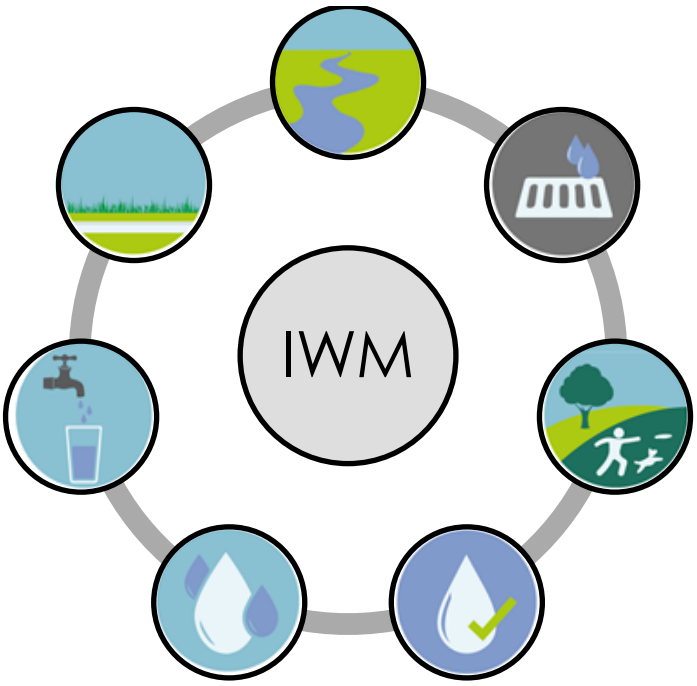


INTEGRATED WATER MANAGEMENT (IWM) POSITION PAPER

FOR THE

NORTHERN AND WESTERN GEELONG GROWTH AREAS

NOVEMBER 2018

Barwon Water

CITY OF GREATER GEELONG

CONTENTS

DISCLAIMER

The Integrated Water Management Position Paper for the Northern and Western Geelong Growth Areas has been prepared in partnership between the City of Greater Geelong and Barwon Water, in collaboration with the Corangamite Catchment Management Authority and Southern Rural Water, and in consultation with the Department of Environment, Water, Land and Planning, Melbourne Water and Deakin University. This position paper seeks to reflect the general views and positions of the participating stakeholders in relation to the delivery of integrated water management in the Northern and Western Geelong Growth Areas; however, it should not be considered as a formal adoption of strategic policy.

EXECUTIVE SUMMARY

The Northern and Western Geelong Growth Areas project will deliver a framework plan to guide the future use and development of two large growth areas to address Geelong's long-term population growth.

The IWM Position Paper for the Northern and Western Geelong Growth Area articulates the importance of the urban water cycle in creating a more liveable, vibrant and sustainable community.

The urban water cycle will play a key role in shaping sustainable communities in the growth areas.

This position paper forms the basis for delivering integrated water management outcomes in the growth areas and considers its seven elements:

- natural waterways, wetlands and floodplains
- major drainage infrastructure for large flow events
- water's interactions with various land uses, particularly public open space
- stormwater management
- alternative water (e.g. rainwater, stormwater, recycled water)
- drinking water and
- sewerage.

Critical stakeholder analysis of a series of objectives and options has been undertaken in relation to each IWM element. A series of four IWM packages combining options ranging from the regulatory minimum to outstanding responsiveness has been considered.

The position paper outlines a set of options and packages at a conceptual level to inform the overall framework plan for the growth areas. Further investigation and delivery of specific options will be undertaken in detailed consideration of the IWM elements as part of future precinct structure planning.

Despite there being challenges associated with some elements, and therefore further work required, the position paper concludes that Package D is the recommended and supported package of IWM options. Package D reflects outstanding delivery of IWM outcomes including:

- highest level improvement to ecological condition
- outstanding multifunctional values and
- outstanding stormwater retardation, treatment and infiltration
- provision of fit for purpose alternative water which replaces drinking water demand.
- safe and reliable drinking water and sewerage services.

Package D potential opportunities and limitations are identified as:

a. Potential opportunities to deliver local-level sewerage services within the western growth area

b. Potential opportunities to investigate provision of alternative water (recycled, stormwater or rainwater), either through the entirety of the growth areas or within targeted areas of the public realm, including key networks of activity and recreation.

c. Potential limitations in the total delivery of outstanding major drainage elements in the Northern Geelong Growth Area, particularly in relation to the capacity for distributed detention in proximity to the Lovely Banks Monocline and rural living areas

d. Potential limitations in the delivery of alternative water elements, in both the Northern Geelong Growth Area and Western Geelong Growth Area, including:

    - Difficulties associated with the provision of dual pipe recycled water particularly in relation to the high cost, low demands and no available source of recycled water near the growth areas.
    - Challenges associated with the provision of stormwater harvesting schemes including cost efficiency, reliability of supply and ongoing maintenance costs.

It is acknowledged that challenges currently exist with regard to the provision of alternative water as described above. Further work is required to investigate the optimum mix of water sources within the development to achieve the overall objectives of the growth areas.

INTRODUCTION

The Northern and Western Geelong Growth Areas project is the City of Greater Geelong's plan to address Geelong's long term population growth. The project delivers a framework plan for two growth areas identified in the 2013 G21 Regional Growth Plan.

The urban water cycle will play a key role in shaping sustainable communities in the growth areas. This position paper forms the basis for delivering integrated water management outcomes in the Northern and Western Geelong Growth Areas.

This position paper provides a basis for understanding how the water cycle enhances the liveability and resilience of urban areas including:

- natural waterways, wetlands and floodplains
- major drainage infrastructure for large flow events
- water's interactions with various land uses, particularly public open space
- stormwater management
- alternative water (e.g. rainwater, stormwater, recycled water)
- drinking water and
- sewerage.

The project method has actively involved all stakeholders in order to build a shared understanding of IWM and its role in the broader vision for the site, improve integration across different elements of urban and water planning and uncover conflicts and synergies as early as possible. The project aims to:

- Engage key stakeholders in identifying IWM solutions at a high level that will that provide for greater public amenity and liveability, enhance environmental values, reduce the use of potable water and increase use of alternative, fit for purpose water.
- Improve processes for embedding IWM in framework planning and enhance collaboration between urban water cycle stakeholders and developers.

The plan builds on work undertaken in stakeholder workshops held in October and December 2016 and August 2018. It includes:

- Relevant strategic policies and visions of the key stakeholders
- Background to IWM and the benefits it can offer
- Background and analysis of the growth areas and their water cycles
- The broader community aspirations for the growth areas, and IWM objectives that will realise these aspirations
- IWM options identification and screening
- Integrated packages or combinations of options with their advantages and disadvantages.

WHAT DO WE MEAN BY INTEGRATED WATER MANAGEMENT?

Water is essential for all life. The water cycle refers to the broader system of how water cycles through the air, land and sea, the functions it performs and the interactions it causes. The way the water cycle interacts with the urban landscape is called the urban water cycle.

Many different factors will influence how successfully the Northern and Western Geelong Growth Areas achieve the community's broader aspiration for more liveable, sustainable and resilient neighbourhoods; the urban water cycle is one of the most important considerations in achieving this outcome.

From an urban planning and design perspective, there are seven elements of the urban water cycle that have a significant role in determining the characteristics which make for a more liveable, sustainable and productive urban landscape, including:

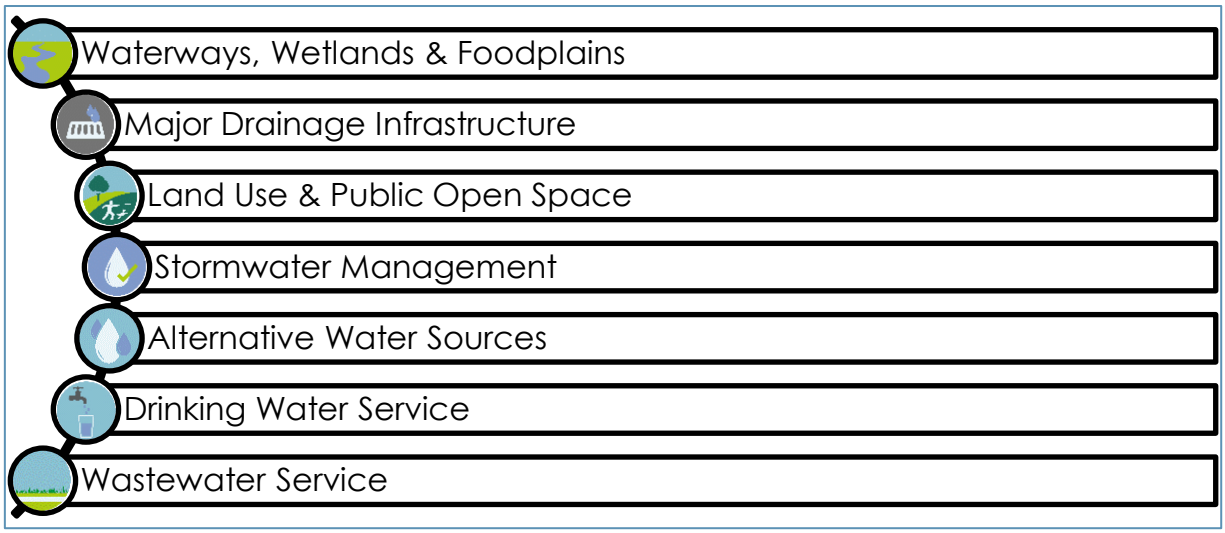
- The flow and presence of water in natural assets like **waterways, wetlands and floodplains**, providing a place for nature, community connection to nature and open space and protecting the community from major flooding
- The controlled flow of water through the landscape in **major drainage** infrastructure to minimise damage from localized flooding and inundation
- Water movement and management as cornerstones of a **land use and open space** plan designed with people in mind, building on the well being provided by water in the urban environment
- **Stormwater management** at property and streetscape scales to retain water for a greener and cooler urban landscape and reduce detrimental downstream impacts
- The active harvesting and reuse of **alternative water sources** generated by the urban landscape (such as rainwater, stormwater and recycled water) to ease pressure on drinking water supplies and utilize excess water
- The provision providing a safe and reliable **drinking water** service to the community
- The provision of a **sewerage** service to protect public health, public amenity and minimise adverse impacts on the environment.

For the purposes of the IWM plan, these seven elements of the urban water cycle are considered in the scope of the plan.

These elements of the urban water cycle system are strongly interconnected and interdependent and they are complex sub-systems in their own right. Typically they are managed as distinct institutional areas, with little integration. For those involved in the planning and design of new urban developments, this fragmentation can lead to sub-optimal outcomes for water's potential role in more liveable, sustainable and productive urban landscapes.

Integrated Water Management (IWM) is an approach that seeks to manage all elements of the water cycle in a more holistic, interconnected way. The central premise of IWM is a greater understanding of the interconnections between these elements in order to identify opportunities to deliver multiple benefits, for the community, environment and the economy.

FIGURE 1 SEVEN ELEMENTS OF INTEGRATED WATER MANAGEMENT



The seven elements of IWM considered for the Northern and Western Geelong Growth Areas have a direct relationship with the strategic outcomes identified by the Barwon Integrated Water Management Forum.

Barwon Integrated Water Management Forum – Strategic Directions Statement

Barwon Integrated Water Management Forum is comprised of regional IWM leaders representing traditional custodians, local government, statutory authorities and government agencies in the Barwon region.

The Barwon IWM Forum has delivered a draft Strategic Directions Statement (July 2018) that outlines an agreed vision and set of strategic outcomes to deliver it.

The vision:

Integrated, collaborative management of the water cycle that enables sustainable environmental, social, cultural and community prosperity for the Barwon Region.

Strategic outcomes (→ *Northern and Western Geelong Growth Areas IWM element*):

1. Safe, secure and affordable supplies in an uncertain future
   → *Stormwater management, alternative water, drinking water*
2. Effective and affordable wastewater systems
   → *Wastewater*
3. Avoided or minimised existing and future flood risk
   → *Major drainage*
4. Healthy and valued waterways and marine environments
   → *Waterways, wetlands & floodplains*
5. Healthy and valued urban, agricultural, rural and green landscapes
   → *Waterways, wetlands & floodplains, land use & public open space, stormwater management*
6. Traditional owner and community values reflected in place-based planning
   → *Land use & public open space*
7. Jobs, economic growth and innovation.

The Northern and Western Geelong Growth Areas is recognised as a "priority" opportunity for the Forum to utilise IWM in response to the region's escalating population growth.

WHO IS INVOLVED IN INTEGRATED WATER MANAGEMENT?

Each of the stakeholders involved in establishing integrated water management in the Northern and Western Geelong Growth Areas play a significant role in managing one or more elements of the water cycle system. The roles they play and the decisions they make can have direct and indirect impacts on various elements of the water cycle system (Table 1). The IWM Plan for the growth areas brings these normally fragmented initiatives together in a systematic way.

City of Greater Geelong (the City) has a direct controlling role in the planning and operation of urban water cycle assets and services including:

- strategic, statutory and municipal planning for areas of new and infill urban development
- a strategic and operational planning role for open space, roads and streetscapes
- managing stormwater, localised flooding and driving water sensitive urban design.

The City also can have an influence on the urban water cycle including:

- as a major user of drinking water and potential user of alternative water
- as a driver for best practice in urban development design and construction
- to represent and engage with its local community on community aspirations.

Barwon Water (BW) has direct responsibility for delivering effective, safe and efficient drinking water, sewerage and recycled water services to the Greater Geelong community including the Northern and Western Geelong Growth Areas. It also has several other broader roles in driving IWM including:

- develop and encourage the IWM approach
- Provide educational material about IWM
- Develop an integrated water cycle strategy in consultation with stakeholders.

The **Corangamite Catchment Management Authority (CCMA)** coordinates, facilitates and leads an integrated approach to the protection and enhancement of land, water and biodiversity of the Corangamite region by engaging and supporting the community and regional partners.

Southern Rural Water (SRW) manages rural water for southern Victoria. This includes delivering water to irrigators in irrigation districts, harvesting bulk water for rural and urban use, licensing and monitoring extractions from most surface and groundwater systems south of the Great Divide and the licensing of the construction of farm dams and groundwater bores in the region.

Developers and their consultants play a critical role in translating statutory, regulatory and municipal guidelines for all elements of water cycle management into precinct structure plans (PSPs) that outline the form of the new urban landscape.

Property owners themselves play crucial roles in how they utilise the urban water cycle and they have direct responsibility for rainwater harvested on their land and septic tanks if installed.

A list of stakeholders involved in the 2016 and 2018 IWM workshops is listed in Appendix 1.

TABLE 1 TYPICAL RESPONSIBILITIES FOR IWM WITHIN THE G21 REGION

Water Cycle	Sub aspects	The City	BW	CCMA	SRW	Property owners
Waterways wetlands, & floodplains	Waterway health			✓		
	Riparian zones	✓		✓		
	Floodplain management			✓		
	Water allocation for consumptive use				✓	
Major drainage infrastructure		✓				
Land use & public open space		✓				
Alternative water sources	Reticulated recycled water		✓			
	Stormwater re-use	✓				
	Rainwater re-use					✓
Stormwater management		✓				
Drinking water service			✓			
Wastewater service	Sewerage Service		✓			
	Septic Tanks	✓				✓

GROWTH AREAS

Northern Geelong Growth Area

The Northern Geelong Growth Area is generally bounded by Bacchus Marsh Road to the east, the Geelong Ring Road to the south, Anakie Road and servicing easements to the west and Staceys Road to the north. The growth area is renowned for the Lovely Banks monocline that defines the local landscape and allows stunning views to the You Yangs, Corio Bay and across Geelong.

The area is mainly used for agricultural land uses and rural living. The landscape consists of rolling hills. The area is close to the Geelong Ring Road Employment Precinct and Lara Township.

According to the G21 Regional Growth Plan Implementation Plan (G21, 2013 P. 94), the Northern Geelong Growth Area (refer to as the Northern "Future Investigation Area")*"has minimal land capability constraints and is relatively straight forward to develop and service; however the public transport options and the potential for isolation from the rest of Geelong would need to be addressed"*.

Preliminary growth estimates:

- 2,089 hectares in total growth area
- 1,325 hectares in developable area (~63% of total)
- 17,108 new dwellings
- 47,901 new Greater Geelong residents.

FIGURE 2 NORTHERN GEELONG GROWTH AREA STUDY BOUNDARY

Western Geelong Growth Area

The growth area is generally bounded by the Geelong Ring Road to the east, the Barwon River to the south, the Geelong-Ballarat rail line to the north and Batesford Township to the west. The growth area is an iconic landscape characterised by the Barwon and Moorabool Rivers with views across the Barrabool Hills and the Batesford quarry as its centrepiece.

The growth area includes a large, operation limestone quarry, farmland, and an existing non-government school and recreation reserve. The growth includes significant natural environment features including the Barwon and Moorabool Rivers, Cowies Creek, Dog Rocks Sanctuary and the Batesford Township and surrounds.

Preliminary growth estimates:

- 3,245 hectares in total growth area
- 1,730 hectares in developable area (63% of total)
- 21,995 new dwellings
- 61,585 new Greater Geelong residents.

FIGURE 3 WESTERN GEELONG GROWTH AREA BOUNDARY

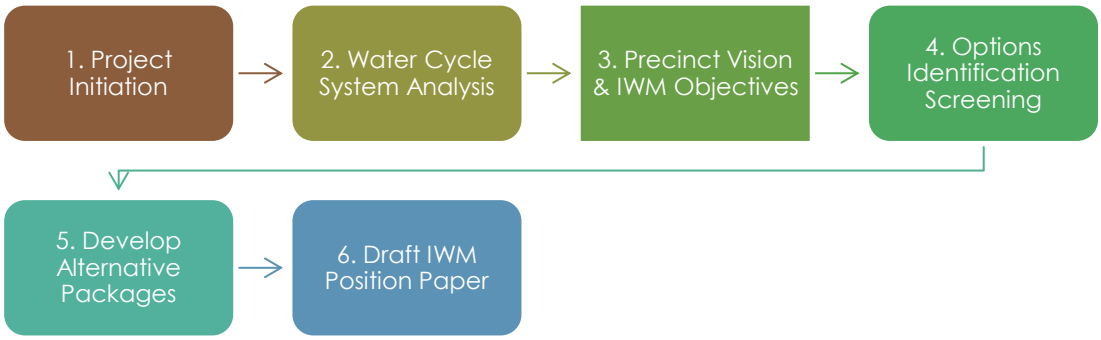
METHODOLOGY

This position paper summarises a series of workshops to:

- Engage key stakeholders in identifying IWM solutions at a high level that will that provide for greater public amenity and liveability, enhance environmental values, reduce the use of potable water and increase use of alternative, fit for purpose water
- Improve processes for embedding IWM in framework planning and enhance collaboration between urban water cycle stakeholders and developers.

The IWM Position Paper for the Northern and Western Geelong Growth Areas is being developed in accordance with a method pioneered by the Barwon Region IWM Network (Barwon Water, 2014) illustrated in Figure 4.

FIGURE 4 STEPS TO DEVELOP THE IWM POSITION PAPER FOR THE NORTHERN AND WESTERN GEELONG GROWTH AREAS



The project was undertaken jointly by City of Greater Geelong and Barwon Water in collaboration and consultation with the following stakeholders:

- City departments in Planning, Engineering, Open Space and Environment
- Barwon Water departments in Strategy, Engineering, and Planning
- Corangamite Catchment Management Authority (CCMA)
- Southern Rural Water (SRW)
- DELWP (Urban Liveability)
- Deakin University
- Additional consultants.

The list of stakeholders engaged is found in Appendix 1.

The IWM Position Paper outlines high-level concepts that will be considered in preparation of the framework plan for the Northern and Western Geelong Growth Areas.

COMMUNITY ASPIRATIONS AND VISION

The concept of liveability in new urban landscapes is becoming increasingly important to the community across Australia. Integrated water management is not an end in itself. The aim of embedding IWM into urban planning is to identify and realise opportunities where the urban water cycle system can contribute to the broader community aspirations for any precinct. The aspirations should be the starting point for defining more specific objectives for each element.

The Northern and Western Geelong Growth Areas project is part of a broader urban planning agenda occurring across Geelong and the wider G21 region. Broadly, the community aspirations for new urban landscapes are articulated in a range of strategic planning documents, including:

- G21 Regional Growth Plan 2013
- G21 Regional Growth Plan Implementation Plan 2013
- Greater Geelong: A Clever and Creative Future (2017)
- COGG Council Plan 2018-2022
- Geelong Public Health and Wellbeing Plan 2013-2017
- Geelong Region Plan 2006
- Greater Geelong Planning Scheme Municipal Strategic Statement (MSS)
- COGG City Plan 2013-2017
- COGG Environment Management Strategy 2014-2017
- COGG (2010) Sustainable Communities Infrastructure Development Guidelines
- Barwon Water Strategy 2030 (2017)
- Corangamite CMA Regional Floodplain Management Strategy
- MPA Growth Corridor Plans Principles
- One Planet Living.

The policy and strategic statements in these documents were used to generate a 'word cloud' to provide high level guidance for framing IWM objectives. This word cloud, illustrated in **Error! Reference source not found.** demonstrates the importance of water and elements related to the urban water cycle in articulating aspirations for the Northern and Western Geelong Growth Areas.

FIGURE 5 STRATEGIC DIRECTIONS FOR NORTHERN AND WESTERN GEELONG GROWTH AREAS WORD CLOUD

Northern and Western Geelong Growth Areas – Vision and Principles

The City of Greater Geelong led a stakeholder and community workshop in July 2017 to establish a vision for the future communities in the growth areas. An overall vision has been developed for the Northern and Western Geelong Growth Areas project and a unique vision and set of principles for each growth area.

The project vision:

The Northern and Western Geelong Growth Areas will exemplify Geelong's transformation as a clever and creative city by building diverse, localized and sustainable neighbourhoods that prioritise self-sufficiency whilst maximising connections to the Geelong community, economy and identity.

Northern Geelong Growth Area

The vision and principles relevant principles to integrated water management for the Northern Geelong Growth Areas:

Northern Geelong will be distinguished by neighbourhoods with panoramic views across the region and built around diverse and accessible employment hubs that epitomise Geelong's creativity, innovation and enterprise.

Create growth areas with high amenity and character: Establish a district of neighbourhoods that exploit the panoramic vistas across the region, deliver an attractive interface to neighbouring precincts and enhance Geelong's local character.

Protect biodiversity, waterways and cultural heritage values: Protect and regenerate biodiversity values of the natural and constructed waterways along the Lovely Banks monocline and heritage values of the Elcho Homestead.

Create integrated open space networks: Cultivate a stunning trail along the ridgeline of the Lovely Banks monocline and substantial green links along infrastructure easements with an adjoining network of recreation reserves and local parks.

Plan for environmental sustainability: Create a carbon positive community that implements ecologically sustainable development principles by prioritising renewable energy production and minimising resource use.

Stage development to ensure the efficient and orderly provision of infrastructure and services: Ensure that staging of development creates early provision of public transport to central Geelong and facilitates coordinated delivery of employment precincts to support job growth in Northern Geelong.

Western Geelong Growth Area

The vision and principles relevant principles to integrated water management for the Western Geelong Growth Areas:

Western Geelong will prosper as a district of lakeside neighbourhoods connected by healthy waterways and attractive open spaces that strengthen Geelong's identity as a city built around water.

Create growth areas with high amenity and character: Establish a district of lakeside and riverside neighbourhoods recognised for their healthy waterways and attractive open spaces that will enhance Geelong's local character.

Protect biodiversity, waterways and cultural heritage values: Protect and regenerate biodiversity and cultural heritage values along the Barwon and Moorabool Rivers, Cowies Creek and the Dog Rocks Sanctuary and establish vegetated constructed waterways.

Create integrated open space networks: Cultivate an exemplary open space network that links the Barwon and Moorabool Rivers to an iconic lake at the Batesford quarry and supports a network of recreation reserves and local parks.

Plan for environmental sustainability: Create an integrated water management system based around the major catchments and prioritise active and public transport networks.

Stage development to ensure the efficient and orderly provision of infrastructure and services: Ensure that staging of development creates early provision of public transport to central Geelong and preserves long term development aspirations adjoining the Batesford quarry.

Barwon Water - *Strategy 2030*

Barwon Water's *Strategy 2030* outlines a vision for a prosperous region with a mission to strengthen the region's economy, livability and sustainability through the delivery of high quality and affordable water and sewerage services.

The strategy identifies and plans for significant and rapid changes to be anticipated in the region including climate change, population growth, economic transition and technological advancement.

The strategy outlines Barwon Water's proposed five step-changes necessary to transition from a utility provider to an enabler of regional prosperity. These include:

- Strategic Partnerships
- Zero emissions
- Zero waste
- Entrepreneurial
- High Performance

Corangamite Catchment Management Authority & Southern Rural Water

CCMA's *Regional Floodplain Management Strategy* and Southern Rural Water's corporate statement also support sustainable, innovative solutions.

SYSTEM ANALYSIS

The basis of any system- based plan is a thorough assessment of the function and performance of the system in its current state. This section explores each of the seven elements and identifies key challenges and opportunities that may influence options and solutions.

WATERWAYS, WETLANDS & FLOODPLAINS

Northern Geelong Growth Area

Land in the growth area falls within eight sub-catchments. All water flows off the escarpment either into Sutherlands Creek to the west, or Cowies and/or Hovells Creeks to the south. The flood management and drainage matters combined with steep terrain in the growth area are significant site constraints. The growth area slopes to the east with some land being above 12% and up to 18-20% on the gullies. This is challenging terrain around which to design and construct a stormwater network. It will also be challenging to convey storm flows across Bacchus Marsh Road to the GREP through rural living areas east of Bacchus Marsh Road. There is also a flat catchment for Hovells Creek at the GREP (adjacent Geelong Ring Road Employment Precinct) and through Lara.

Challenges	Opportunities
• Major change in gradient over short transect could exacerbate stormwater and flooding issues • Natural drainage lines are not well defined • Downstream impacts of increased frequency and volume of flows on sensitive estuary environment and/or Cowies Creek • Rural living area east could prevent appropriate drainage of the site	• Change hydrology and manage better • Natural waterways could be ephemeral • Area downstream of precinct is currently under development

Western Geelong Growth Area

Land in the growth area falls within more than ten drainage catchments or sub-catchments in three river basins, namely Cowies Creek in north, Moorabool River in the east and Barwon River in the south. The topography includes river valleys with steep slopes, escarpments and a working quarry. It poses significant challenges and opportunities with respect to natural waterways, wetlands and floodplains.

Challenges	Opportunities
• Steep slopes and extensive earthmoving required around quarry • Significant and complex geotechnical and groundwater conditions due to quarry dewatering • Groundwater management, loss of water from Moorabool River to quarry • Significant flooding along both river valleys	• Quarry could be an exceptional water feature and regional open space asset • Moorabool and Barwon Rivers are major natural assets • Area lends itself to natural connectivity between Geelong and Batesford

MAJOR DRAINAGE

Northern Geelong Growth Area

Large overland flows make their way into fairly small natural drainage pathways which typically flow east down the Lovely Banks monocline. The upper plateau is relatively flat, with steep slopes along the eastern edge.

Challenges	Opportunities
• Increased flows and volumes could exacerbate downstream flooding issues in Lara, which already has some drainage issues • Constraints in Elcho Drain system • Drainage lines not well defined • Private land constraints at base of escarpment • Steep topography on escarpment will drive high velocity flows, potentially increasing height thus cost of retarding basins • Cannot put increased flows down existing gullies on monocline; highly erosive soils, high velocitites, poor infiltration	• Relatively gentle slopes on the escarpment • Natural drainage lines running down the eastern slope may be a potential opportunity for some natural open space • Relatively flat terrain could minimize major drainage infrastructure construction costs • Climate change could alter the functional requirements and/or sustainable operation of major drainage

Western Geelong Growth Area

Given the prevalence of major water conveyance channels and receiving waters, there are limited man-made major drains within the study area. The Moorabool River was diverted to a new man made channel (in some parts concrete lined) to allow the quarry operations to occur. Challenges and opportunities associated with additional major drainage infrastructure will be closely linked to waterways, wetlands and floodplains element and the land use and open space element.

Challenges	Opportunities
• Quarry intersects several major drainage lines • Steep topography on escarpment will drive high velocity flows • Significant drainage issues in southern area • Providing stormwater quantity and quality solutions for escarpment areas in close proximity to the Moorabool River	• Quarry could be a significant receiveing water for major overland drainage flows • Opportunity to retain considerable major flows on site and combine with open space • Moorabool River could benefit from improved drainage flows • Drainage infiltration may be possible across much of the site

LAND USE & PUBLIC OPEN SPACE

Northern Geelong Growth Area

The high landscape will provide opportunities for landscape vistas. The land is relatively flat and stable with the exception of potential geotechnical instability along the Lovely Banks Monocline. The standard provision requirement for public open space is 10% (unencumbered land). Unencumbered land means that the land provided for open space is usable and not affected by encumbrances such as flooding.

Challenges	Opportunities
• No known existing natural values or biodiversity assets or values on site that can be integrated into natural open space networks • Limited opportunities to build on existing environmental assets • Land restrictions, current land use on escarpment may restrict open space	• May be existing now waterway values; some ephemeral waterways also may be present • Consider alternative ways of providing an integrated open space network not water cycle asset based • Natural drainage lines running down the eastern may be a potential opportunity for some natural open space • Extensive view spaces

Western Geelong Growth Area

The growth area's unique natural water cycle assets including the Moorabool and Barwon Rivers, Cowies Creek and the quarry lake provide an exceptional opportunity for a land use and public open space layout with outstanding social, environmental and economic values. The group highlighted the importance of a land use and open space layout which is complementary to the water cycle rather than turning its back on it. Key features raised included extent, quality and connectivity of public open space using waterways and drainage corridors and the potential future value of the quarry as a recreational water body.

Challenges	Opportunities
• Overburden areas need to be managed • Steep slopes pose landslip issues • Ring Road is significant east west barrier • large areas of open space may require considerable irrigation	• Significant biodiversity along open space corridors • Barwon and Moorabool Rivers provides potential significant open space link into central Geelong

STORMWATER MANAGEMENT

Northern Geelong Growth Area

Geotechnical investigations required to assess if there is a need to establish stormwater detention ponds on the monocline. Possible need for an erosion management overlay on the slope. Potential instability associated with the Lovely Banks Monocline, erosion and landslips.

Challenges	Opportunities
• Potential high maintenance costs of WSUD stormwater measures • Infiltration on plateau could be problematic due to soils • Topography will lead to fast flows and high volumes of stormwater • Long linear wetlands as retarding basins, sufficiently sized for existing flowrates • Potential downstream impact on Hovells Creek • Also need to manage impact on Cowies Creek • Capital costs of WSUD measures • Construction sediment impacts	• Use of streetscapes for complimentary flow retardation, quality • High value downstream ecology could drive higher levels of stormwater management • Property based rainwater harvesting via rain water tanks on steeper areas could help reduce runoff

Western Geelong Growth Area

The varied topography of the area, extensive waterways and quarry, present unique opportunities for water sensitive urban design associated with stormwater management. Topographical variations also suggest fit-for purpose stormwater management options as required.

Challenges	Opportunities
• Steep slopes and extensive earthmoving heightens risk of instability for stormwater detention basins so Geotechnical investigations required • Overburden areas adjacent to quarry pose stormwater challenges to be considered in rehabilitation plan • Stormwater impacts on waterways including flow regime, water quality and erosion • shallow basalt geology may pose challenges and increased costs for construction of stormwater wetlands • Providing stormwater quantity and quality solutions for escarpment areas in close proximity to the Moorabool River	• Opportunity to re-direct stormwater to the future lake in the quarry • Potential for some end of line stormwater wetlands along valley floor • Opportunity to limit the number of discharge points to natural waterways and exert better control over flow and quality of stormwater discharge

ALTERNATIVE WATER

Alternative water refers to water which can be used for a range of uses that has not been provided through the drinking water network (such as rainwater, stormwater, recycled water, groundwater or river water). The quality of this alternative water can be highly variable, depending on the source, the treatment and the intended end use. Regardless of the source, the water must be of a certain quality that makes it suitable for a particular end use, i.e. it must be 'fit-for-purpose'.

Northern Geelong Growth Area

Challenges	Opportunities
• Lack of data on water demand balance and split between potable and alternative • No groundwater available • Site will generate considerably more water than can be retained without extensive distributed retention • No available source of recycled water	• Potential to use recycled wastewater from NWP or alternate source • Potential to store and harvest stormwater on the plateau or downstream • Mitigate the risk of increased frequency of runoff

Western Geelong Growth Area

Challenges	Opportunities
• Lack of data on water demand balance and split between potable and alternative • No groundwater available • Site will generate considerably more water than can be retained without extensive distributed retention • Extraction of water could impact downstream • No available source of recycled water	• Potential to harvest water from the quarry, which could store recycled water • Property based rainwater harvesting on steeper areas could help reduce runoff and larger block sizes could accommodate a higher than standard use of alternative water on properties • A local water reclamation plant may be possible, providing a source of Class A, Water • Mitigate the risk of increased frequency of runoff

DRINKING WATER

The existing Geelong Water Treatment and Transfer System requires augmentation around 2045 in order to supply the expected peak daily demands of Geelong and the proposed growth areas. Although the overall capacity of the water treatment and transfer system is estimated to be adequate for several decades, there is limited capacity in existing distribution networks and therefore extensions of large trunk mains is required.

Northern Geelong Growth Area

The growth area is not within Barwon Water's current water supply network. It requires a significant amount of new water infrastructure to service growth.

Challenges	Opportunities
• Requires signifcant new water infrastructure within precinct • Sequencing impacts could affect costs • Higher costs and GHG emissions to pump water uphill	• Flexibility where infrastructure can be located • Easements could be integrated with open space connectivity

Western Geelong Growth Area

The growth area is not within Barwon Water's current water supply network. It requires a significant amount of new water infrastructure to service growth.

Challenges	Opportunities
• Requires new water infrastructure within precinct • The area is not within Barwon Water's current water supply network so new water distribution infrastructure is required • Moorabool River is flow stressed, so no potential to harvest from River • The quarry lake could be a potential source of drinking water if treated to required level • Complex site likely to have various staging challenges for planning drinking water infrastructure	• Flexibility where infrastructure can be located • Easements could be integrated with open space connectivity • Drinking water supplies are secure and could service the area • Development could enhance flows in Moorabool River • Potential for groundwater to be used as a supply source

SEWERAGE

The existing Geelong sewerage system has inadequate capacity to accept ultimate (full development) flows from the Growth Areas without major trunk infrastructure upgrades. However there will be an ability to accept flows from initial stages of development in this area. Reticulated sewerage is required as part of all residential development in the growth areas under planning regulations.

Northern Geelong Growth Area

Challenges	Opportunities
• No sewerage infrastructure within precinct • Sequencing impacts could affect costs	• Flexibility where infrastructure can be located • Easements could be integrated with open space connectivity • Main sewer could be located in floodplain • Existing gravity sewerage network can accommodate early development

Western Geelong Growth Area

Challenges	Opportunities
• Area is not within Barwon Water's current sewerage network, so new infrastructure is required • Limited capacity to connect northern section of growth area into existing sewer network • Main sewer may have to be located in floodplain, posing environmental risks • Complex site with staging challenges for planning sewerage infrastructure • Shallow basalt geology may pose challenges and increased costs for construction of sewerage infrastructure	• Opportunities to investigate localised WRP at a later date • Flexibility where infrastructure can be located • Easements could be integrated with open space connectivity

HOW THE WATER CYCLE CAN CONTRIBUTE

The natural water cycle assets including waterways, wetlands and floodplains are a fundamental characteristic of the natural landscape. New urban landscapes should be designed to be in synergy with the existing landforms and the movement of water across the landscape, rather than working against these characteristics.

These natural features often provide pre-existing opportunities for urban open spaces and multi-purpose linkages throughout the development. The cost of reshaping these natural assets like waterways, wetlands and floodplains can also be very costly for developers. Similarly, major drainage infrastructure which conveys large flows (beyond the capacity of the stormwater network) is also a close second consideration based on its importance to the overall layout of the site and cost.

The actual land use plan for the site should be responsive to the previous elements. Land use types, road layout and layout of public open space should be take advantage of natural water cycle elements and major drainage rather than be in competition with them. The land use plan should not encroach or impede the natural movement of water through the landscape and where possible, it should be taking greatest advantage of such characteristics.

Stormwater management is a major issue in all new urban developments, because of the increased amount of runoff caused by a massive change to non-pervious surfaces like roofs, roads and pathways. A more water-sensitive approach to urban landscape design is needed to manage these larger, faster flows and try to retain as much water as possible within the urban landscape.

Some of the water used in new urban landscapes can come from other sources of water than the drinking water supply. As outlined above, stormwater volumes are increased and could be harvested and reused, similarly with rainwater generated from rooftops. Recycled water from wastewater treatment plants can also be used for irrigating green spaces. Given climate change impacts on surface waters, it is important to consider all alternative sources of water for a new development in the design phase.

Drinking water and sewerage servicing can typically be planned and designed to fit within urban design layouts, however these too should be part of an integrated design approach. Not only can the quantum of service required by these services be altered by other factors, but land use implications like pipe easements can be considered in an overall open space strategy.

INTEGRATED WATER MANAGEMENT OBJECTIVES

The word cloud and reference documents were used as the basis for developing draft IWM objectives, one for each of the seven elements.

Note that these objectives are used as the basis for framing different options for each element. They are only relevant if development occurs and if so, they will be bound by various pieces of mandatory legislation such as the Water Act, Water Industry Act, Planning and Environment Act, Subdivision Act, Planning Scheme, etc. These rules and regulations will set the mandatory minimum required for various design characteristics and criteria.

However, for several of these elements, there is some flexibility as to the extent to which the design exceeds the regulatory minimum standard. For example, the provision of a minimum amount of open space is a mandatory requirement of any development. In the case of stormwater, the City has mandatory obligation under the Water Act and planning scheme regarding quality, flooding, adverse impact, third party right to water and others.

Whereas for drinking water and sewerage any option considered must meet the regulatory standard and there is no requirement to exceed this. These are essential services which makes them far less flexible in terms of design alternatives.

Based on these observations, two types of objectives have been identified:

- **'Flexible' Objective**: some discretion exists as to the extent to which the option exceeds the regulatory minimum standard required. Alternative options exist based on the level to which they exceed the regulatory minimum option (RMO).
- **'Essential service' Objective**: for drinking water and sewerage to a new development, the regulatory standard is the level that must be achieved, regardless of the technical option.

The IWM objectives for each element are illustrated in Table 2.

The term 'multi-functional' has also been used extensively across the objectives. This term refers to the type, diversity and extent of social, environmental and economic benefits derived from the element given its ability to perform more than one function. For example, an overland drainage corridor that provides visible water, green space and a linear pedestrian and cycle access offers a higher level of multi-functionality than the same drainage pipe buried underground. Similarly, a flood retarding basin that is accessible and useful to the local community by design when it is not holding back floodwaters is better than one designed just for flood control.

TABLE 2 DRAFT IWM OBJECTIVES

	ELEMENT	OBJECTIVE	
	**Waterways, wetlands, floodplains**	Ensure the ecological condition and functionality of waterways, wetlands and floodplains is protected, maintained and restored and these assets offer multi-functional values in the urban landscape.	Flexible
	**Major drainage**	Optimise the multi-functional values of major drainage through a strategy which distributes and integrates water into the urban landscape, ensures no adverse downstream impacts, and is sustainable over time.	Flexible
	**Land use & open space**	Ensure land use and open space within the development maximises opportunities for multi-functional land uses associated with the water cycle.	Flexible
	**Stormwater management**	Manage stormwater in a way that ensures there are no adverse downstream impacts and it enhances the urban landscape. In relation to the natural waterway corridors in the Western Geelong Growth Area, manage stormwater in a way that maintains and enhances the predevelopment hydrology of the areas and minimises downstream impacts.	Flexible
	**Alternative water**	Maximise the use of alternative water at source (where possible) to meet fit-for-purpose needs and deliver multi-functional benefits.	Flexible
	**Drinking water**	Ensure safe, reliable and quality drinking water services to meet mandatory standards for uses requiring drinking water.	Essential service
	**Sewerage**	Ensure safe, reliable and quality sewerage services that meet mandatory standards.	Essential service

OPTIONS IDENTIFICATION

Once the objectives for each element were developed, stakeholders then discussed the factors and principles that needed to be considered in framing different options to meet the objectives.

For the five elements that are identified to have **flexible** objectives, these principles provided a basis for describing what constituted a suite of options arranged on a left-right spectrum based on their ability to achieve the stated objective; from minimum to maximum. This spectrum acknowledges the 'Regulatory Minimum Option' as the minimum regulatory requirement for the objective and then provides Options 1-3 that offer increasing achievement of that objective, as shown in FIGURE 6.

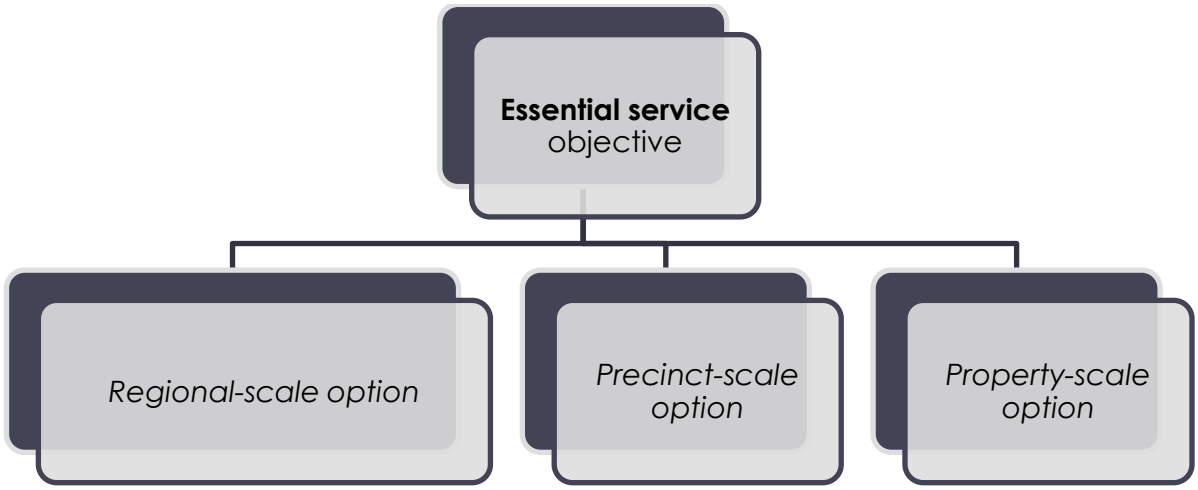
Options have been framed at a conceptual level, meaning they do not include many technical details of how it could be achieved. For some options, key technical design features have been included for greater clarity.

FIGURE 6 OPTIONS STRUCTURE FOR FLEXIBLE OBJECTIVES

Regulatory Minimum Option (RMO)	Option 1	Option 2	Option 3
• *Meets minimum regulatory requirements for flexible objective*	• *Slightly better achievement of the objective comparted to the RMO*	• *Better achievement of objective compared to Option 1*	• *Outstanding achievement of objective compared to other options*

For the two **essential service** objectives, provision of drinking water and wastewater services to the area, no discretion exists to provide a level of achievement less than the stated objective implies. Whilst there may be different technical design solutions to achieve these objectives, all solutions must achieve the mandatory standards implied in the objective (FIGURE 7). Whilst these have also been arranged in a table, they should not be considered as being on the same spectrum as discussed for flexible objectives above.

FIGURE 7 OPTIONS STRUCTURE FOR ESSENTIAL SERVICE OBJECTIVES



WATERWAYS, WETLANDS AND FLOODPLAINS

The objective for waterway, wetland and floodplain management in the growth areas is: *Ensure the ecological condition and functionality of waterways, wetlands and floodplains is protected, maintained and restored and these assets offer multi-functional values in the urban landscape.*

The following principles were agreed as the basis for framing options to meet this objective:

- Higher levels of ecological condition on site are required (i.e. the area must be restored from its current condition as a minimum), whilst downstream detrimental impacts must be avoided
- Hydrological functionality of waterways, wetlands and floodplains should not be compromised (including flow quantity, storage, conveyance and timing)
- Higher levels of social and economic values from waterways, wetlands and floodplain assets are preferred.

Using these principles, the following options for waterways, wetlands and floodplains were identified.

Regulatory Minimum Option	Option 1	Option 2	Option 3
• Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	• Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	• Significant improvement in ecological condition through rehabilitation; expanded buffer widths of 100m consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	• Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.

MAJOR DRAINAGE

The objective for major drainage in the growth areas is: *A plan for major drainage which manages flows and assets in a way that ensures there are no adverse downstream impacts, it enhances the urban landscape and is sustainable over time.*

The following principles were agreed as the basis for framing options to meet this objective:

- Hydrological functionality of major drainage pathways should not be compromised (including flow quantity, storage, conveyance and timing)
- Major drainage assets with higher environmental value are preferred
- Major drainage assets with capacity for higher social and economic values from are preferred
- Major drainage assets that can be effectively maintained are preferred
- In the Northern Geelong Growth Area, major drainage assets which allow for greater infiltration, retardation or reuse of water on the plateau to reduce flow velocity and volume down the escarpment are preferred
- In the Western Geelong Growth Area, major drainage assets that allow for greater infiltration, retardation or reuse of water distributed across the site to reduce flow velocity and volume into rivers is preferred.

Using these principles, the following options for major drainage were identified:

Regulatory Minimum Option	Option 1	Option 2	Option 3
• Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	• Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	• Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	• Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.

LAND USE AND PUBLIC OPEN SPACE

The objective for land use and public open space (as it relates to the water cycle) in the growth areas is: *Ensure land use and open space within the development maximises opportunities for multi-functional land uses associated with the water cycle*.

The following principles for land use and public open space layout were agreed as the basis for framing options to meet this objective:

- More responsive to the natural landform is preferred
- Greater synergy with natural and constructed water cycle assets is preferred
- Broader regional scale benefits is preferred
- Ability to be effectively maintained is preferred.

Using these principles, the following options for land use and public open space were identified:

Regulatory Minimum Option	Option 1	Option 2	Option 3
• Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	• Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	• Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	• Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.

STORMWATER MANAGEMENT

The objective for stormwater management in the growth areas is: *Manage stormwater in a way that ensures there are no adverse downstream impacts and it enhances the urban landscape*.

The following principles were agreed as the basis for framing options to meet this objective:

- A stormwater management plan that increases infiltration, retention and treatment at source and distributed across the area is preferred to a plan with predominantly end of line detention, infiltration and treatment
- A stormwater plan that enhances urban landscape liveability is preferred
- Need to consider different scales of management: neighbourhood, streetscape and property.

Using these principles, the following options for stormwater management were identified:

Regulatory Minimum Option	Option 1	Option 2	Option 3
• **Northern Geelong Growth Area:** Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation / treatment wetland; limited retention of stormwater on the plateau, with end of line wetlands below escarpment. • **Western Geelong Growth Area:** Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands with predominantly hydrological functional values.	• **Northern Geelong Growth Area:** Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation / treatment wetland; limited retention of stormwater within the plateau, some end of line wetlands above escarpment with some additional multifunctional values. • **Western Geelong Growth Areas:** Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands above some additional multifunctional values.	• **Northern Geelong Growth Area:** Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale. • **Western Geelong Growth Area:** Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration throughout the landscape, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability value at property and streetscape scale.	• **Both growth areas:** Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.

ALTERNATIVE WATER SOURCES

The objective for alternative water services in the growth areas is: *Maximise the use of alternative water at source (where possible) to meet fit-for-purpose needs and deliver multi-functional benefits.*

The following principles were agreed as the basis for framing options to meet this objective:

- All alternative water sources must meet the standards required for the intended purpose
- Source of supply of alternative water may vary by scale (i.e. regional, precinct, property) but must meet required standards for security and reliability for the intended purpose
- Source of supply of alternative water may vary by supply origin (e.g. rainwater, stormwater, groundwater, river-water, wastewater)
- Options that increase the proportion of alternative water use (compared to drinking water) are preferred.
    - Note that Barwon Water estimates alternative water sources could provide a maximum of 30% of the areas total water balance when fully developed.
    - Note all options must have a complementary 'Drinking Water' Option.
    - Alternative water options may be complementary (more than one source is possible) but this is likely to lead to duplication and higher costs per unit of water provided.

Using these principles, the following options for alternative water sources were identified:

Regulatory Minimum Option	Option 1	Option 2	Option 3
•Zero alternative water used within the precinct	•Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet)	•Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces)	•Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for non potable uses(e.g. Class A recycled water, use of major stormwater wetlands for extensive internal demand nodes)

DRINKING WATER

The objective for drinking water services in the growth areas is: *Ensure safe, reliable and quality drinking water services to meet mandatory standards for uses requiring drinking water.*

The following principles were agreed as the basis for framing options to meet this objective:

- All drinking water services must meet mandatory standards under Australian Drinking Water Guidelines for quality, so it is a mandatory objective
- Source of supply of drinking water may vary by scale (i.e. regional, precinct, property) but must meet required standards for security and reliability (95%)

- Source of supply of drinking water may vary by supply origin (e.g. reticulated network, groundwater, river-water, stormwater, wastewater (IPR/DPR))
- Options that reduce the proportion of total water demand using drinking water (compared to alternative fit-for-purpose water) are preferred.
    - Note that Barwon Water estimates alternative water sources could provide a maximum of 30% of the growth areas total water balance when fully developed.
    - Note options other than 100% drinking water must have a complementary 'alternative water' option.
    - Note drinking water options are not complementary (one option only).

Using these principles, the following options for drinking water were identified:

Regional scale	Precinct scale	Property scale
•Safe, reliable and quality drinking water provided via connection to regional drinking water network	•Safe, reliable and quality drinking water provided via connection to drinking water source at a precinct scale (IPR, DPR, Stormwater reuse)	•Safe, reliable and quality drinking water provided via connection to drinking water at a property scale

SEWERAGE

The objective for sewerage services in the growth areas is: *Ensure safe, reliable and quality sewerage services to meet mandatory standards.*

The following principles were agreed as the basis for framing options to meet this objective:

- Sewerage service comprises sewage conveyance and treatment, which may vary by scale at which a solution is delivered (i.e. regional, precinct, property)
- All options must meet mandatory standards under Department of Health and EPA Guidelines.

Using these principles, the following options for sewerage were identified:

Regional scale	Precinct scale	Property scale
•Safe, reliable and quality sewerage services provided via connection to regional sewerage system	•Safe, reliable and quality sewerage services provided connection to local sewerage system	•Safe, reliable and quality sewerage services provided at a property scale

OPTIONS SCREENING

Once this comprehensive list has been identified and arranged, the options are screened based on their ability to realistically achieve the stated objective and for any social, environmental, economic, political or strategic issues or conflicts that preclude the option from being implemented in practice. Any options that are deemed unacceptable for whatever reason are coded as red, providing the stakeholders with a clear picture of what will and will not be considered as part of integrated water management in the growth areas.

Whilst each of these options may be able to satisfy the objective, the list needed to be screened for any options that fail any major "deal breakers" (a condition or criteria which renders that option unacceptable to one or more parties).

The options were screened against five "deal breaker" criteria:

1. **Strategic**: Is the option compatible with the stakeholder's strategic goals?

2. **Legislation, policy and governance**: Is the option consistent with legislation or policy?

3. **Environmental**: Is the option acceptable in terms of environmental impacts?

4. **Financial**: Is the estimated cost and/or financial risk reasonable?

5. **Social**: Is the option likely to be acceptable to the community at large?

The viability of each option when screened against these deal-breaker criteria was established by stakeholder consensus and is documented using the following 'traffic light' colour coding:

Green	No deal breakers; likely to be acceptable.
Yellow	Some uncertainty on one or more deal breaker; may be acceptable.
Red	One or more major deal breakers; unlikely to be acceptable.

Detailed options screening for each growth area is documented in Appendices 2 and 3.

Figures 8 and 9 outline a 'viable options matrix' that summarises the options screening for each growth area.

FIGURE 8 VIABLE OPTIONS MATRIX: NORTHERN GEELONG GROWTH AREA

Flexible opportunity

ELEMENT	Regulatory Minimum Option	Option 1	Option 2	Option 3
Waterways, wetlands, floodplains	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	Significant improvement in ecological condition through rehabilitation; expanded buffer widths of 100m consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.
Major drainage	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.
Land use & open space	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater on the plateau, with end of line wetlands below escarpment.	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the plateau, some end of line wetlands above escarpment with some additional multifunctional values.	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale.	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.
Alternative water	Zero alternative water used within the precinct.	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).

Essential service opportunity

Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network	Safe, reliable and quality drinking water provided via connection to drinking water source at a precinct scale (IPR, DPR, Stormwater Reuse).	Safe, reliable and quality drinking water provided via connection to drinking water at a property scale.
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Safe, reliable and quality sewerage services provided at a property scale by AWT.

Figure 9 Viable Options Matrix: Western Geelong Growth Area

Flexible objective

ELEMENT	Regulatory Minimum Option	Option 1	Option 2	Option 3
Waterways, wetlands, floodplains	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	Significant improvement in ecological condition through rehabilitation; expanded buffer widths consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.
Major drainage	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.
Land use & open space	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands with predominantly hydrological functional values.	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands, with some additional multifunctional values.	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration throughout the landscape, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability value at property and streetscape scale.	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.
Alternative water	Zero alternative water used within the precinct.	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).

Essential objective

ELEMENT	Regional	Precinct	Property
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Safe, reliable and quality drinking water provided via connection to drinking water source at a precinct scale (IPR, DPR, Stormwater Reuse).	Safe, reliable and quality drinking water provided via connection to drinking water at a property scale.
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Safe, reliable and quality sewerage services provided at a property scale by AWT.

IWM PACKAGES

Defining a plan to deliver integrated water management in the Northern and Western Growth Areas requires the packaging of a combination of IWM options across each of its seven elements. For each growth area, stakeholders considered four packages of options to identify synergies and conflicts in their delivery as part of future urban development:

- 'Package A' ("regulatory minimum") consists of the regulatory minimum options for the 'flexible' objectives and regional-scale 'essential services' objectives.
- 'Package B' ("slightly better") is a combination of Option 1 'flexible' objectives paired with regional-scale 'essential services' objectives.
- 'Package C' ("better") is a combination of Option 2 'flexible' objectives paired with regional-scale 'essential services' objectives.
- 'Package D' ("outstanding") is a combination of Option 3 'flexible' objectives paired with 'essential services' objectives on the regional-scale (drinking water) and local-scale (sewerage).

Appendix 3 outlines a detailed summary of each package including the advantages and disadvantages of its delivery as part of urban development in the growth areas.

Analysis of packages

Stakeholders analysed each package with the following consensus:

- Package A does not meet the requirements of the stakeholders' strategic policies and does not reflect the community vision for urban development in the growth areas and is discounted from further consideration.
- Package B meets some baseline requirements of the stakeholders' strategic policies but better outcomes offered in Package C are considered feasible. The package does not reflect the community vision for urban development in the growth areas and is discounted from further consideration.
- Package C meets the requirements of most of the stakeholders' strategic policies but outstanding outcomes offered in Package D are considered feasible in most cases. The package does not entirely reflect the community vision for urban development in growth areas and may not achieve benchmarks in key strategic policies such as One Planet Living and the Clever and Creative Future measures of success.
- Package D meets the requirements of the stakeholders' strategic policies and is considered feasible in most cases. For the Northern Geelong Growth Area, some limitations may apply to capacity for distributed detention in proximity to the monocline and throughout the rural living areas. The provision of alternative water within the growth areas to reduce drinking water demand is preferable, however challenges exist which requires further investigation.
- Drinking water supplied via connection to the regional network is feasible and supported.
- Sewerage services supplied via connection to the regional network is feasible and supported, although local servicing may be preferred subject to future consideration.

CONCLUSION AND RECOMMENDATION

The IWM Position Paper for the Northern and Western Geelong Growth Area articulates the importance of the urban water cycle in creating a more liveable, vibrant and sustainable community.

The position paper forms the basis of a shared vision for the delivery of integrated water management in the development of the growth area and will inform the future stages of the planning process. The proposed IWM objectives provide a sound framework for incorporating IWM into the framework plan and subsequent precinct structure planning programme.

It is the conclusion of the position paper that the community and institutional attitudes to water in the urban landscape are more advanced that the current regulatory framework allows. As such, packages that satisfy or slightly exceed the minimum regulatory and statutory requirements are deemed to be inadequate to address the IWM objectives agreed by stakeholders. The do not meet the broader strategic policy objectives of the stakeholders.

Packages C and D best represent the objectives of the stakeholders and broader community in relation to the future growth and prosperity of the Barwon Region. It is acknowledged that delivering some elements in Package D will require a higher level of investment in capital and maintenance cost and must be further considered as part of future planning and development.

The position paper outlines a set of options and packages at a high-level and conceptual level to inform the overall framework plan for the growth areas. Further investigation and delivery of specific options will be undertaken in detailed consideration of the IWM elements as part of future precinct structure planning.

The position paper concludes that Package D is the recommended and supported package of IWM options. Package D reflects outstanding delivery of IWM outcomes including:

- highest level improvement to ecological condition
- outstanding multifunctional values and
- outstanding stormwater retardation, treatment and infiltration
- provision of fit for purpose alternative water which replaces drinking water demand
- safe and reliable drinking water and sewerage services.

Package D potential opportunities and limitations are identified as:

a. Potential opportunities to deliver local-level sewerage services the western growth area

b. Potential opportunities to investigate provision of alternative water (recycled, stormwater or rainwater), either through the entirety of the growth areas or within targeted areas of the public realm, including key networks of activity and recreation

c. Potential limitations in the total delivery of outstanding major drainage elements in the Northern Geelong Growth Area, particularly in relation to the capacity for distributed detention in proximity to the Lovely Banks Monocline and rural living areas

d. Potential limitations in the delivery of alternative water elements in both the Northern Geelong Growth Area and Western Geelong Growth Area, including:
    - Challenges associated with the provision of dual pipe recycled water particularly in relation to high cost, low demands and no available source of recycled water near the growth areas.

- Challenges associated with the provision of stormwater harvesting schemes including cost efficiency, reliability of supply and ongoing maintenance costs.

It is acknowledged that challenges currently exist with regard to the provision of alternative water as described above. Further work is required to investigate the optimum mix of water sources within the development to achieve the overall objectives of the growth areas.

APPENDICES

APPENDIX 1 WORKSHOP STAKEHOLDERS CONTRIBUTORS

Name	Organisation	Workshop 1 Northern (2016)	Workshop 2 Northern (2016)	Workshop 1 Western (2016)	Workshop 2 Western (2016)	Workshop 3 Both (2018)
Nat Anson	CoGG					•
Gail Altmann	CoGG	•	•	•	•	•
Justin Hinch	CoGG					•
Burke Renouf	CoGG					•
Bruce Humphries	CoGG		•		•	
Alastair Bain	CoGG					•
Rob Anderson	CoGG	•	•		•	
James Hamilton	CoGG			•		
Simon Harding	CoGG	•	•	•	•	
Bojan Ritonja	CoGG				•	
Matthew Wilson	CoGG					•
Johanna Thielemann	CoGG / Water Technology					•
Angus Ramsay	Southern Rural Water	•			•	•
Rhys Bennett	Barwon Water	•	•	•	•	•
Tony Overman	Barwon Water	•	•	•	•	
Kate Milburn	Barwon Water					•
Geoff Taylor	Corangamite CMA				•	•
Darren Wilkie	Corangamite CMA	•		•		
Donna Burns	DELWP	•	•		•	
Elliot Stuart	DELWP	•	•		•	
Brian Robert	DELWP			•		
Emma Stewart	DELWP			•		
Anna May	DELWP					•
Nathan McDonald	DELWP	•	•		•	
Heath Baker	Melbourne Water					•
Shane McGlynn	SMEC	•				
Tim Rhodes	SMEC	•	•			•
Neil Craigie	NCA		•			
David Downie	Deakin Uni			•		

Michael Gerner	Golder Associates			•	•	
Cintia Dotto	Water Technology			•	•	
John Pelchen	McCann Group			•	•	
Samantha Ramsey	Ramsey Property Group			•	•	
Peter Steele	HipVHype Sustainability			•		
Jamie Comley	J Comley Consulting					•
Mark Jempsen	Venant Solutions					•
Erin Jacobi	Water Technology					•
Thomas Cousland	Water Technology					•
Kirsten Kilpatrick	Tract Consulting		•			

APPENDIX 2 OPTIONS SCREENING SUMMARY - NORTH

IWCM Element	OptionNo	Option Description	Meets Objective	Policy, Gov	Strategic	Enviro	Financial	Social	Comments
Waterways, wetlands, floodplains	Regulatory Minimum	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	✓	✗	✗	✗	✓	✗	Unlikely to be acceptable. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Waterways, wetlands, floodplains	Option 1	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	✓	!	!	!	✓	!	May be acceptable. May not reflect Govt, COGG and CMA aspirations for natural water cycle assets; may not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Waterways, wetlands, floodplains	Option 2	Significant improvement in ecological condition through rehabilitation; expanded buffer widths of 100m consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	✓	✓	✓	✓	✓	✓	Acceptable.
Waterways, wetlands, floodplains	Option 3	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.	✓	✓	✓	✓	!	✓	Deemed acceptable.
Major Drainage	Regulatory Minimum	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	✗	!	!	!	✓	!	Unlikely to be acceptable. May not meet Govt, Local Govt and CMA aspirations for drainage on site; may not reflect strategic aims of developers.
Major Drainage	Option 1	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	✓	✓	✓	✓	✓	✓	Acceptable.
Major Drainage	Option 2	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	✓	✓	✓	✓	✓	✓	Acceptable.
Major Drainage	Option 3	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.	✓	✓	✓	✓	!	✓	Acceptable for the majority of developable land, although some challenges to establish this in the rural living areas.
Land Use & Public Open Space	Regulatory Minimum	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	✗	✗	✗	✗	✓	✗	Unlikely to be acceptable. Does not achieve objective. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; may not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Land Use & Public Open Space	Option 1	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	✓	✓	✓	✓	✓	✓	Acceptable.
Land Use & Public Open Space	Option 2	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	✓	✓	✓	✓	✓	✓	Acceptable.
Land Use & Public Open Space	Option 3	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.	✓	✓	✓	✓	!	✓	Acceptable for the majority of developable land, although he extent of area required for open space below the escarpment is a limiting factor. Major opportunity for blue-green links in Elcho Park should be investigated.
Stormwater Management	Regulatory Minimum	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater on the plateau, with end of line wetlands below escarpment.	✗	✗	!	✗	✓	✗	Not acceptable. Does not meet objective. May not align with Govt, Local Government and Developer aspirations.
Stormwater Management	Option 1	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the plateau, some end of line wetlands above escarpment with some additional multifunctional values.	✓	✓	✓	✓	✓	✓	Acceptable. Group deemd this is the very least of what should be required.
Stormwater Management	Option 2	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale.	✓	✓	✓	✓	✓	✓	Acceptable.
Stormwater Management	Option 3	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.	✓	✓	✓	✓	✓	✓	Acceptable.
Alternative Water	Regulatory Minimum	Zero alternative water used within the precinct.	✗	✗	✗	✗	✗	✗	Not acceptable. Does not reflect Government policy directions for greater use of alternative water.
Alternative Water	Option 1	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	✓	✓	✓	✓	!	✓	Acceptable.
Alternative Water	Option 2	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	✓	✓	✓	✓	✓	✓	Acceptable.
Alternative Water	Option 3	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).	✓	!	✓	✓	!	✓	Dual Reticulation unlikely to be acceptable due to cost of dual infrastructure for limited alternative water use. Stormwater retained on site could enable higher level of in-precinct use.
Drinking water	Regulatory Minimum	Safe, reliable and quality drinking water provided via connection to regional drinking water network	✓	✓	✓	✓	✓	✓	Acceptable.
Drinking water	Option 1	Safe, reliable and quality drinking water provided via connection to drinking water source at a precinct scale (IPR, DPR, Stormwater Reuse).	✓	✗	✗	✓	✗	!	Unlikely to be acceptable. Unlikely to be able to achieve reliability to supply 100% drinking water from precinct scale sources; does not align with recent regional scale security improvements (e.g. MGP, AB); not aligned with BW Urban Water Strategy; high financial cost relative to direct connection with existing regional scale sources.
Drinking water	Option 2	Safe, reliable and quality drinking water provided via connection to drinking water at a property scale.	✗	✗	✗	✗	✗	✗	Unlikely to be acceptable. Cannot achieve water reliability, safety and quality guarantees with a property scale solution across the development. Against government policy. Against Barwon Water and COGG policy.
Sewerage	Regulatory Minimum	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	✓	✓	✓	✓	✓	✓	Acceptable.
Sewerage	Option 1	Safe, reliable and quality sewerage services provided connection to local sewerage system.	✓	✓	✓	!	✗	✓	Maybe acceptable. Maybe difficult to meet environmental approvals. Potentially costly.
Sewerage	Option 2	Safe, reliable and quality sewerage services provided at a property scale by AWT.	✗	✗	✗	✗	✗	✗	Unlikely to be acceptable. Cannot achieve water reliability, safety and quality guarantees with a property scale solution across the development. Against government policy. Against Barwon Water and COGG policy.

APPENDIX 3 OPTIONS SCREENING SUMMARY – WEST

IWCM Aspect	OptionNo	Option Description	Meets Objective	Policy, Gov	Strategic	Enviro	Financial	Social	Comments
Waterways, wetlands, floodplains	Regulatory Minimum	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	✓	✗	✗	✗	✓	✗	Unlikely to be acceptable. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Waterways, wetlands, floodplains	Option 1	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	✓	!	!	!	✓	!	May be acceptable. May not reflect Govt, COGG and CMA aspirations for natural water cycle assets; Little encroachment unacceptable to CCMA. May not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Waterways, wetlands, floodplains	Option 2	Significant improvement in ecological condition through rehabilitation; expanded buffer widths consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	✓	✓	✓	✓	✓	✓	Acceptable.
Waterways, wetlands, floodplains	Option 3	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.	✓	✓	✓	✓	✓	✓	Acceptable.
Major Drainage	Regulatory Minimum	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality, predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	✗	!	!	!	✓	!	Unlikely to be acceptable. May not meet Govt, Local Govt and CMA aspirations for drainage on site; may not reflect strategic aims of developers.
Major Drainage	Option 1	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	✓	✓	!	✓	✓	✓	Maybe acceptable. Does not include strong focus on distributed drainage management, an important factor for COGG.
Major Drainage	Option 2	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	✓	✓	✓	✓	✓	✓	Acceptable.
Major Drainage	Option 3	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.	✓	✓	✓	✓	!	✓	Acceptable although could be costly to establish and operate.
Land Use & Public Open Space	Regulatory Minimum	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	✗	✗	✗	✗	✓	✗	Unlikely to be acceptable. Does not achieve objective. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; may not strategically aligned to Developer's intentions, likely to be socially and environmental unacceptable.
Land Use & Public Open Space	Option 1	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	✓	✓	✗	✓	✓	✗	Unlikley to be acceptable to the community. Not aligned to COGG or develop expectations.
Land Use & Public Open Space	Option 2	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	✓	✓	✓	✓	✓	✓	Acceptable.
Land Use & Public Open Space	Option 3	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.	✓	✓	✓	✓	✓	✓	Acceptable.
Stormwater Management	Regulatory Minimum	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands with predominantly hydrological functional values.	!	!	!	!	✓	!	May be acceptable. May result in risk of end of line stormwatwer treatment only. May not align with Govt, Local Government and Developer aspirations.
Stormwater Management	Option 1	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands, with some additional multifunctional values.	✓	✓	✓	✓	✓	✓	Acceptable.
Stormwater Management	Option 2	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration throughout the landscape, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability value at property and streetscape scale.	✓	✓	✓	✓	✓	✓	Acceptable.
Stormwater Management	Option 3	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.	✓	✓	✓	!	✓	✓	Likley to be acceptable but high opex costs could be prohibitive.
Alternative Water	Regulatory Minimum	Zero alternative water used within the precinct.	✗	✗	✗	✗	✗	✗	Not acceptable. Does not reflect Government policy directions for greater use of alternative water.
Alternative Water	Option 1	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	✓	✓	✓	✓	!	✓	Acceptable.
Alternative Water	Option 2	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	✓	✓	✓	✓	✓	✓	Acceptable.
Alternative Water	Option 3	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).	✓	!	✓	✓	!	✓	May be acceptable; could use water from quarryt; maybe saline; could be shandied with groundwater or stormwater.
Drinking water	Regulatory Minimum	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	✓	✓	✓	✓	✓	✓	Acceptable.
Drinking water	Option 1	Safe, reliable and quality drinking water provided via connection to drinking water source at a precinct scale (IPR, DPR, Stormwater Reuse).	✓	✗	✗	✓	✗	!	Unlikely to be acceptable. Unlikely to be able to achieve reliability to supply 100% drinking water from precinct scale sources; does not align with recent regional scale security improvements (e.g. MGP, AB); not aligned with BW Urban Water Strategy; high financial cost relative to direct connection with existing regional scale sources.
Drinking water	Option 2	Safe, reliable and quality drinking water provided via connection to drinking water at a property scale.	✗	✗	✗	✗	✗	✗	Unlikely to be acceptable. Cannot achieve water reliability, safety and quality guarantees with a property scale solution across the development. Against government policy. Against Barwon Water and COGG policy.
Sewerage	Regulatory Minimum	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	✓	✓	✓	✓	✓	✓	Acceptable.
Sewerage	Option 1	Safe, reliable and quality sewerage services provided connection to local sewerage system.	✓	✓	✓	!	✗	✓	Maybe acceptable. Maybe difficult to meet environmental approvals. Potentially costly.
Sewerage	Option 2	Safe, reliable and quality sewerage services provided at a property scale by AWT.	✗	✗	✗	✗	✗	✗	Unlikely to be acceptable. Cannot achieve water reliability, safety and quality guarantees with a property scale solution across the development. Against government policy. Against Barwon Water and COGG policy.

APPENDIX 4 IWM PACKAGES SUMMARY – NORTH

ELEMENT	Package A	Package B	Package C	Package D
Waterways, wetlands, floodplains	RMO Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	Option 1 Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	Option 2 Significant improvement in ecological condition through rehabilitation; expanded buffer widths of 100m consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	Option 3 Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.
Major drainage	RMO Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	Option 1 Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Option 2 Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Option 3 Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.
Land use & open space	RMO Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	Option 1 Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	Option 2 Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	Option 3 Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.
Stormwater management	RMO Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater on the plateau, with end of line wetlands below escarpment.	Option 1 Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the plateau, some end of line wetlands above escarpment with some additional multifunctional values.	Option 2 Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale.	Option 3 Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.
Alternative water	RMO Zero alternative water used within the precinct.	Option 1 Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	Option 2 Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	Option 3 Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).
Drinking water	Regional-scale Safe, reliable and quality drinking water provided via connection to regional drinking water network	Regional-scale Safe, reliable and quality drinking water provided via connection to regional drinking water network	Regional-scale Safe, reliable and quality drinking water provided via connection to regional drinking water network	Regional-scale Safe, reliable and quality drinking water provided via connection to regional drinking water network
Sewerage	Regional-scale Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Regional-scale Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Precinct-scale Safe, reliable and quality sewerage services provided connection to local sewerage system.	Precinct-scale Safe, reliable and quality sewerage services provided connection to local sewerage system.

APPENDIX 5 IWM PACKAGES SUMMARY – WEST

ELEMENT	Package A	Package B	Package C	Package D
Waterways, wetlands floodplains	RMO Meet minimum regulatory requirements for ecolo condition, with minimal rehabilitation and minim 30m buffers in accordance with Clause 14.02-1 of ' maybe some encroachment of flood storage or flo conveyance.	Option 1 Some rehabilitation to improve ecological condit beyond minimum, buffers slightly exceed minim 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyanc natural water assets have some multifunctional values.	Option 2 Significant improvement in ecological conditi through rehabilitation; expanded buffer widt consistent with MW Guidelines; no encroachm on flood storage or conveyances; natural wate assets have considerable multifunctional valu	Option 3 Highest level possible of improvement in ecologic condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in som areas; high amenity flood storage and/or conveyan natural water assets have outstanding multifunctio values.
Major drainage	RMO Major drainage strategy meet minimum regulator requirements and provide minimal multi-functionality; predominantly piped major drainag flows to catchment end detention where possible minimal above ground major drainage pathways w little multifunctional use.	Option 1 Major drainage strategy includes some open drainage pathways, with predominantly piped ma drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Option 2 Major drainage strategy includes significant o drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Option 3 Major drainage strategy includes predominantly op major drainage pathways with significant multifunctional values; major drainage pathways a distributed detention are a vital part of the active space linkages in the site.
Land use & open space	RMO Land use plan has limited synergy with natural landform; minimum open space with basic synerg with water cycle assets; providing basic local ben	Option 1 Land use plan shows some responsiveness to nat landform and synergy with water cycle assets; go beyond minimum extent required; providing goo local and some broader benefits.	Option 2 Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly grea extent of open space; provides some blue-gre links with multi-functional use and offering lo and some regional scale; co-location and integration with other land uses.	Option 3 Land use plan maximises responsiveness to natura landform and shows outstanding synergy with wat cycle assets; providing extensive blue-green links diverse multi-functional use and offering regional broader scale benefits.
Stormwater management	RMO Stormwater management plan meets minimum requirements through conventional components; and kerb/channel to underground pipes to end of retardation/ treatment wetland; limited retentio stormwater within the streetscape aside from end line wetlands with predominantly hydrological functional values.	Option 1 Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwa within the streetscape aside from end of line wetlands, with some additional multifunctional values.	Option 2 Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltra throughout the landscape, predominantly thro distributed wetlands with some swales and bioretention close to source; adds some landscape liveability value at property and streetscape scale.	Option 3 Stormwater management plan provides outstandir distribution of stormwater retardation, treatment infiltration across the site, property and streetsca scale; much reduced extent of end of line wetland with a blue/green feel to the urban precinct throu extensive WSUD.
Alternative water	RMO Zero alternative water used within the precinct.	Option 1 Safe, reliable and quality alternative water provi by property scale source, reducing total precinct drinking water demand by approximately 10% (e. tank to toilet).	Option 2 Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources reducing total precinct drinking water demand approximately 20% (e.g. stormwater reuse fro wetlands to nearby demand nodes; Class C wa to irrigated spaces).	Option 3 Safe, reliable and quality alternative water provid precinct scale sources reducing total precinct drink water demand by approximately 30% and/or potentially providing alternative water for off site (e.g. Class A recycled water via dual pipe, use of m stormwater wetlands for extensive internal dema nodes).
Drinking water	Regional-scale Safe, reliable and quality drinking water provided connection to regional drinking water network.	Regional-scale Safe, reliable and quality drinking water provide connection to regional drinking water network.	Regional-scale Safe, reliable and quality drinking water provi via connection to regional drinking water network.	Regional-scale Safe, reliable and quality drinking water provided connection to regional drinking water network.
Sewerage	Regional-scale Safe, reliable and quality sewerage services provi via connection to regional sewerage system.	Regional-scale Safe, reliable and quality sewerage services prov via connection to regional sewerage system.	Precinct-scale Safe, reliable and quality sewerage services provided connection to local sewerage system	Precinct-scale Safe, reliable and quality sewerage services provi connection to local sewerage system.

APPENDIX 6 IWM INDIVIDUAL PACKAGES – NORTH

PACKAGE A

ELEMENT	Regulatory Minimum Package (A)	Advantages	Disadvantages
Waterways, wetlands, floodplains	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	Can be implemented according to current planing scheme. Likely to be low capital cost. Allows for higher developable land.	Whilst this option may be aligned with current planning minimum standards, it does not reflect Government, COGG, developer and CMA aspirations for natural water cycle assets. Therefore it is likely to be considered a less thasn optimal option.
Major drainage	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	High confidence in engineering based major drainage mitigation and management.	Fully enclosed undergrounnd drainage could be more costly than nsome above ground major drainage lines. May not meet Govt, Local Govt and CMA aspirations for drainage on site; may not reflect strategic aims of developers.
Land use & open space	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	Provides maximum developable land.	Reduces the total open space and is unlikley to meet the precicnt objective. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; may not strategically aligned to Developer's intentions, likely to be socially and environmentally unacceptable.
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater on the plateau, with end of line wetlands below escarpment.	Likely to be least capital and operating costs.	Does not provide significasnt oppoirtunity for water to be inetgerated into the urban landscaspe. Does not rteally meet the precicnt objective. May not align with Govt, Local Government and developer aspirations.
Alternative water	Zero alternative water used within the precinct.	Likely to be least capital and operating cost.	Unlikely to be acceptable as it does not reflect Government policy directions for greater use of alternative water.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Likely to be least capital and operating costs.	Use of regional system reduces ability to recycle and use water locally.

APPENDIX 6 IWM INDIVIDUAL PACKAGES – NORTH

PACKAGE B

ELEMENT	Package B	Advantages	Disadvantages
Waterways, wetlands, floodplains	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	Provides an extra degree of waterway protection and enhancement, with greater attention to multifunctional values.	
Major drainage	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Introduces some delighted water in major drainage lines. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	
Land use & open space	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	Improved liveability through increased synergy between land use plan and water cycle assets.	
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the plateau, some end of line wetlands above escarpment with some additional multifunctional values.	Some multifunctional values incorporated into wetlands at top of escarpment.	Acceptable. Group deemed this is the very least of what should be required. Limited retention of stormwater within the urban landscape apart form end of line wetlands.
Alternative water	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	Introduces water retention into the area at property scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Requires extensive at-property scale investment in infrastructure and maintenance.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Likely to be least capital and operating costs.	Use of regional system reduces ability to recycle and use water locally.

APPENDIX 6 IWM INDIVIDUAL PACKAGES – NORTH

PACKAGE C

ELEMENT	Package C	Advantages	Disadvantages
Waterways, wetlands, floodplains	Significant improvement in ecological condition through rehabilitation; expanded buffer widths of 100m consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	Provides an significant improvement in waterway protection and enhancement, with greater attention to multifunctional values.	Higher cost of establishment and maintenance. Reduction in developable land.
Major drainage	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Introduces accessible green spaces to the precinct, which are likely to be highly valued given the topography. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	Higher cost of establishment and maintenance. Reduction in developable land.
Land use & open space	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	Improved liveability through increased synergy between land use plan and water cycle assets.	Higher cost of establishment and maintenance. Reduction in developable land.
Stormwater management	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale.	Significant efforts to retain water in the urban landscape. Given the topography and likely impact of heat island effect, this could be a major liveability benefit.	Higher cost of establishment and maintenance. Reduction in developable land.
Alternative water	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	Introduces water retention into the area at hub scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Stormwater reused may not achieve reliability sufficient to justify internal network during all seasons and during drought.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Eases pressure on regional network. Provides opportunity for localised recycled water use.	Likely to be challenging for gain environmental approvals and more costly.

APPENDIX 6 IWM INDIVIDUAL PACKAGES – NORTH

PACKAGE D

ELEMENT	Package D	Advantages	Disadvantages
Waterways, wetlands, floodplains	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.	Provides an extensive improvement in waterway protection and enhancement, with extensive multifunctional values.	Higher cost of establishment and maintenance. Reduction in developable land.
Major drainage	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.	Introduces extensive green spaces to the precinct, which are likely to be highly valued given the topography. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	Higher cost of establishment and maintenance. Reduction in developable land.
Land use & open space	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue-green links with diverse multi-functional use and offering regional and broader scale benefits.	Improved liveability through increased synergy between land use plan and water cycle assets.	Higher cost of establishment and maintenance. Reduction in developable land.
Stormwater management	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.	Significant efforts to retain water in the urban landscape. Given the topography and likely impact of heat island effect, this could be a major liveability benefit.	Higher cost of establishment and maintenance. Reduction in developable land.
Alternative water	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).	Introduces water retention into the area at hub scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Stormwater reused may not achieve reliability sufficient to justify internal network during all seasons and during drought.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Eases pressure on regional network. Provides opportunity for localised recycled water use.	Likely to be challenging for gain environmental approvals and more costly.

APPENDIX 7 IWM INDIVIDUAL PACKAGES – WEST

PACKAGE A

ELEMENT	Regulatory Minimum Package (A)	Advantages	Disadvantages
Waterways, wetlands, floodplains	Meet minimum regulatory requirements for ecological condition, with minimal rehabilitation and minimum 30m buffers in accordance with Clause 14.02-1 of VPP; maybe some encroachment of flood storage or flow conveyance.	Can be implemented according to current planning scheme. Likely to be low capital cost. Allows for higher developable land.	Whilst this option may be aligned with current planning minimum standards, it does not reflect Government, COGG, developer and CMA aspirations for natural water cycle assets. Therefore it is likely to be considered a less than optimal option.
Major drainage	Major drainage strategy meet minimum regulatory requirements and provide minimal multi-functionality; predominantly piped major drainage flows to catchment end detention where possible; minimal above ground major drainage pathways with little multifunctional use.	High confidence in engineering based major drainage mitigation and management	Fully enclosed underground drainage could be more costly than some above ground major drainage lines. May not meet Govt, Local Govt and CMA aspirations for drainage on site; may not reflect strategic aims of developers.
Land use & open space	Land use plan has limited synergy with natural landform; minimum open space with basic synergy with water cycle assets; providing basic local benefits.	Provides maximum developable land	Reduces the total open space and is unlikely to meet the precinct objective. Does not reflect Govt, COGG and CMA aspirations for natural water cycle assets; may not strategically aligned to Developer's intentions, likely to be socially and environmentally unacceptable
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof and kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands with predominantly hydrological functional values.	Likely to be least capital and operating costs	Does not provide significant opportunity for water to be integrated into the urban landscape. Does not reality meet the precinct objective. May not align with Govt, Local Government and Developer aspirations.
Alternative water	Zero alternative water used within the precinct.	Likely to be least capital and operating cost	Unlikely to be acceptable as it does not reflect Government policy directions for greater use of alternative water
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Likely to be least capital and operating costs	Use of regional system reduces ability to recycle and use water locally

APPENDIX 7 IWM INDIVIDUAL PACKAGES – WEST

PACKAGE B

ELEMENT	Package B	Advantages	Disadvantages
Waterways, wetlands, floodplains	Some rehabilitation to improve ecological condition beyond minimum, buffers slightly exceed minimum 30m in accordance with 14.02-1 of VPP; little encroachment of flood storage or flow conveyance; natural water assets have some multifunctional values.	Provides an extra degree of waterway protection and enhancement, with greater attention to multifunctional values.	Encroachement on floodplain unlikley to be acceptable to CCMA. Provides a low level of focus on natural waterway assets that does not match the developer and council expectations.
Major drainage	Major drainage strategy includes some open drainage pathways, with predominantly piped major drains, primarily end of line detention; some multifunctional values of exposed drainage pathways.	Introduces some day-lighted water in major drainage lines. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	Does not necessarily lead to a distributed plan for managing major drainage.
Land use & open space	Land use plan shows some responsiveness to natural landform and synergy with water cycle assets; goes beyond minimum extent required; providing good local and some broader benefits.	Improved liveability through increased synergy between land use plan and water cycle assets.	This level of land use plan sesnsitity with mnatural water cycle assets was deemed lower that was desired by developers and Council.
Stormwater management	Stormwater management plan meets minimum requirements through conventional components; roof to tank on site then kerb/channel to underground pipes to end of line retardation/ treatment wetland; limited retention of stormwater within the streetscape aside from end of line wetlands, with some additional multifunctional values.	Some multifunctional values incorporated into wetlands at top of escarpment.	Acceptable. Group deemed this is the very least of what should be required. Limited retention of stormwater within the urban landscape apart form end of line wetlands.
Alternative water	Safe, reliable and quality alternative water provided by property scale source, reducing total precinct drinking water demand by approximately 10% (e.g. tank to toilet).	Introduces water retention into the area at property scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Requires extensive at-property scale investment in infrastructure and maintenance.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided via connection to regional sewerage system.	Likely to be least capital and operating costs.	Use of regional system reduces ability to recycle and use water locally.

APPENDIX 7 IWM INDIVIDUAL PACKAGES – WEST

PACKAGE C

ELEMENT	Package C	Advantages	Disadvantages
Waterways, wetlands, floodplains	Significant improvement in ecological condition through rehabilitation; expanded buffer widths of consistent with MW Guidelines; no encroachment on flood storage or conveyances; natural water assets have considerable multifunctional values.	Provides an significant improvement in waterway protection and enhancement, with greater attention to multifunctional values.	Higher cost of establishment and maintenance. Reduction in developable land.
Major drainage	Major drainage strategy includes significant open drainage pathways with associated accessible passive green spaces; partially distributed detention, lesser road network used for high flows; some piped major drains.	Introduces accessible green spaces to the precinct, which are likely to be highly valued given the topography. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	Higher cost of establishment and maintenance. Reduction in developable land.
Land use & open space	Land use plan is highly responsive to natural landform and shows significant synergy with water cycle assets; provides significantly greater extent of open space; provides some blue-green links with multi-functional use and offering local and some regional scale; co-location and integration with other land uses.	Improved liveability through increased synergy between land use plan and water cycle assets.	Higher cost of establishment and maintenance. Reduction in developable land.
Stormwater management	Stormwater management plan significantly exceeds minimum, with good distribution of stormwater retardation, treatment and infiltration on the plateau, predominantly through distributed wetlands with some swales and bioretention close to source; adds some landscape liveability and blue-green value at property and streetscape scale.	Significant efforts to retain water in the urban landscape. Given the topography and likely impact of heat island effect, this could be a major liveability benefit.	Higher cost of establishment and maintenance. Reduction in developable land.
Alternative water	Safe, reliable and quality alternative water provided by sub-precinct ('hub') scale sources, reducing total precinct drinking water demand by approximately 20% (e.g. stormwater reuse from wetlands to nearby demand nodes; Class C water to irrigated spaces).	Introduces water retention into the area at hub scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Stormwater reused may not achieve reliability sufficient to justify internal network during all seasons and during drought.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Eases pressure on regional network. Provides opportunity for localised recycled water use.	Likely to be challenging for gain environmental approvals and more costly.

APPENDIX 7 IWM INDIVIDUAL PACKAGES – WEST

PACKAGE D

ELEMENT	Package D	Advantages	Disadvantages
Waterways, wetlands, floodplains	Highest level possible of improvement in ecological condition through rehabilitation; buffer widths consistent with and exceed MW Guidelines in some areas; high amenity flood storage and/or conveyance; natural water assets have outstanding multifunctional values.	Provides an extensive improvement in waterway protection and enhancement, with extensive multifunctional values.	Higher cost of establishment and maintenance. Reduction in developable land.
Major drainage	Major drainage strategy includes predominantly open major drainage pathways with significant multifunctional values; major drainage pathways and distributed detention are a vital part of the active open space linkages in the site.	Introduces extensive green spaces to the precinct, which are likely to be highly valued given the topography. Likely to be lower cost than extensive daylighting or full undergrounding of major drainage.	Higher cost of establishment and maintenance. Reduction in developable land.
Land use & open space	Land use plan maximises responsiveness to natural landform and shows outstanding synergy with water cycle assets; providing extensive blue green links with diverse multi-functional use and offering regional and broader scale benefits.	Improved liveability through increased synergy between land use plan and water cycle assets.	Higher cost of establishment and maintenance. Reduction in developable land.
Stormwater management	Stormwater management plan provides outstanding distribution of stormwater retardation, treatment and infiltration across the site, property and streetscape scale; much reduced extent of end of line wetlands with a blue/green feel to the urban precinct through extensive WSUD.	Significant efforts to retain water in the urban landscape. Given the topography and likely impact of heat island effect, this could be a major liveability benefit.	Higher cost of establishment and maintenance. Reduction in developable land.
Alternative water	Safe, reliable and quality alternative water provided by precinct scale sources reducing total precinct drinking water demand by approximately 30% and/or potentially providing alternative water for off site use (e.g. Class A recycled water via dual pipe, use of major stormwater wetlands for extensive internal demand nodes).	Introduces water retention into the area at hub scale. Can potentially reduce some storm flow intensity and drinking water demands for the development.	Stormwater reused may not achieve reliability sufficient to justify internal network during all seasons and during drought.
Drinking water	Safe, reliable and quality drinking water provided via connection to regional drinking water network.	Likely to be least capital and operating costs. Existing capacity in network to provide.	Places greater demand on regional water sources.
Sewerage	Safe, reliable and quality sewerage services provided connection to local sewerage system.	Eases pressure on regional network. Provides opportunity for localised recycled water use.	Likely to be challenging for gain environmental approvals and more costly.