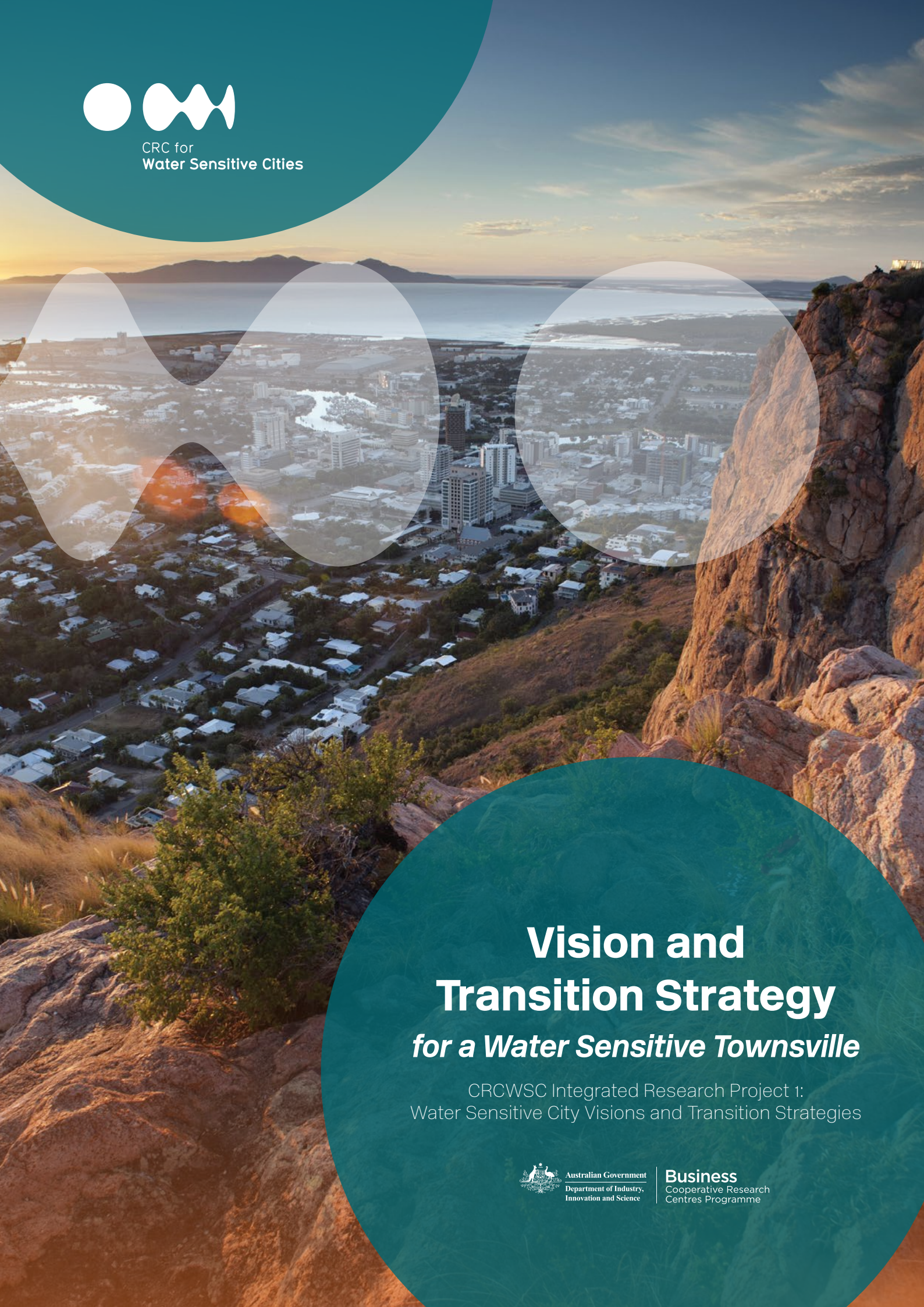

CRC for
Water Sensitive Cities

Vision and Transition Strategy

for a Water Sensitive Townsville

CRCWSC Integrated Research Project 1:
Water Sensitive City Visions and Transition Strategies

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

Vision and Transition Strategy for a Water Sensitive Townsville
Water sensitive city visions and transition strategies (IRP1)
IRP1–1–2018

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The authors would also like to thank Travis Farley at TBD Design for creating the illustrations in this report and helping bring Townsville's water sensitive city vision to life.

Disclaimer

Executive Summary

Townsville's relationship with water has been shaped by its unique dry tropical climate and extreme weather patterns and events. The traditional land owners and custodians, the Bindal and Wulgurukaba people, relied on the region's waterways and adapted their way of life to the dramatic seasonal variations. As the area became settled by Europeans and the town began to grow, water supply, sanitation and drainage services were provided through infrastructure solutions to suit the needs of a growing population. More frequent droughts and cyclones as a result of a changing climate, as well as pressures on surrounding marine and other natural environments, have more recently led to an increased focus on climate resilience, urban liveability, and ecosystem health. Water is now seen not just as a resource to support development and urbanisation, but also as delivering broad values firmly embedded in the daily lives of Townsville's people.

A project by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) brought together 29 leading thinkers across water, planning, environment and development in Townsville in a series of 3 action research workshops. They considered the city's long-term water aspirations, benchmarked today's water sensitive performance and explored strategic priorities for the short- to medium-term that will be important in pursuing their water sensitive city vision.

The vision for Townsville as a future water sensitive city depicts the values and outcomes to be secured over the next 50 years:

Townsville is an attractive, resilient city that manages water to enhance healthy ecosystems, embrace dramatic natural water cycles, drive world-leading innovation, and support citizens who are proud of their dry tropical identity.

1. Townsville celebrates being an attractive, liveable city with integrated and multi-purpose built and natural environments that feature water, bring people together and showcase the city's dry tropical climate.
2. Water is managed holistically to ensure reliability of Townsville's water system and the long-term sustainability of its resources.
3. Townsville's waterways, wetlands, coastline, and surrounding marine and inland environments are healthy, valued, and continuously enhanced.
4. Townsville people are proud of their connection to water and are empowered to be active and responsible water stewards.
5. Townsville is an international water innovation hub that showcases water sensitive technology, practices and design for the dry tropics.
6. Inclusive water governance in Townsville enables integration, collaboration, innovation and collective leadership.
7. Indigenous water knowledge, values and ways of thinking are valued in the Townsville community and incorporated into water planning, design and management.

The CRCWSC's Water Sensitive Cities (WSC) Index was used to benchmark Townsville's current water sensitive performance. Townsville scored highest for the goals of Achieve equity of essential services (3.9/5) and Improve ecological health (3.1/5). Areas for improvement include Ensure good water sensitive governance (2.4/5) and Improve productivity and resource efficiency (2.4/5). These results are presented on the next page: (a) against each of the WSC Index goals, and (b) as a percentage attainment of each water sensitive city-state.

Townsville's progress towards its vision was analysed using the CRCWSC's Transition Dynamics Framework, which assesses the presence of important enabling factors that would support a city's transition to a new practice. This analysis indicates that Townsville has made significant advancements towards water sensitive practices, with strong leadership from champions, a growing knowledge base, pilot projects and a range of policy, regulative and practical tools to guide new practices.

To further advance Townsville's water sensitive city transition, particular focus is needed on establishing platforms that will support collaboration across diverse stakeholders to drive new solutions for a range of issues associated with water sensitivity. Specific high level strategies recommended to address priority transition needs in the short- to medium-term:

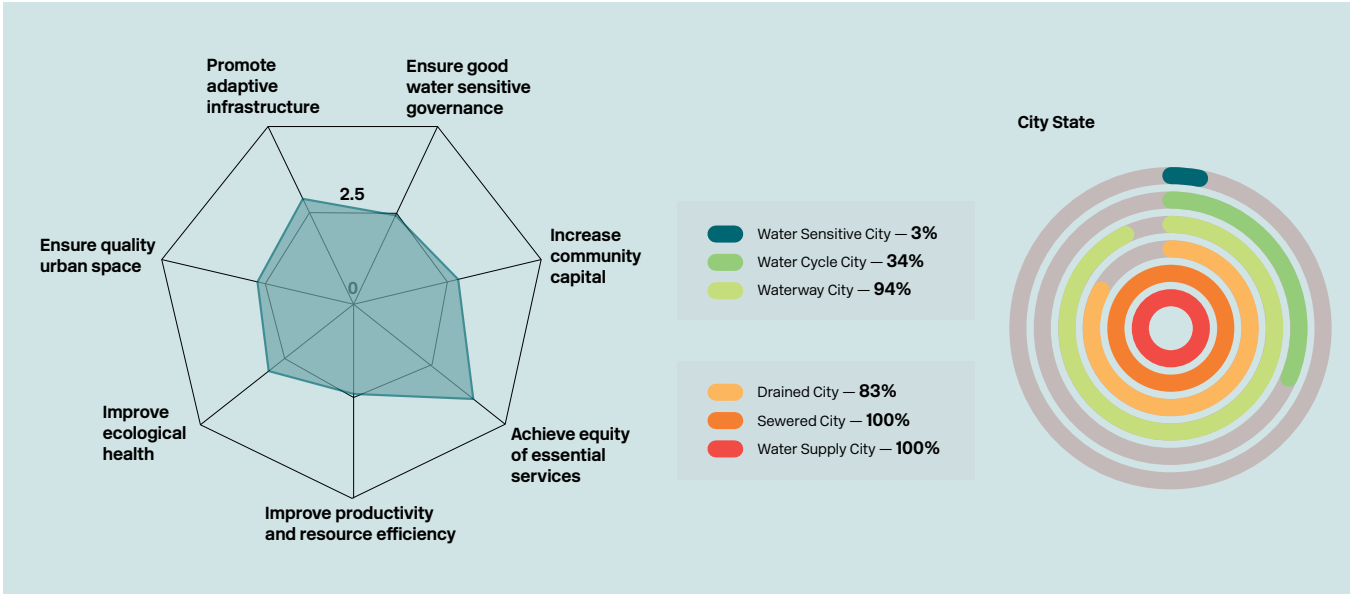
I. Embed Townsville's water sensitive aspirations in a broad city vision and organisational policies, plans and strategies.

II. Establish platforms that will support and drive integration and collaboration within Council and with external stakeholders.

III. Develop new knowledge on issues and potential solutions for particular aspects of Townsville's water sensitive city vision.

IV. Learn from and scale innovations to provide on-ground demonstrations and practical guidance for water sensitive approaches in the dry tropics context.

Townsville has strong momentum towards achieving its vision of a future water sensitive city. However, strategic attention is needed to overcome the social and institutional barriers that could impede further on-ground progress. The recommendations presented in Vision and Transition Strategy for a Water Sensitive Townsville aim to provide orientation and guidance for stakeholders across Townsville in navigating these barriers and advancing its water sensitive city agenda.



WSC Index results for Townsville (a) organised by WSC Index goal, and (b) filtered by city-state

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Glossary

CRCWSC	Cooperative Research Centre for Water Sensitive Cities
Collaboration platform	A forum, network, group, program, project, or other mechanism for connecting a diverse group of stakeholders to share knowledge and information, develop ideas and establish a collective voice
IRP1	CRCWSC Integrated Research Project 1 *Water Sensitive City Visions and Transition Strategies*
JCU	James Cook University
Narrative	A well-articulated rationale and/or compelling case for a particular practice or action, including a description of its ecological, economic, and social benefits
Traditional Owners	Traditional custodians of Greater Townsville's catchments, together with other Aboriginal people who have made it their home
Transition	A fundamental shift in cultures, structures and practices as society changes from one pattern of socio-technological development to another, usually more sustainable, pattern
Transition Dynamics Framework	A framework that conceptualises how system-wide changes in practice (e.g. the transition to water sensitive practices) unfold over time, based on the establishment of key enabling factors: individual and organisational champions, platforms for connecting, science and knowledge, projects and applications, and tools and instruments
Urban form	The physical characteristics that make up the built environment, including urban density and size, parcels and buildings, public spaces, ecological assets and key services such as transport and drainage
Urban Water Transitions Framework	A framework that conceptualises different forms of urban water servicing as a city responds to evolving drivers: Water Supply City, Sewered City, Drained City, Waterways City, Water Cycle City, and Water Sensitive City
WSC	Water Sensitive City; a WSC provides water system services in a way that reflects an integrated approach to infrastructure, the built form, the environment, governance and community, in order to deliver outcomes that support the enduring sustainability, liveability, resilience and productivity for a place's community and ecosystems
WSUD	Water Sensitive Urban Design; an approach to the planning, design and maintenance of urban landscapes that will deliver WSCs through protecting and enhancing natural water systems and integrating the management of the total water cycle
WSC Index	A tool to benchmark and diagnose the water sensitive performance of a place (from the municipal to metropolitan scale), based on 34 indicators organised by seven goals: good water sensitive governance, community capital, equity of essential services, productivity and resource efficiency, ecosystem health, quality urban space, and adaptive infrastructure

1. Introduction

1.1 About this report

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) was invited to develop a WSC vision and transition strategy for Townsville. This forms part of the *Water Sensitive City Visions and Transition Strategies* integrated research project (IRP1), which aims to deliver a suite of participatory methods and associated tools for guiding cities and towns in accelerating their water sensitive transitions.

The project involved facilitation of stakeholder discussions across a series of three full-day workshops, stakeholder interviews, literature review and the application of benchmarking and diagnostic tools to inform detailed analysis. 29 of Townsville's leaders and strategic thinkers from across water, planning, environment, and other related sectors participated in the project between October and December 2017.

This report presents the key outputs of the project. Its purpose is to provide a framework for orienting and coordinating strategic action across the many different stakeholders who will need to collaborate for Townsville's envisioned water future to be achieved. It is anticipated that this summary report can be used as a resource to inform the design and implementation of strategic and operational programs of action within Townsville City Council, departments of the Queensland and Australian Government and other organisations.

This report is complemented by a companion document, *Benchmarking, Envisioning and Transition Planning for a Water Sensitive Townsville: Final Case Report* that provides a full description of the case study methodology as well as the detailed analyses that underpin the results.

Alongside the production of practical guidance for the Townsville water sector contained in this report and its companion document, the engagement process overall has been valuable for strengthening relationships amongst stakeholders and building momentum and commitment for driving Townsville's transition towards its envisioned water sensitive future.

Anonymous quotes from participants in this process are used throughout the report to illustrate key points. Perceptions expressed in the quotes should not be interpreted as representative of the views of the whole participant group, or of the authors.

1.2 What are water sensitive transitions?

As cities and towns globally are grappling with the challenges of climate change and rapid urbanisation, practitioners, decision-makers and academics are recognising the importance of water in supporting urban liveability, sustainability and resilience for a city's long-term prosperity.

In Australia, the vision of the WSC is now widely used to represent an aspirational concept in which water has a central role in shaping a city. In a WSC, people are not disrupted by flooding, and can enjoy reliable water supplies, effective sanitation, healthy ecosystems, cool green landscapes, efficient use of resources, and beautiful urban spaces that feature water and bring the community together.

A WSC incorporates innovative infrastructure, design and governance solutions. For example, water recycling at different scales through wastewater recovery and stormwater harvesting provides a diversity of water sources and improves the health of downstream rivers and creeks by reducing pollution and flow impacts. Water sensitive urban designs integrate nature-based infrastructure into the landscape to provide hydraulic and water treatment functions, as well as amenity benefits such as an aesthetic environment and mitigation of urban heat island effects. Integrated and collaborative land use and water planning results in catchment-scale approaches to enhancing flood resilience and connecting areas of green and blue to create ecosystem and recreation corridors throughout the city footprint. Citizens are active in caring for water and the environment, and there is cohesion amongst the community as their sense of place and collective identity is nurtured through their connection with water.

Many places are starting to articulate aspirations represented by the WSC concept. Becoming a WSC requires a significant departure from the conventional mode of water servicing, which typically manages water as separate streams for water supply, wastewater and stormwater through large-scale, centralised infrastructure. These traditional water systems have given us critical benefits such as clean water, safe sanitation and effective drainage, and this mode of servicing is still an important part of a WSC. However, we now recognise that adaptations are needed to address key social and environmental vulnerabilities that result from conventional approaches, such as degraded waterways, uncertain and extreme rainfall patterns and growing community expectations for improved liveability.

The Urban Water Transitions Framework presented in Figure 1 depicts the evolution in water system servicing as these drivers unfold. Most cities in the world would appear somewhere on this continuum, however, a city's journey from a water supply city through to the aspirational WSC is not linear. Australian cities are typically somewhere between a drained city and a water cycle city, with observable features across all six of the city-states.

Becoming a WSC requires significant changes in policy and practice as the water servicing system moves through different city-states. A successful transition will therefore rely on commitment and alignment amongst many different people and organisations.

Developing a shared perspective of water today, a compelling vision for the future and a framework to guide coherent strategic action is critical for establishing the understanding, motivation and capacity amongst stakeholders to drive their WSC transition.

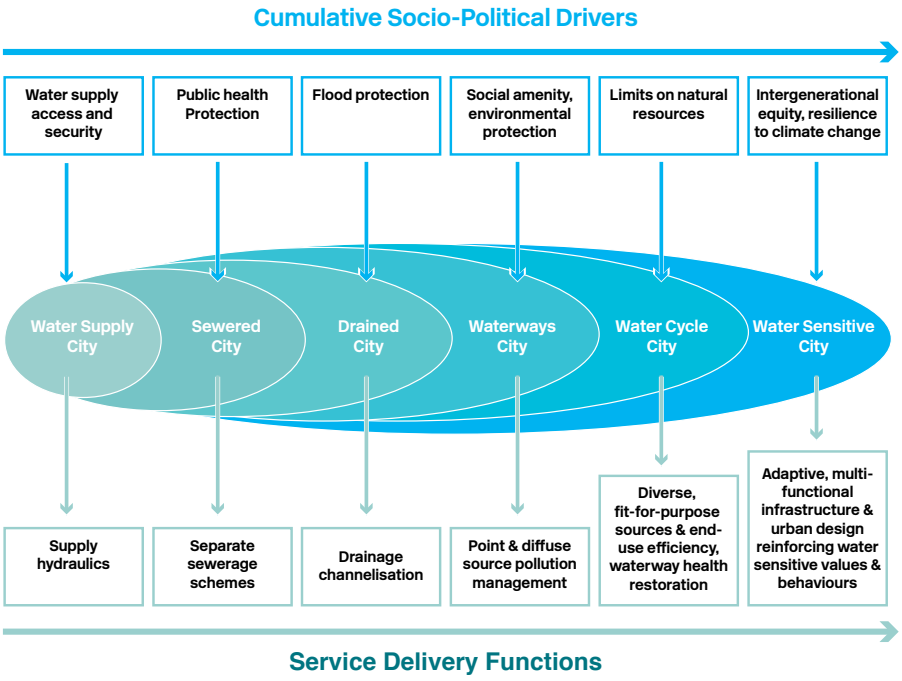


Figure 1: Urban Water Transitions Framework (Brown, Keath & Wong, 2009)[1]

[1]Brown, R., Keath, N., & Wong, T. (2009). Urban water management in cities: historical, current and future regimes. *Water Science and Technology: A Journal of the International Association on Water Pollution Research*, 59(5), 847–55.

2. Townsville's Water Story

2.1 Looking to the past

Townsville is an iconic Australian city situated in the Dry Tropics of North Queensland. It is adjacent to the world heritage listed Great Barrier Reef, which creates opportunities for tourism, science and research. The City has been shaped by its unique dry tropical climate and extreme weather events such as droughts and cyclones. It is blessed with natural assets such as Mount Stuart, the Paluma Range, Castle Hill, Cape Pallarenda, Cleveland Bay, the Strand, Ross River, and the Great Barrier Reef, all of which play a pivotal role in creating Townsville's dry tropical lifestyle that locals and visitors cherish. Water is seen not just as a resource to support development and urbanisation but also as delivering broad values firmly embedded in the daily lives of Townsville's people.

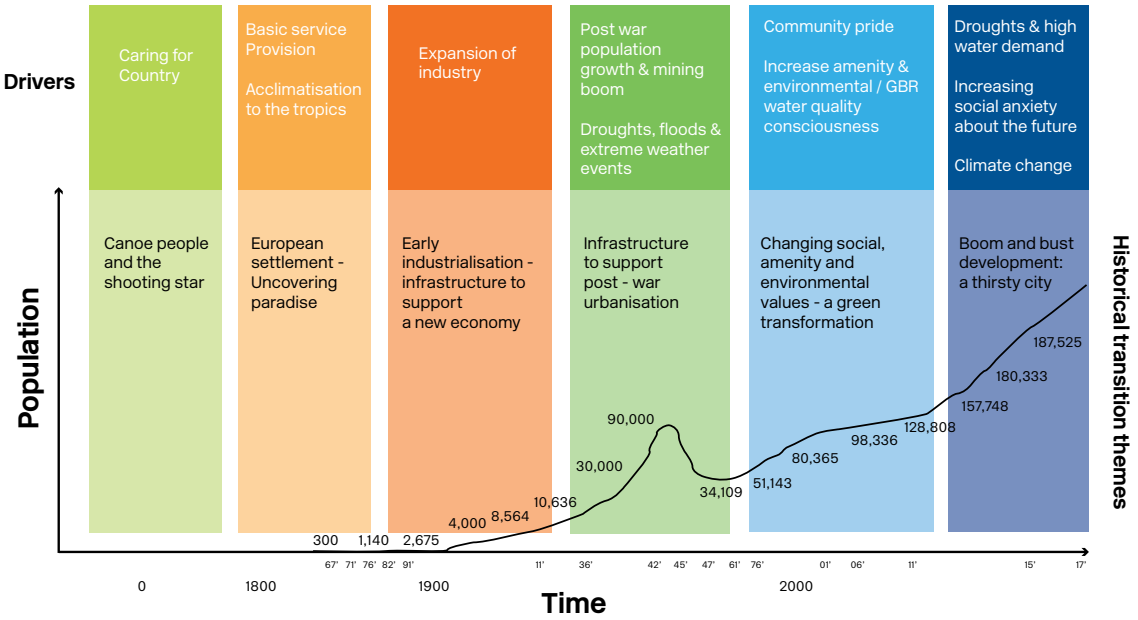


Figure 2: Townsville's water story comprises key themes influenced by unique drivers over time

Pre-1800AD: Caring for our country - *Canoe people and the shooting star*

Traditional Owners and custodians, the Bindal and Wulgurukaba, are recognised as the first people to have inhabited the Townsville region.

An important symbol of the Wulgurukaba (meaning 'canoe people') is the Carpet Snake. The Wulgurukaba creation story tells of the creation snake that comes down from the Herbert River, went out to sea creating the Hinchinbrook Channel and down to Palm and Magnetic Islands. His body broke up leaving parts along the coast. The tail of the snake is at Halifax Bay, his body is at Palm Island, while his head rests at Arcadia, Magnetic Island (Townsville City Council, 2017).

The Bindal people call the country "Thul Garrie Waja". An important symbol for the Bindal people is the shooting star (Townsville City Council, 2017). The approximate area of interest for the Bindal Traditional Owners is north of Townsville from Black River, south to the Haughton River, east to the Barrier Reef (excluding Magnetic Island) and west to the Mingela Range (NQ Dry Tropics, 2017).

The Aboriginal people relied on the region's waterways for survival and adapted their way of life to seasonal variations. The region's creeks, rivers and floodplains were a rich source of food and plants, which were used to make tools and equipment such as fishing nets and canoes. Other raw materials from the waterways were used for making baskets, necklaces, huts and canoes for fishing and transportation. During the dry season, the Aboriginal people lived a relatively settled existence concentrating near lagoons and large water holes and making use of the riverine environment. In the wet season, when neither water nor game was restricted, they were much more geographically dispersed (Townsville City Council, 2014). The Aboriginal people lived their lives completely connected to and reliant on the natural water cycle, allowing them to thrive in the harsh dry tropical conditions. Rowes Bay, Garbutt and the Town Common remain contemporary wetlands for Traditional Owners of the area.

1800s – 1900s: European settlement – *Uncovering paradise*

After Captain James Cook encountered Townsville and Magnetic Island in 1770, Townsville was settled by Europeans in 1864 due to the recognition of Cleveland Bay as an important port facility. Townsville's maritime-based industry continued to grow in the following years, with the discovery of copper, lead, and zinc resources in the early 1900s leading to a rapid expansion of Townsville's pastoral and goldmining industry and the establishment of the Townsville Port (Port of Townsville, 2017).

The first European settlers on Magnetic Island arrived in 1876. Early settlers from the mainland found relief from the heat on Magnetic Island, with Picnic Bay becoming a favoured resort for local holiday-makers. Magnetic Island continues to be considered a suburb of Townsville and is popular with locals and visitors.

The first water conflict between Aboriginal people and European settlers arose over a wetland on the Strand, which ultimately died off due to overuse and pollution by the settlers. The wetland has since been artificially reconstructed, with Melaleucas re-planted around it. The story, called "Hambalena Spirit Rising", is now told in interpretive panels and represents a shift in environmental consciousness and wetland management.

The Townsville Water Authority was established in 1882 to provide reticulated water to Townsville residents. As urban development spread, new water supplies were constructed. In 1885, Willmett's Well (located near today's suburb of Mundingburra) and Hurbert's Well (located near what is now Ross River Road and West Street) were constructed (Townsville City Council, unknown). This supply supported approximately 13,000 residents by the end of the 19th century.

November 26, 1896 saw one of the first documented cyclones, with Tropical Cyclone Sigma striking the town and causing a reported £600,000 damage (Townsville City Council, 2014). Cyclones would continue to shape the lifestyles of local residents throughout Townsville's history.

This period was strongly influenced by the need to establish basic services such as water supply and the Port. It was also a time where the early settlers had to acclimatise to an unfamiliar dry tropical climate that included tropical cyclones.

1900s – 1950: Early industrialisation – *Infrastructure to support a new economy*

The North Queensland gold rush and the continuing growth of the pastoral and mining industry led to population increases and urbanisation. Resulting water shortages in the early 1900s led to the commencement of the damming of the Ross River. A series of weirs was constructed on the Ross River for water supply, with pumping from Gleeson's Weir commencing in 1923. Aplin's Weir was constructed in 1927 to prevent tidal inundation of the water supply and to enhance groundwater recharge (Townsville City Council, 2017).

By 1936 the population had risen to more than 36,000. Weirs on the Ross River, with some local use of bores, continued to provide the primary water supply, however these supplies were stretched to their limits and the first water restrictions were imposed that same year.

In part to help mitigate unemployment, funding from the Queensland Treasury in 1933 enabled approval by Council of one of the first major investments in sanitation infrastructure with 6600 acres sewered in the main City area at a cost of £13,000 (National Library of Australia, 1939).

With declaration of war in Australia in 1941, Townsville became one of the largest defence training bases in Australia and its population swelled to more than 100,000 people between 1941 and 1943. This rapid population growth placed even greater pressure on the water supplies, sanitation and waste management services.

This period of history continued to be influenced by the early growth of the new town through the expansion of industry, provision of sanitation services, and the establishment of Townville as a major temporary defence training and supply base during World War II.

1950 – 1990: Post-war growth and development – *Infrastructure to support post-war urbanisation*

Conflict in Asia in the 1960s saw the permanent establishment of a defence base in Townsville, named Lavarack Barracks in 1966. This defence capability expansion was accompanied by an urban development expansion in the 1970s, required to house the various personnel. Urban development was also triggered by then Prime Minister Gough Whitlam's government who, in the 1970s, pushed for growth in regional centres like Townsville. Another large investment in the region came in 1961 through the establishment of what is now the second oldest university in Queensland – James Cook University (JCU) – which is now internationally recognised for its programs in marine and tropical research (JCU, 2017).

Magnetic Island saw major infrastructure investment in the 1970s, when it became the first Queensland off-shore island to receive water supply from the mainland. An eight kilometre long submarine pipeline was constructed, along with a network of reticulation mains and storage reservoirs to supply water to approximately 600 residences. In May 1970, the Bulletin reported that it was "widely predicted" that completion of the reticulated water scheme would set off a building spree on the island (Fielding, 2016).

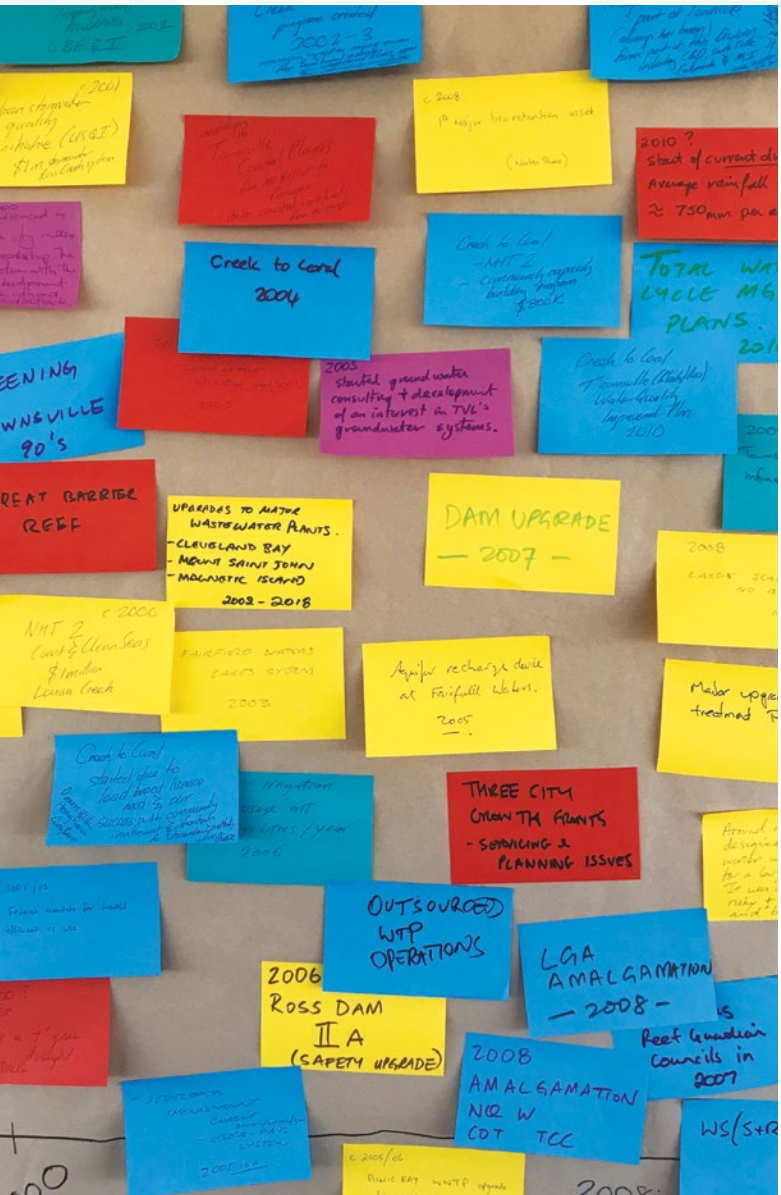
State and Federal funding for water infrastructure in Townsville saw the construction of Ross River Dam (completed in 1971), which provides both water supply and flood protection services. The Mount St John Wastewater Treatment Plant, now one of Townsville's largest wastewater treatment plants, started operations in 1972 and has been continually upgraded since then to meet the demands of an ever-increasing population (Townsville City Council, 2017).

The construction of Ross River Dam came just in time, with Tropical Cyclone Althea making landfall near Townsville on Christmas Eve 1971. Despite this cyclone, the wet seasons of the early 1970s were considered 'normal', but this quickly flipped in 1974 which saw one of the most intense wet seasons experienced in a long time, although this record would not last for long (Townsville City Council, 2017).

Population growth was a key theme during this post-war period, and with growth came another investment boom in water-related infrastructure and the realisation that this infrastructure needed to be able to respond to substantial fluctuations in climate conditions and extreme weather events. Building resilience to climate variability has remained a focus for the City to this day and beyond.

1990 - 2008: Changing social, amenity and environmental values – *a green transformation*

A forerunner in environmental management, Townsville City Council employed one of the first dedicated environmental officers in Australian local government history in 1988 and, later in 1996, established a full Environmental Planning Unit (Townsville City Council, 2003). The late 1980s and 90s saw an impressive and award-winning effort by the Council on conservation and land management, with the first Environmental Conservation Strategy launched in 1993. Collaboration with the Great Barrier Reef Marine Park Authority (GBRMPA) and the Department of Planning led to further environmentally-focused programs and strategies (Townsville City Council, 2003). Wetlands of Townsville were mapped in the 1990s by JCU scientists (Bruce, 2004), which led to official protection of the mangroves, wetlands and sand dune systems of the South Bank of the Ross River as an Environmental Conservation Park in 2013. An extensive dugong protection area was also established in the eastern end of Cleveland Bay.



Extreme climate events in the following years tested Townsville's water infrastructure, with the worst flood on record experienced in January 1998. These big rains put drainage and stormwater management on the front agenda for Council. Several long, hot dry seasons in the early 2000s led to drought conditions and high water demand across the city. The dry landscape was unflatteringly dubbed 'Brownsville' by many, which generated a strong desire by local residents to prove otherwise.

> ***"Our climate is a major challenge... we face very different conditions than Melbourne or Sydney. We are always going to use more water than them."***

In response to the growing push to be seen as a 'green' tropical city, and under the leadership of the then Mayor Tony Mooney, the Greening Townsville and later the Community Greening programs were established as a partnership between Council, community, local schools and businesses. It included substantial investment in irrigation systems, community tree plantings, native plant giveaways and revitalisation of many open spaces and parklands. The Greening Townsville Program, in conjunction with the Strand and foreshore redevelopment, community landcare groups, Creekwatch programs and remediation of Ross River, Louisa Creek and Magnetic Island, helped to transform Townsville into a more modern, liveable city. At the same time, Council commenced catchment and landscape education tours in conjunction with Conservation Volunteers Australia and others, which led to Council achieving Advanced Ecotourism Certification in 2006. These initiatives were heralded as huge successes, with a legacy of smart, highly instrumented irrigation systems, inviting open spaces that helped drive local tourism and development opportunities, and a proud local community (Townsville City Council, 2003). The initiatives also led Council to establish a Greening and Waterway Team to work on waterway management and landscape ecology.

Council becoming an early adopter of an integrated approach to waterway management, involving engineers, environmental specialists and planners, along with businesses and residents. Associated initiatives include the Clean Seas Program and Urban Stormwater Initiative, coastal zone management rehabilitation projects, a mangrove management strategy, and implementing an erosion control course for professionals.

"One of the biggest barriers in Townsville, this is where they had the reputation of Brownsville, they've used a lot of water to overcome that and now they can't go back."

A national growing environmental consciousness and a regulatory driver to introduce more stringent licencing controls of the city's wastewater treatment plants and request for load-based licensing led to the establishment of the Creek to Coral initiative in 2003 by Townsville and Thuringowa City Councils, in partnership with the then Queensland Environmental Protection Agency (EPA), and with support from GBRMPA. This initiative was the first to bring attention to the relationships between inland waterways and coastal marine environments. The Creek to Coral partnership, although infrastructure based, sought to involve the community in ways such as the Creekwatch program. The partnership was instrumental in the development of Townsville's Black-Ross Water Quality Improvement Plan in 2010 and other community-based wetland and waterway projects.

While water security remained on the agenda during this period, the growing sense of community pride in the City and environmental concern strongly influenced government policy and program investment. These initiatives also led to one of the first integrated sustainability departments in local government around Australia, which grouped water, energy, revegetation and wildlife management under one natural resources management portfolio, Integrated Sustainability Services (ISS).

2008 – 2017: Boom and bust development – *a thirsty city*

A combination of factors resulted in high unemployment in Townsville, including the end of the mining boom, the Storm Financial collapse whose head office was in Townsville, and later the Yabulu Nickle refinery closure. This economic downturn impacted the city's urban development, tourism, and export sectors, and created a level of social anxiety amongst local residents regarding Townsville's economic future. This public anxiety would eventually extend to water security, with concerns about the sufficiency of water infrastructure to support industry (existing and new) along with maintaining local amenity values of waterways. Meanwhile, through the amalgamation of Townsville City Council, Thuringowa City Council and NQ Water, the integrated sustainability model remained in place, which linked all aspects of active waterway and wetland management with planning. This linkage has since changed to improve the narrative of an evolving water sensitive city and address remaining challenges around water supply and conservation. Community education around water conservation and ecological health also grew with the establishment of the Rowes Bay Sustainability Centre, implementation of more waterwise gardens and green infrastructure, and the water smart technology trial as part of the IBM Smarter Cities award program in 2011.
Tropical Cyclone Yasi brought an above-average wet season in 2011, and once again created a heightened focus on disaster management, and social and infrastructure resilience. Subsequent failed wet seasons caused dam levels to drop to 15% in November 2017. Pumping from the Burdekin Dam commenced to augment the low water levels, and level three water restrictions were introduced in late 2016. The community's response to the water restrictions has been mixed, with a large majority of citizens reducing daily water use. Others, however, have used it as a platform to question government infrastructure planning decisions and to demand their entitlement to their normal water allocation paid for through rates and taxes. The Water for Townsville Action Group (WFTAG) has become the voice of many disheartened community members, using social media to give residents a platform to share information and 'to pose questions and legitimate infrastructure solutions' (Water for Townsville Action Group, 2017).

"What does water security actually mean? How does demand management relate to that? The wider community thinks that water security is about providing water to them so they can use as much as they want, whenever they want. If we are actually able to drive demand down, we are actually able to have better water security with what we've already got. It's not a conversation that many people want to hear."

Water security has been a key dimension of Townsville's City Deal, signed in December 2016, which represents a 15 year multi-level government agreement to improve the lives of Townsville residents through investment in jobs, economic growth, infrastructure and a more liveable city. As part of the investment package, $215 million will fund a 36km duplication of the Haughton pipeline as a water security measure. In addition, $10 million will address demand management measures that aim to reduce potable water consumption by residents, industry and local businesses; and implement integrated smart technology solutions favourable to both the water utility and residents.

Recent attention on the condition of the Great Barrier Reef has caused public concern over the health of local waterways. UNESCO's World Heritage Committee agreed to keep the Great Barrier Reef off the 'in danger' list on the provision that State and Federal Governments continue to work closely to invest in and implement the Reef 2050 Long-term Sustainability Plan. This Plan has been supported with State and Federal Government funding to realise significant land management practice change and develop catchment load reduction targets.

More recently, Council has made substantial progress in integrated waterway management around aquatic weeds, and are using an aquatic weed harvester to harvest weeds and treat with microbial formulations to promote soil formation, reduce transportation costs, and to train local Council staff in reducing carbon emissions. This work builds on years of learning how to be more resilient when responding to cyclones and pollution management of wetlands using microbial formulations.

Urban water quality in the Great Barrier Reef region has only recently been seen as an issue of State concern, with the Reef Water Quality Task Force recommending to improve existing minimum regulatory standards and compliance capacity for point source pollution and stormwater, erosion and sediment control in urban and industrial areas. This has been done in consultation with affected industries and gives explicit regard to the costs and benefits of those standards.

2.2 Looking ahead to Townsville's water future

Townsville's population of nearly 200,000 is expected to double by 2050, which presents the city with the challenge of maintaining and enhancing its liveability and sustainability in the face of future uncertainties such as climate change and urban growth. Townsville is also striving to establish a strong economy driven by local commercial opportunities, and will need to ensure affordability and equity in service provision are maintained for its communities.

The impacts of climate change will mean less reliable wet seasons and higher temperatures, reducing inflows to dams and increasing evaporation losses. Hotter days will also result in more heat-related illnesses and deaths, and higher energy consumption from air conditioning. Prolonged drought periods will make it more difficult to maintain green parks and gardens. Sea level rise and an increase in extreme weather events (e.g. cyclones) will put coastal and vulnerable areas of Townsville at higher risk of flooding and inundation

Population growth and urbanisation are also putting pressure on Townsville's existing water systems. More water will be needed to meet growing demand, and consideration will need to be given to how water can be used more efficiently in times of excess. Measures will need to be taken to protect the surrounding environments from increased pollutant loads from a bigger city. Urban planning and design will need to be strategically integrated with water planning as part of an ongoing effort to maintain a green and liveable Townsville.

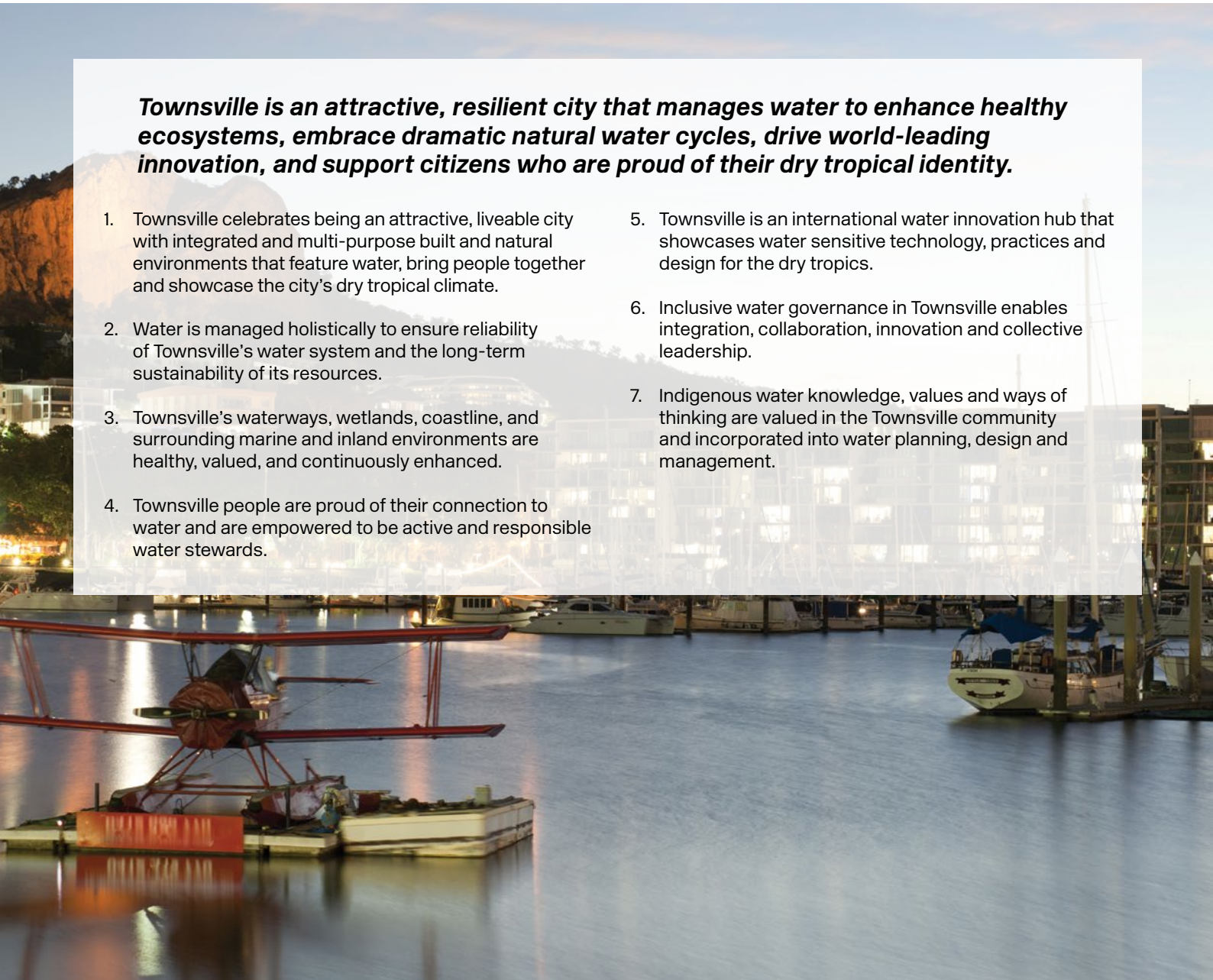
While these drivers are a challenge for existing water systems services and processes, they also present an opportunity to change the 'business-as-usual' approach. Townsville's City Deal, particularly its investment in additional water infrastructure and demand management initiatives, provides an opportunity to examine water issues holistically and in new, innovative ways, with the confidence that immediate water security concerns are being addressed. Links with universities, particularly JCU, can help to build the capabilities needed for innovation. Moving forward, there is a more positive outlook for Townsville's water sector, with significant water system investments committed and a willingness to collaborate between levels of government, the community and business sectors. Townsville has the potential to become an exporter of knowledge and expertise on water management in the dry tropics and to become the world's first tropical, water sensitive city.

> ***"I think the opportunities in a place like this are significant."***

The people of Townsville are proud of their city and its unique dry tropical environment. They appreciate their surrounding natural assets and the associated active, outdoor lifestyle offered; and value the connectedness of their communities and the benefits of a city scale that puts everything they need within a short drive. Business-as-usual water management may not be sufficient to ensure protection of these values, especially in the face of a changing climate and growing population. A more water sensitive approach would help ensure the health and safety of future populations, while also protecting natural systems, contributing to the city's liveability, and ensuring Townsville strengthens as an attractive, international city. The following sections of the report describe what participants consider it means to be a water sensitive Townsville and present recommended strategies for achieving the necessary changes in practice.

3. Vision for a water sensitive Townsville

The 50-year water sensitive vision for Townsville aims to orient and align the actions of stakeholders over the long-term. The aspirations of project participants for their city's water future are expressed as a suite of outcome statements with accompanying rich descriptions. The timeframe enables people to stretch their ambitions beyond today's systems and constraints to reflect on the transformative change that is possible over such a period.



Townsville is an attractive, resilient city that manages water to enhance healthy ecosystems, embrace dramatic natural water cycles, drive world-leading innovation, and support citizens who are proud of their dry tropical identity.

1. Townsville celebrates being an attractive, liveable city with integrated and multi-purpose built and natural environments that feature water, bring people together and showcase the city's dry tropical climate.
2. Water is managed holistically to ensure reliability of Townsville's water system and the long-term sustainability of its resources.
3. Townsville's waterways, wetlands, coastline, and surrounding marine and inland environments are healthy, valued, and continuously enhanced.
4. Townsville people are proud of their connection to water and are empowered to be active and responsible water stewards.
5. Townsville is an international water innovation hub that showcases water sensitive technology, practices and design for the dry tropics.
6. Inclusive water governance in Townsville enables integration, collaboration, innovation and collective leadership.
7. Indigenous water knowledge, values and ways of thinking are valued in the Townsville community and incorporated into water planning, design and management.

1. **Townsville celebrates being an attractive, liveable city with integrated and multi-purpose built and natural environments that feature water, bring people together and showcase the city's dry tropical climate.**

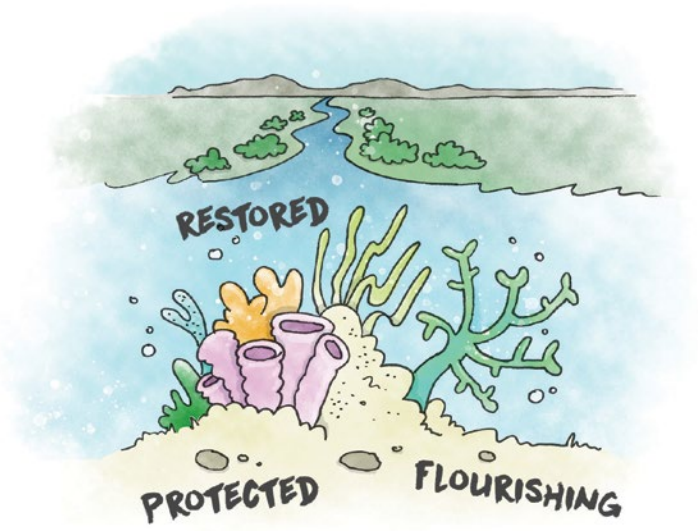
   Water and the landscape is integrated to our urban form, connecting people to surrounding waterways and natural features such as The Strand, Ross River and Magnetic Island. Urban spaces are designed to provide multiple functions and benefits including harvesting stormwater and connecting communities. Streets, footpaths and cycleways are lined with trees for shaded, cool commuting and create a network of green and blue corridors throughout the city. Gardens and landscapes reflect Townsville's dry tropical environment and incorporate appropriate native and exotic plants. Residents flock to shady and cool open spaces to escape the heat and interact with other community members. Townsville attracts people from around the world for water and environmental-based adventures, including opportunities to experience the Great Barrier Reef World Heritage Area.

2. **Water is managed holistically to ensure reliability of Townsville's water system and the long-term sustainability of its resources.**

   Natural water systems and catchments are monitored and protected for long-term sustainability and resilience. A diversity of water sources are utilised at an optimal portfolio to ensure a sustainable and reliable water supply. Water system options are assessed based on whole-of-life costs and consider social, environmental, economic and technological impacts and benefits. Water infrastructure is adaptive, robust and provides multiple functions. Decentralised infrastructure is utilised along with large-scale centralised systems to enable choice and flexibility in service delivery. All water streams are utilised to fit their intended purpose. Wastewater is collected, managed and discharged to best practice environmental and public health standards. Groundwater is part of a managed system utilised for storage and distribution. Stormwater is harvested, treated and used for multiple purposes. System losses through evaporation and leakage are minimised or captured. Resources such as energy and nutrients are recovered from wastewater and stormwater, and reused where appropriate to minimise impacts on surrounding waterways and the waters of the Great Barrier Reef. A holistic understanding of Townsville's water system is communicated to the community.

3. **Townsville's waterways, wetlands, coastline, and surrounding marine and inland environments are healthy, valued and continuously enhanced.**

   Townsville's rivers and creeks, wetlands, coastline, aquifers, forests and reef environments are healthy and continuously enhanced. The Great Barrier Reef is flourishing, protected and enjoyed for recreation, while also providing opportunity for world-leading marine research. The dry tropics region and adjacent Wet Tropics World Heritage Area are valued for their diversity and attract people from around the world for ecotourism. Townsville's waterways have been restored and provide local amenity, connecting people to their surrounding natural ecosystems. Townsville's catchments are healthy, protected and resilient. Magnetic Island is valued by Townsville residents for its reef environment and native flora and fauna.

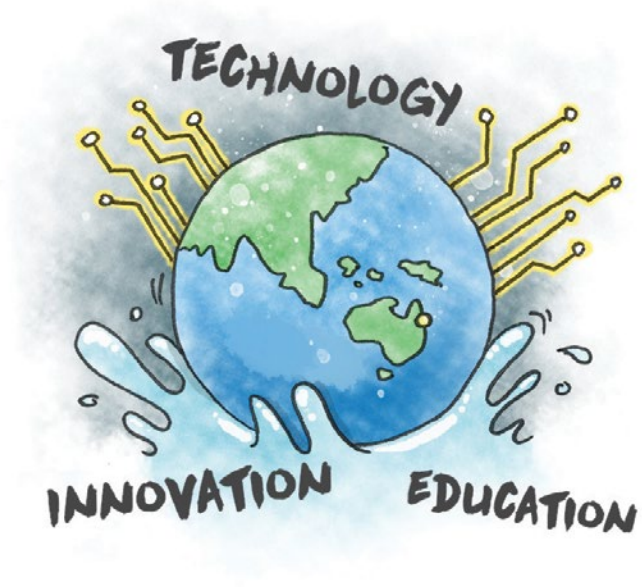


4. **Townsville's people are proud of their connection to water and are empowered to be active and responsible water stewards.**

   Townsville's past, present and future water stories help bind the Townsville community and create a sense of belonging. Everyone understands and appreciates the interconnectedness of the entire water cycle and the catchment they live in. People value water deeply, which drives them to use it responsibly and adopt water sensitive behaviours. Water system diversity is valued and embraced through choices and options in lifestyle. Communities participate in water planning and decision-making and are eager to do so. The community accepts and encourages innovation, are active in adopting new practices and technologies and are eager to showcase demonstration projects. People are safe from flooding and are prepared for natural disasters. Knowledge about ecological and cultural values of water and its sustainable management are integrated into schools, universities, industries and work places.

5. **Townsville is an international water innovation hub that showcases water sensitive technology, practices and design for the dry tropics.**

   Townsville is a living laboratory that demonstrates best practice in water cycle management and attracts people from around the world to learn from Townsville's experiences. Research and technology development anticipates, responds and adapts to changing drivers and circumstances. Opportunities from the water industry, such as manufacturing, consulting, and training, are exported internationally to support and drive a strong economy for Townsville. Residents are empowered by technologies at multiple scales and are educated in order to actively participate in water management. Innovation capability is built and maintained through water sensitive city education and training.



6. **Inclusive water governance in Townsville enables integration, collaboration, innovation and collective leadership.**

   Townsville's water governance arrangements reflect an integrated approach to water system services, and city planning and design. Collaboration across sectors, disciplines and levels of government is embedded in institutional culture, systems and processes to develop and implement innovative solutions. Townsville's water sensitive city vision is championed and embedded through shared leadership into policy and practice. Water governance structures and processes are flexible and adaptive, which enables collective leadership across departments, organisations and scales. Decision-making reflects long-term water sensitive city goals for Townsville, fostering resilience to extreme events and other crises, and the water sensitive city agenda endures. Leadership is driven by community values and aspirations, and residents and business are empowered to be part of water planning and decision-making. Sharing knowledge and data openly drives transparency and evidence-based decision making.

7. **Indigenous water knowledge, values and ways of thinking are valued in the Townsville community and incorporated into water planning, design and management.**

   Aboriginal and Torres Strait Islander knowledge and stories about water are understood and embraced throughout the community. Culturally significant sites (e.g. Enduring Spring in the Town Common) are identified, preserved and enhanced. Townsville's water story captures a holistic, long-term way of understanding the region and resonates with Indigenous ways of thinking. Indigenous communities actively participate in water planning and decision-making, built on the foundation of strong relationships with water professionals.

4. Assessing Townsville's current water sensitive performance

Planning Townsville's transition to its WSC vision requires a detailed understanding of its current performance in relation to its aspirations. The CRCWSC's Water Sensitive Cities (WSC) Index[2] is a benchmarking tool designed for this purpose. It articulates seven WSC goals, which organise 34 indicators representing the major attributes of a WSC. These indicators are also mapped to the idealised city-states represented in the Urban Water Transitions Framework (Figure 1) to provide a benchmarked city-state.

While a city's local WSC vision may not emphasise all indicators of the WSC Index to the same degree, the tool enables diagnosis of key areas of strength and aspects for improvement. These insights can then inform the prioritisation of actions, and provide a framework for ongoing monitoring and evaluation of a city's water sensitive performance.

4.1 Townsville's WSC indicator scores

The WSC Index was applied to Townsville to benchmark current water sensitive performance. Figure 3 below shows the WSC Index goal results for Townsville (shown by the shaded teal area). Table 1 below provides the individual indicator scores for each goal.

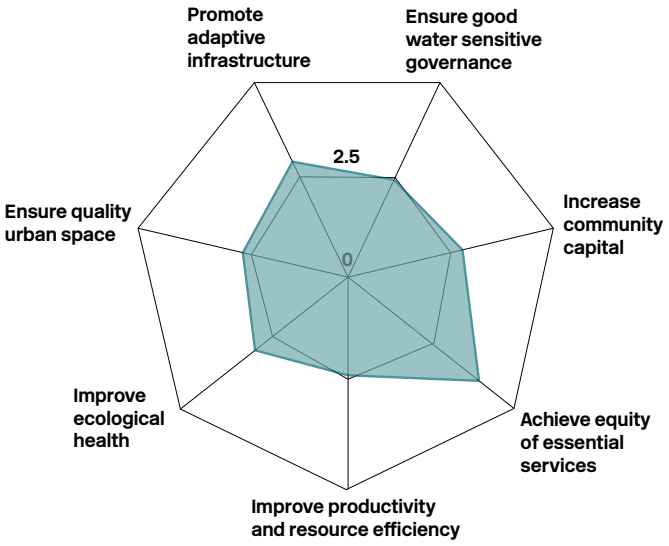


Figure 3: Townsville's performance (shaded teal area) compared to the water sensitive goals

[2] CRCWSC. (2018). *Water Sensitive Cities Index*. Retrieved from https://watersensitivecities.org.au/solutions/wsc-index/.

Table 1: WSC Index scores (goals and indicators) for Townsville

WSC Index Goal and Indicators	Score /5	WSC Index Goal and Indicators	Score /5
1. Ensure good water sensitive governance	2.4	**4. Improve productivity and resource efficiency**	**2.4**
1.1 Knowledge, skills and organisational capacity	2.5	4.1 Benefits across other sectors because of water-related services	3.0
1.2 Water is key element in city planning and design	2.5	4.2 Low GHG emission in water sector	2.0
1.3 Cross-sector institutional arrangements and processes	2.0	4.3 Low end-user potable water demand	2.0
1.4 Public engagement, participation and transparency	2.0	4.4 Water-related commercial and economic opportunities	3.0
1.5 Leadership, long-term vision and commitment	3.0	4.5 Maximised resource recovery	2.0
1.6 Water resourcing and funding to deliver broad societal value	2.5	**5. Improve ecological health**	**3.1**
1.7 Equitable representation of perspectives	2.5	5.1 Healthy and biodiverse habitat	3.0
2. Increase community capital	**2.8**	5.2 Surface water quality and flows	3.5
2.1 Water literacy	2.0	5.3 Groundwater quality and replenishment	2.0
2.2 Connection with water	4.0	5.4 Protect existing areas of high ecological value	4.0
2.3 Shared ownership, management and responsibility for water assets	2.0	**6. Ensure quality urban space**	**2.7**
2.4 Community preparedness and response to extreme events	4.0	6.1 Activating connected urban green and blue space	3.5
2.5 Indigenous involvement in water planning	2.0	6.2 Urban elements functioning as part of the urban water system	2.0
3. Achieve equity of essential services	**3.9**	6.3 Vegetation coverage	2.5
3.1 Equitable access to safe and secure water supply	4.0	**7. Promote adaptive infrastructure**	2.8
3.2 Equitable access to safe and reliable sanitation	4.0	7.1 Diverse fit-for-purpose water supply system	2.0
3.3 Equitable access to flood protection	3.5	7.2 Multi-functional water system infrastructure	3.0
3.4 Equitable and affordable access to amenity values of water-related assets	4.0	7.3 Integration and intelligent control	3.0
		7.4 Robust infrastructure	3.5
		7.5 Infrastructure and ownership at multiple scales	2.5
		7.6 Adequate maintenance	3.0

4.2 Townsville's benchmarked city-state

Figure 4 summarises the city-state benchmarking results for Townsville. Percentage attainment for each city-state ranged from 100% as a Water Supply City and Sewered City, through to 3% as a Water Sensitive City. This section summarises the key elements that contribute to the overall percentage attainment of each city-state.

100% Water Supply City & Sewered City

Water supply and sanitation services are managed and provided by Townsville Water and Waste, a division within Townsville City Council. It supplies more than 51,000 megalitres of safe, high-quality potable water to over 83,000 service connections in the Townsville region each year, and collects and treats more than 16,000 megalitres of sewage each year. This reliable service provision means that Townsville has been rated 100% as a Water Supply and Sewered City.

From a water supply perspective, the Ross River Dam and Paluma Dam have historically provided sufficient water for the city; however with several failed wet seasons in a row, the implementation of water restrictions and commencement of pumping from the Burdekin Dam ensures residents continue to have access to potable water. The Water Security Task Force, as part of the City Deals program, has identified short-to-medium term solutions for securing Townsville's water supply and is exploring long-term solutions as well.

Townsville Water and Waste operates six sewage treatment plants and over 180 sewage pump stations. All wastewater is treated to high quality and discharged to the environment, with a small portion of it reused (e.g. for parks and the golf course on Magnetic Island).

83% Drained City

Townsville rated 83% as a Drained City. There is an extensive amount of knowledge and information around flood risk, and flood risk modelling has been conducted across Townsville through the City Wide Flood Constraints Project, which aimed to identify areas likely to be inundated during river and rainfall flood events. While this information is informing the design of some new developments, there are limited adaptations being considered for existing vulnerable areas. Some low-lying areas are still being inundated by coastal flooding and king tides.

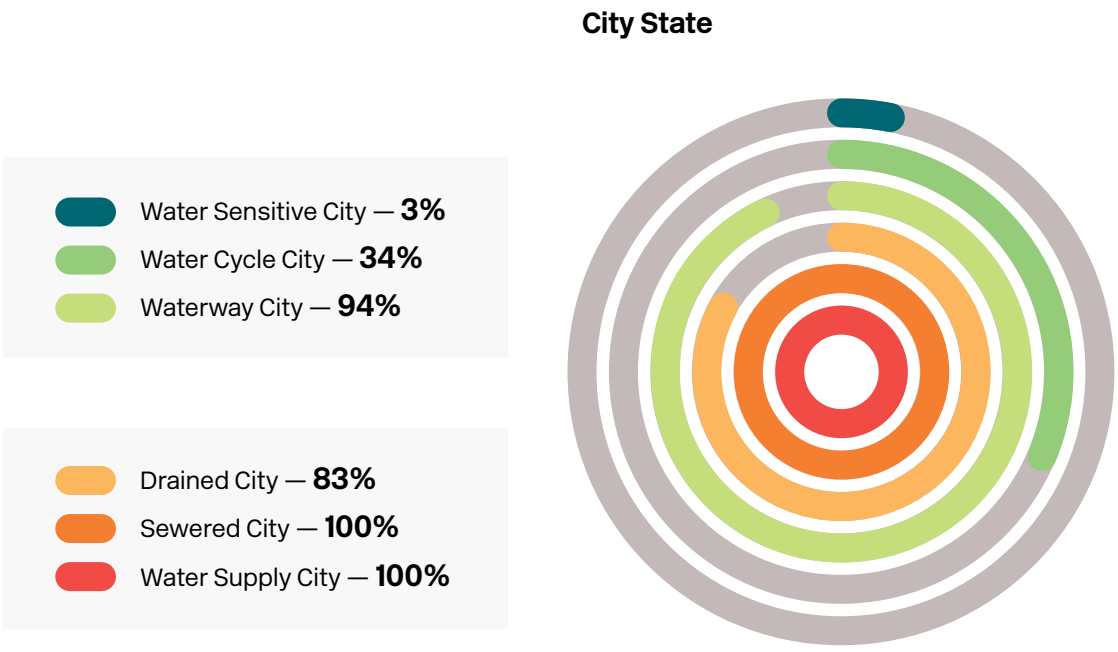


Figure 4: Summary of Townsville's performance against the ideal measures for each city-state

"It is the dry tropics, so we don't have a particularly reliable water supply. It is also very variable. So managing stormwater volumetrically is a challenge"

At the time the workshops were conducted, there had not been a major flood event since 2011. In the context of relatively frequent staff turnover, this means many professionals working at Council have not experienced flooding in Townsville and may lack awareness of the risks. The development of the Townsville Floodplain Management Strategy, however, is a good opportunity going forward to build community resilience to flooding by guiding future infrastructure investment, land use planning, development controls, emergency management and community programs.

94% Waterway City

Townsville rated 94% as a Waterway City, reflecting its significant focus on receiving water quality and protection of surrounding natural assets. Townsville's proximity to the Great Barrier Reef world heritage area and surrounding fringing reef systems has resulted in extensive legislation on surface water quality (including wastewater treatment and discharge quality). The Creek to Coral initiative was established in partnership with Townsville City Council, Thuringowa Council and the then Queensland Environmental Protection Agency, and was supported by the Great Barrier Reef Marine Park Authority. It promotes a 'whole-of-catchment' approach to managing water to help protect the marine environment from impacts of land-based activities. While there is a lot of attention on the health of receiving marine waters, there is limited capacity and capability to implement effective mitigation measures.

Water Sensitive Urban Design and stormwater quality improvement devices are being implemented across Townsville (e.g. basins, wetlands and sediment traps). While these solutions are seen to be effective in improving surface water quality to an extent, there are ongoing issues with irrigation, maintenance and highly concentrated sediment loads from new developments.

The general public feels connected to their surrounding marine and terrestrial environments, which is evident through active lifestyles centred around water activities such as boating, fishing, paddle-boarding, and scuba diving. They value areas such as Magnetic Island, the Strand, and Ross River for connecting them to nature and providing opportunities for recreation and amenity.

"That's been a major challenge – we spend a lot of money on bioretention basins, wetlands and treatment things that are ineffective in Townsville because you need to irrigate them 11 months of the year. You put them in and they pretty much do one treatment a year, because it doesn't rain for most of the year and then they get hit with this influx…and I don't know how much that affects downstream"

34% Water Cycle City

Townsville rated 34% as a Water Cycle City. It is in the early stages of considering ways to diversify its water supply and pursue a more holistic and integrated approach to water management. The current approach to water supply tends to focus on large-scale infrastructure to secure supply. Non-potable water sources currently being utilised include the use of private bores for groundwater extraction, however these are not integrated into the broader water supply system and there is limited consideration of extraction impacts on the groundwater system. Other household-scale solutions such as rainwater tanks and greywater recycling are perceived to be either inefficient in the dry tropical context or too challenging to navigate regulative barriers.

The majority of Townsville's wastewater is treated to a very high standard and discharged to the environment. This potentially creates a major opportunity for effluent reuse within Townsville, however there are still challenges regarding the cost of reducing salinity and getting water back to markets with suitable use profiles. The two wastewater treatment plants on Magnetic Island treat and reuse all wastewater on native parklands and a golf course. While effluent reuse has historically not been considered, it is now seen to be on the agenda.

"Regarding effluent reuse…cost is without a doubt the number one inhibitor."

At the time of the workshops, Level 3 water restrictions were in place and programs such as the Dry Tropics Water Smart Initiative and Townsville Water Futures aim to reduce water consumption and raise awareness amongst the community in reducing their usage. Despite these initiatives, many residents continue to use large allocations of water for outdoor use. The current pricing structure, based on household allocations, does not act as a disincentive for high consumption, reinforcing a perception amongst the community that they have 'the right' to use all of the allocated water they have paid for. Greater diversity and flexibility in water system service delivery will be needed to obtain Water Cycle City status.

"We have some of the highest [consumption] rates in Australia, and there's a perception that we don't get a lot from it."

3% Water Sensitive City

To achieve a Water Sensitive City, Townsville will need to implement solutions that fulfil the multiple objectives of ecosystem protection and restoration, security of supply, flood risk management, public health, amenity, liveability and economic sustainability, among others. While Townsville has begun to make strides towards a Water Sensitive City, significant efforts will be needed to transition to water sensitive technologies and practices.

5. Advancing Townsville's water sensitive city transition

Townsville's transition towards its water sensitive city vision will require significant changes across the structures, cultures and practices of urban and water system planning, design, management, engagement and decision-making.

These changes are likely to happen over a long timeframe, in the order of decades, as new water sensitive practices are established and replace old practices. CRCWSC research has identified water sensitive transitions unfold over six phases: an (1) issue with old practice emerges and (2) becomes more defined; people develop (3) shared understanding and agreement about the issue; (4) knowledge about solutions is disseminated; and new solutions are (5) diffused through policy and practice, eventually becoming (6) embedded as new mainstream practice.

The CRCWSC's Transition Dynamics Framework (see Appendix A for more detail) sets out five types of enabling factors that help to drive progress through these phases of change: **champions, platforms for connecting, science and knowledge, projects and applications, and practical and administrative tools.** Together, these five factors create an enabling environment for accelerating a water sensitive transition.

Building the momentum for transition will require a diverse range of strategies and actions that progressively establish these enabling conditions. Strategies and actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current transition progress to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

This section presents recommended strategies for advancing Townsville's water sensitive transition based on analysis of the city's transition progress to date. Strategies are identified to advance the overall water sensitive Townsville vision, as well as its individual thematic elements.

5.1 Assessing Townsville's WSC transition progress

The CRCWSC's Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Townsville's aspired change in practice as it advances towards its water sensitive city vision (Table 2). It provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

The overall transition progress assessment for Townsville suggests that significant advancements have been made towards its water sensitive vision. However, it is at risk of stagnation if critical enabling conditions are not established to shore up Phase 2 (issue definition) and start pushing into Phase 4 (knowledge dissemination). A brief explanation and justification of the transition assessment follows.

Table 2: Overall assessment of Townsville's transition progress

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. **Issue Emergence**	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. **Issue Definition**	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. **Shared Understanding & Issue Agreement**	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. **Knowledge Dissemination**	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. **Policy & Practice Diffusion**	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. **Embedding New Practice**	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Notes: Green boxes indicate the enabling factor is fully present and regression into the previous phase is unlikely. Yellow boxes indicate some presence, however they are vulnerable to regressing to the previous phase. Red boxes indicate a complete absence of the enabling factor, and that progression is unlikely.

This overall assessment for Townsville suggests that while there are some significant advancements in the champions, knowledge, projects, and tools that support change in practice, there are few platforms for connecting stakeholders around the broad range of issues associated with water sensitive cities. Townsville City Council is seen as a major champion in advancing certain water sensitive projects, however, this is mainly due to individual champions in departments. Individual champions external to Council are also driving specific aspects of Townsville's WSC vision, however they are finding it difficult to implement solutions due to the lack of a broader enabling environment for innovative solutions.

There are many collaboration platforms across Townsville, for example, the Water Security Taskforce, Water for Townsville Action Group, Creek to Coral Partnership, and the Reef Guardian Program. While these are generally issue-specific and narrow in scope, they could provide important opportunities to create leverage for establishing an overarching platform to drive action towards Townsville's WSC vision as a whole.

Small-scale projects and trials of new technologies are happening across Townsville, including smart metering trials driven by JCU and WSUD projects in new developments (including stormwater capture and household-scale water efficiency technologies). However, it has been challenging to mainstream these innovations and there has generally not been an explicit learning agenda associated with their implementation. Significant demonstrations, such as the new stadium development, generally rely on funding injections from State or Federal Government.

Organisational policies and plans across Townsville are beginning to incorporate WSC principles, however they are not yet unified by a common water vision. The City Plan, for example, articulates liveability through connected green and blue spaces across Townsville, however it does not link to practice and thus provides limited implementation guidance. Extensive targets and regulation exist for water quality due to the proximity of the Great Barrier Reef, but these are not yet linked with the City's water sensitive aspirations.

5.2 Strategies for advancing Townsville's overall vision

Based on this analysis, the following four high-level strategies are recommended for progressing Townsville's transition:

I. Embed Townsville's water sensitive aspirations in a broad city vision and organisational policies, plans and strategies

II. Establish platforms that will support and drive integration and collaboration within Council and with external stakeholders

III. Develop new knowledge on issues and potential solutions for particular aspects of Townsville's water sensitive city vision

IV. Learn from and scale innovations to provide on-ground demonstrations and practical guidance for water sensitive approaches in the dry tropics context

I. Embed Townsville's water sensitive aspirations in a broad city vision and organisational policies, plans and strategies

It is critical to link the narrative of the benefits of the envisioned water sensitive city with the aspirations for Townsville more broadly, including the city's future prosperity, the health and wellbeing of its people, and the preservation and enhancement of its natural environments. Townsville appears to be in the early stages of shaping such a broader city vision, so there is potential for the ideas, values and priorities expressed in this water sensitive vision to have direct influence. Clear articulation of the importance of a water sensitive approach to achieving Townsville's broad city vision will be essential to harness the support of leadership and the general community.

The WSC vision for Townsville needs to become embedded within the policies, plans and strategies of Townsville City Council and other stakeholder organisations. This will enable and encourage an integrated and holistic approach to water management that works towards the shared future water vision for Townsville, and will provide a framework for supporting intra- and inter-organisational alignment and the implementation of solutions.

II. Establish platforms that will support and drive integration and collaboration within Council and with external stakeholders

Townsville's professional workforce at all levels of seniority appears to be fairly transient, with only a handful of project participants having been in the city for more than ten years. As such, while its scale is significantly smaller than major metropolitan cities, the professional networks and relationships (both formal and informal) that must underpin the collective pursuit of Townsville's water sensitive vision need focus. In addition, it would be valuable to review Townsville's organisational structures and processes to consider how they could more explicitly function as platforms that create greater opportunities for integration and collaboration.

Establishing a platform that supports and drives collaboration will provide an opportunity for people to share knowledge, ideas and lessons across disciplines, departments, organisations and sectors. This will be critical for examining issues in more detail and from different perspectives, for informing the development of innovative solutions, and for identifying opportunities to implement solutions that will advance Townsville's water sensitive vision on the ground.

Platforms can take a variety of forms and should be developed according to the specific need and focus. These could include a Water Sensitive Transition Network that meets regularly to progress the vision and transition agenda, a community of water sensitive practice that hosts events, digital platforms for information sharing, specific projects or initiatives that require collaboration, embedded organisational structures that facilitate integration. There are a number of existing collaboration platforms in Townsville, such as the Creek to Coral Partnership, the Water Security Task Force, and the Reef Guardian Program, that, while they have a pre-existing issue focus, may be valuable to draw upon in establishing platform(s) to advance the city's water sensitive vision more broadly.

III. Develop new knowledge on issues and potential solutions for particular aspects of Townsville's water sensitive city vision

Knowledge will underpin many elements of a successful transition to a more water sensitive Townsville. In some cases, new knowledge is needed to better define issues and to establish the need for an action or response. Where the need is unfamiliar or novel, new knowledge may be needed to understand the various responses or solutions available and the associated costs and benefits. Developing and implementing solutions can be very challenging and carry significant risks. Pilots and demonstrations of solutions can help to show the benefits and also build capability in the delivery of solutions. This can include knowledge on how to manage risks, whether they be technical, financial or reputational. Ultimately, the collective knowledge of solutions will need to be harnessed to support decision-making and guide implementation.

Townsville has a characteristic attitude of self-reliance and 'getting it done'. This is reflected in both the sporting team success and professional culture of the City. This attitude has helped drive significant investment in knowledge and trialling solutions, but translation of new approaches into the mainstream has often been limited. This may reflect a situation where individual champions may be working in isolation, or the transient professional population of Townsville that sees knowledge lost as champions move on. It may also reflect the weakness of collaboration and knowledge-sharing platforms, or poor alignment of strategic priorities across people and sectors. More systematic investment in solution development, aligned with strategic priorities and knowledge sharing platforms that span sectors, disciplines, stakeholders and levels of government will be important to advancing the vision for a more water sensitive Townsville.

IV. Learn from and scale innovations to provide on-ground demonstrations and practical guidance for water sensitive approaches in the dry tropics context

Becoming a water sensitive city will require a range of innovative solutions across social, technical and design domains to be developed and mainstreamed. There has been a range of innovative water solutions trialled in Townsville, such as water efficiency appliances, smart metering, and nutrient and algae recovery. However, to date, there has been limited progression of these innovations beyond the trial stage, and lessons from their experimentation have not yet been incorporated into practical guidance on how they might be improved and eventually implemented.

In addition, there is good awareness of innovative solutions that have been implemented outside Townsville, but many have not been locally tried or demonstrated to explicitly consider the city's dry tropical context. These local applications will be important for developing and testing solutions that suit Townsville's specific conditions, demonstrate their benefits, costs and risks in the local context, and to foster the practical knowledge and experience of practitioners in Townsville.

5.3 Strategies for advancing individual vision elements

A more detailed assessment of Townsville's transition progress was also conducted, using the CRCWSC's Transition Dynamics Framework (Appendix A) to consider each of the individual themes of the city's water sensitive vision.

Figure 5 below summarises the current transition progress for each individual vision theme and highlights the variety across them. Vision themes early in their transition will require different types of strategies to progress further change than those later in their transition.

This analysis informed the development of specific recommendations for strategies to advance each part of Townsville's water sensitive city vision. The following sections present a brief explanation and justification of the transition progress assessment and associated recommended strategies.

Vision Outcome 1: Townsville celebrates being an attractive, liveable city with integrated and multi-purpose built and natural environments that feature water, bring people together and celebrate the city's dry tropical climate.

The need for more integrated water systems and urban planning and design is acknowledged by individual champions within Council and by some private developers. However, it is not yet recognised across the broad range of people and organisations who need to be involved in delivering water sensitive planning and design outcomes. In addition, health and cooling benefits of solutions such as street trees, for example, have not yet been quantified or incorporated into a business case to communicate the value of these solutions.

People desire more connected green and blue spaces throughout Townsville, and projects around the new stadium development, Ross Creek bike paths, and JCU campus corridors are demonstrating this connection. There are also some small-scale WSUD projects in new developments. While policy that aims to integrate water and urban planning and design exists (e.g. State Planning Policy, Council's Street Tree Policy), the link to implementation and practice on the ground could be strengthened. In particular, the Townsville City Plan articulates the need for better integration of water and urban planning to deliver liveability outcomes such as green and blue corridors. However, guidance for developers on how to implement these solutions effectively and without creating maintenance or environmental issues is limited.

"I haven't seen any conversations around better urban design, both in terms of new build and also existing build. It's just not part of the conversation at all about water savings and retention."

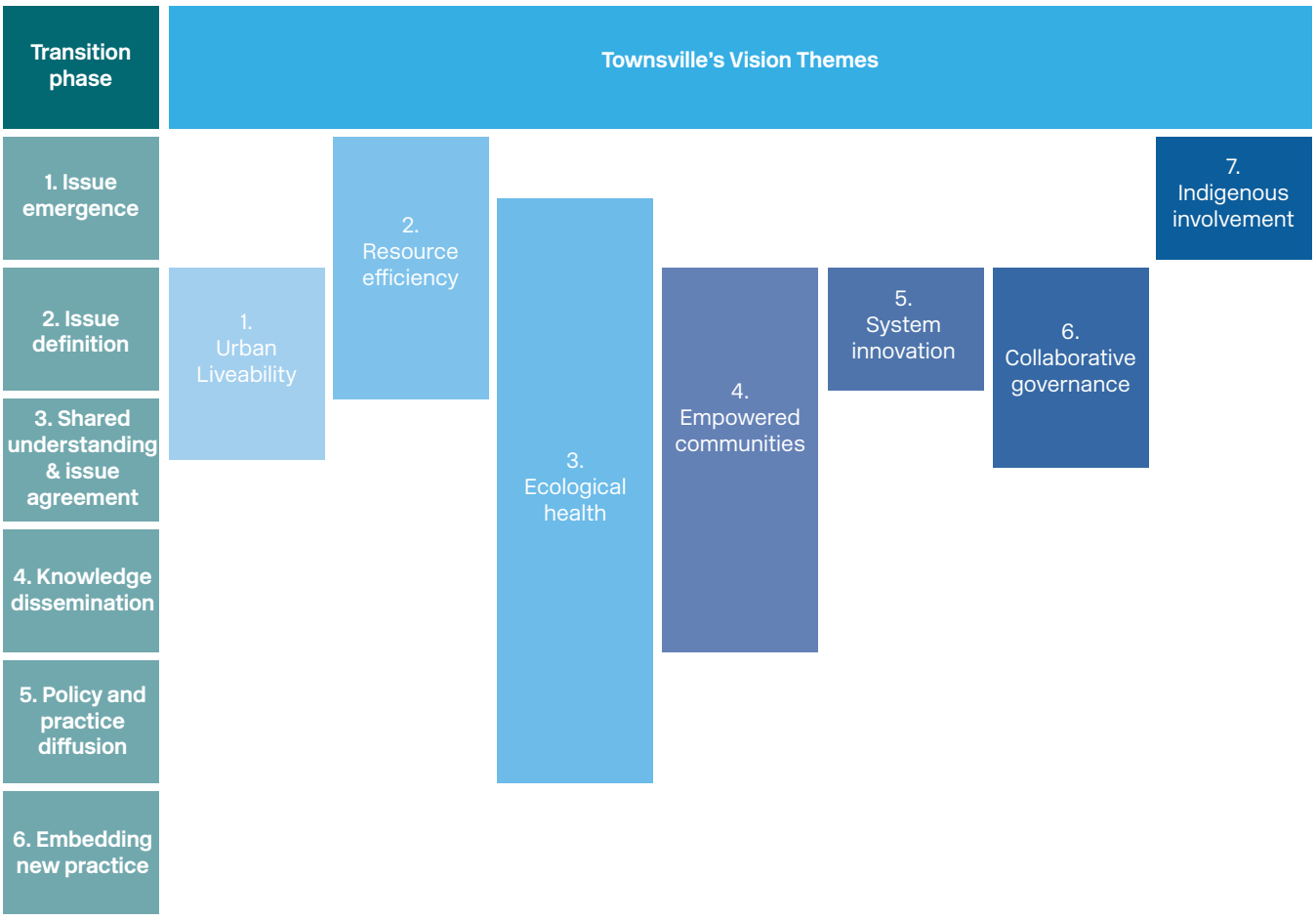


Figure 5: Summary of transition phases for each of the vision outcomes

Table 3: Recommended strategies to advance integrated water and urban planning and design

No.	Strategies	Outcome
1.1	Establish a platform to connect champions around the need to improve quality urban space and the potential of water sensitive solutions to do so	A broad range of stakeholders understand and communicate the benefits of water sensitive urban design solutions
1.2	Examine and evaluate evidence to quantify the value of quality urban space solutions and inform the development of a business case (e.g. microclimate benefits)	The costs, benefits and risks of quality urban space solutions are understood and communicated to a broad range of stakeholders
1.3	Develop and communicate a compelling narrative that articulates the importance of multi-functional, connected urban green and blue spaces across both the public and private realm	Broad support exists from private developers and Council demonstrates leadership in driving the implementation of these solutions
1.4	Implement pilot scale trials and demonstrations for innovative urban design solutions that enable the built environment to function as part of water system service delivery, and significant trials and demonstrations of connected blue and green spaces	Quality urban space solutions are demonstrated to provide evidence of their costs, benefits, and risks, and to learn about the capabilities needed for their effective implementation
1.5	Incorporate a learning agenda into new and existing demonstrations of quality urban space solutions	Solutions are refined and inform the development of practical guidance
1.6	Strengthen the effectiveness of the City Plan in supporting the water sensitive city vision by linking it to the overarching narrative and business case for quality urban space solutions supported by water sensitive design principles	Implementation of the City Plan is improved and linked to Townsville's water sensitive city vision

Vision Outcome 2: Water is managed holistically to ensure reliability of Townsville's water system and the long-term sustainability of its resources.

While Townsville is excelling at providing safe and secure potable water supply and sanitation to its residents, services are typically delivered through traditional centralised, large-scale infrastructure that does not prioritise diversity or flexibility of service options. In the recent period of drought, the reliability of the water supply system based on this approach has been challenged, prompting consideration of how resilience can be ensured into the future. The current pricing structure of a set rate for a water allocation (with the option for a user pays model) potentially raises issues of affordability amongst residents. Solutions such as alternative water sources or pricing options are beginning to be considered but with focus on affordability rather than broader community equity, flexibility and choice.

"There's two elephants in the room – one is demand management, and the other one is pricing. They're not being discussed but they're under the surface and real hot potatoes"

While organisations such as the Queensland Water Directorate and Water Services Association Australia exist as platforms to bring together water stakeholders at the national and state level, they do not yet play a local role in bringing champions together to explore current infrastructure issues and opportunities. Projects aimed at improving Townsville's water infrastructure include the smart metering trials led by Council to monitor water system leakages, and Innovation House, a demonstration project by Stockland and Finlay homes that demonstrates household-scale infrastructure and technologies for water efficiency. Catchment load targets for receiving waterways have led Council to drive small-scale projects on nutrient and energy recovery but these do not currently form part of a broader resource recovery agenda.

"I don't think, in terms of water treatment, that the (stormwater) systems match our climate. Because they rely on plants to do the treatment, which means you need to irrigate them, which means when you have water restrictions and you turn the irrigation off, they die"

There is limited knowledge about the application of decentralised and green infrastructure solutions that are effective in Townsville's dry tropical environment. For example, ongoing challenges with irrigation and sediment make it difficult for green infrastructure solutions to be incorporated and maintained. Utilising groundwater as a resource and monitoring the health of groundwater systems and impacts of extraction is just emerging as an issue in Townsville and not enough is yet known about the groundwater system to clearly articulate the issues and opportunities.

Table 4: Recommended strategies for achieving holistic resource management

No.	Strategies	Outcome
2.1	Examine and evaluate evidence about the need for flexibility and choice in delivering water system services, including infrastructure and pricing options	The costs, benefits and risks (including avoided costs and risks) are understood for service providers and customers in providing flexibility and choice for customers in their water system services
2.2	Develop a narrative for the value of diverse multi-functional infrastructure that is connected to a broad city vision for Townsville and water's role in delivering the vision	The importance and economic value of diverse multi-functional infrastructure is communicated to a broad range of stakeholders to begin building a collective voice
2.3	Establish a platform that brings focus to diverse, flexible infrastructure, building on and broadening the scope of existing platforms	A collective voice exists around the need for diverse, flexible and adaptive infrastructure
2.4	Develop new knowledge about design and maintenance of green infrastructure in the dry tropics	Green infrastructure solutions exist that are appropriate and cost effective for the dry tropics context
2.5	Expand the existing Council water strategy to include an integrated and holistic approach for pursuing flexible, diverse, intelligent infrastructure at multiple scales	An integrated and holistic approach to water management exists beyond traditional centralised water systems
2.6	Implement significant demonstrations of adaptive infrastructure, incorporating a learning agenda and linking to a broader narrative that emphasises the importance of such approaches	An understanding of how these solutions can be delivered, evidence of their costs, benefits and risks, and an understanding of the capabilities needed for their effective implementation
2.7	Develop and share new knowledge about Townsville's groundwater system	The management of groundwater reflects the interconnectedness between groundwater and surface water and utilises groundwater as a sustainable resource while protecting local ecosystems
2.8	Examine and evaluate evidence about the need for a holistic approach to nutrient and energy recovery	The costs, benefits, risks and potential of nutrient and energy recovery are understood

Vision Outcome 3: Townsville's waterways, wetlands, coastline, and surrounding marine and inland environments are healthy, valued and continuously enhanced.

Townsville's close proximity to the Great Barrier Reef means the Great Barrier Reef Marine Park Authority and the Queensland Office of the Great Barrier Reef play significant roles in minimising the impact of surface water on the reef ecosystems. The Reef 2050 Water Quality Improvement Plan and introduction of the report card process provides an effective water quality monitoring framework for the Reef. Platforms such as the Creek to Coral program and Reef Guardian Program are beginning to connect a broad range of stakeholders around this issue. However, with the Great Barrier Reef playing such a significant local, national and international role, other aspects of Townsville's natural environment have received less attention. While water quality objectives for Townsville are articulated (in the Black Ross Water Quality Improvement Plan and the Environmental Protection Policy for Water), these values and objectives are not widely disseminated or acknowledged.

There is substantial knowledge and available solutions on how to improve and monitor water quality and habitat health, such as sediment traps and constructed wetlands. Projects such as the Louisa Creek retrofit and Ross River mangrove restoration has helped improve waterway health. The Water Environmental Protection Policy outlines environmental values and water quality objectives for the Townsville region. These monitoring frameworks, however, focus mainly on receiving water quality and do not address systemic issues in waterways and riparian zones. They also do not yet take into account the impacts of urban runoff on receiving waterways and the Great Barrier Reef.

"There is an opportunity to connect to the reef...we don't yet understand the impact of urban runoff, we are just now starting to consider it."

Table 5: Recommended strategies to advance ecosystem health

No.	Strategies	Outcome
3.1	Articulate and communicate local values with respect to Townsville's waterways and ecosystems (in addition to the Reef)	An understanding of local values inform a catchment-wide management approach to waterway management
3.2	Consolidate existing knowledge and data on the health of waterways and riparian zones, and the impacts of urban runoff	A comprehensive knowledge base informs a catchment-wide management approach to waterway management
3.3	Develop a strategic and catchment-wide approach to managing urban runoff and protecting waterways and riparian zones, building on the existing Reef 2050 Water Quality Improvement Plan	Targets, a monitoring framework and a management strategy exist and underpin a whole-of-catchment approach to water quality and ecosystem health

Vision Outcome 4: Townsville's people are proud of their connection to water and are empowered to be active and responsible water stewards.

"The level of service is a key thing that needs to be understood ... no one has agreed to how much water is OK"

During the recent period of drought, the Water Security Taskforce has given significant attention to consulting with the community on the issue of water security. There is also an emerging interest within Townsville City Council to engage more effectively with communities on a broader set of water issues and in a way that goes beyond managing perception risks. There is currently momentum from senior champions within Council to explore what this would mean and how it can be done. There are several examples of platforms that aim to engage the community, for example, the Water for Townsville Action Group, the Reef Guardian Program, and Local Management Advisory Committees. While these platforms provide a good basis for community engagement, they tend to focus on a single issue rather than linking to a broad vision for Townsville's water system, and at times they become politicised. The resources provided through the City Deals' Community Water Transition Package may provide an opportunity for pursuing broader community engagement solutions.

Potable water demand is widely acknowledged as an issue that needs attention across Townsville, and champions (particularly in Council and some private developers) are becoming influential in implementing water efficiency projects and demand reduction initiatives across Townsville. Some examples are Council's Dry Tropics Water Smart Initiative and associated community activities, and the North Shore development that incorporates water efficiency technologies and appliances.

Flood risk in Townsville is generally well understood, informed by Council's extensive flood risk modelling and identification of high flood risk areas. Some new developments are incorporating flood mitigation infrastructure in their urban design; however, there has been less focus on existing vulnerable developments. In addition, knowledge and data from flood modelling are not yet incorporated consistently into planning decisions.

Table 6: Recommended strategies for advancing community engagement and stewardship

No.	Strategies	Outcome
4.1	Develop a clear organisational strategy for approaching community engagement with the aim of empowering communities to be active water stewards	Support and direction for approaching community engagement in a new way exists within Council
4.2	Establish a platform to explore community engagement solutions beyond risk minimisation, drawing on strengths from platforms driven by non-Council organisations	People collaborate and share knowledge to develop innovative community engagement solutions
4.3	Explore and examine barriers to effective community engagement and how these barriers can be overcome through new engagement solutions	Knowledge from external organisations helps to develop innovative community engagement solutions for Townsville
4.4	Develop and commit to a long-term potable water demand strategy that addresses both demand and supply solutions, informed by lessons from existing projects and embedded in a strong water sensitive city narrative	Organisational commitment and direction for a holistic approach to driving low end-user potable water demand exists
4.5	Develop adaptation solutions for existing areas of high flood risk	All parts of Townsville benefit from appropriate and/or integrated flood risk mitigation measures
4.6	Improve policy and regulatory frameworks to ensure land use planning and urban development considers flood risk mitigation objectives	Knowledge around flood risk is translated into practice and adaptation solutions are implemented for supporting Townsville's water sensitive city vision

Vision Outcome 5: Townsville is an international water innovation hub that showcases water sensitive technology, practice and design for the dry tropics.

There has been water-related innovation in Townsville, led by Council in partnership with JCU, particularly in relation to resource recovery (e.g. a bio-solid reuse program for agriculture, investigations into using algae for bio-recovery). These initiatives have typically been driven by internal champions and focus on implementing small-scale studies and pilot projects, and have not yet led to ongoing commitment or funding to upscale their application.

The broader cross-sectoral and commercial benefits that water services can provide are starting to receive recognition, but this agenda is not currently actively pursued. For example, the open space irrigation system operated by Council may have commercial and economic opportunities that have not been fully explored. Council are beginning to consider some broader benefits of water sensitive approaches (such as human health benefits of urban cooling and greening) but they have not been defined or quantified in the local Townsville context.

"Council really wants innovation and is trying to link in more with JCU. Smart meters for example have hit road blocks...so that's where we've got the intent, it's just trying to get the action at the moment."

Table 7: Recommended strategies for advancing water sensitive technology and innovation

No.	Strategies	Outcome
5.1	Learn from existing resource recovery projects to develop a business case for innovative water sensitive solutions	A business case for resource recovery that supports innovation towards Townsville's broader water sensitive city vision
5.2	Enable and encourage innovation uptake through organisational culture, systems and processes	Innovative ideas are mainstreamed beyond the pilot project phase
5.3	Examine the costs and benefits of solutions that create broad cross-sectoral and commercial benefits	The potential for implementing water management solutions that provide broad, cross-sectoral and commercial benefits is understood

Vision Outcome 6: Inclusive water governance enables integration, collaboration, innovation and collective leadership.

The need for better collaboration and integration across sectors, disciplines and levels of government is widely acknowledged across Townsville, however this approach is challenging to implement due to traditional departmental and disciplinary silos. Existing policies and plans (e.g. the State Planning Policy and Townsville City Plan) are promising in their articulation of the need for integration between levels of government, but do not yet explicitly acknowledge the role of water in achieving desired outcomes for the City and are not designed to link to projects and initiatives on the ground.

There are good examples of platforms that enable collaborative governance on specific issues. The Reef Urban Stormwater Management Improvement Group aims to identify opportunities for people and organisations to work together on areas of mutual benefit with respect to the Great Barrier Reef and local water quality improvement. The Queensland Water Directorate provides an opportunity for sharing knowledge and ideas across the state, mainly around water supply and sewerage. Several projects and initiatives in Townsville demonstrate collaborative governance solutions for particular issues or opportunities. The North Shore development provides a good example of water and land-use planning working together to achieve broader environmental and social outcomes. The Water Security Task Force, as part of the City Deals Program, involved people coming together to consider water security options. These examples show the potential for collaborative approaches but they have not been set up to pursue broader WSC principles.

"It's around the way that societies have evolved to manage water, where they look at the silos of potable water or wastewater or stormwater or groundwater...and they tend to look at it as silos...but that doesn't think about water holistically and doesn't take into account the opportunities looking across all streams of water, so that's our biggest challenge I think."

Table 8: Recommended strategies for advancing collaborative and inclusive governance

No.	Strategies	Outcome
6.1	Develop a broad city vision for Townsville that articulates the role of water in delivering future aspirations	A basis for working together is established in order to achieve shared future aspirations
6.2	Embed Townsville's water sensitive vision in organisational policies and plans	A framework exists to support organisational alignment and widespread implementation of solutions
6.3	Establish an ongoing platform to explore the issue of collaborative governance for achieving water sensitive outcomes	The sharing of ideas and solutions is promoted to encourage collaboration across sectors, disciplines and levels of government
6.4	Explore and pilot solutions for collaborative and integrated governance approaches that will deliver the broad city vision, beyond issue-specific solutions	A suite of governance solutions aimed at achieving broad water sensitive city outcomes exist, including evidence of their costs, benefits, and risks

Vision Outcome 7: Indigenous water knowledge, values and ways of thinking are valued in the Townsville community and incorporated into water planning and design.

The need for greater and more meaningful engagement with Aboriginal and Torres Strait Islander communities in water planning and decision-making is just emerging as an issue in Townsville. Examples where Indigenous communities have been engaged include the Great Barrier Reef Marine Park Authority's Indigenous Advisory Board, and numerous development projects across Townsville (e.g. North Shore development) that consulted with Indigenous people throughout the development process.

The recent creation of two positions in Council dedicated to Indigenous affairs, along with the development of Council's Reconciliation Action Plan, provide an opportunity to further advance this issue.

"I'm not aware of it happening [Indigenous involvement]. I'm not aware of any conversation about that...there's not a great community acceptance. It's changed a lot with migration. There's still an institutional hesitancy.

Table 9: Recommended strategies for advancing greater Indigenous involvement

No.	Strategies	Outcome
7.1	Profile the benefits of Indigenous knowledge and values in achieving Townsville's water sensitive vision and the importance of greater and more meaningful Indigenous involvement in water planning	The need for better and more meaningful engagement with Indigenous communities is broadly acknowledged

5.4 Towards strategy implementation

The vision developed as part of this project is ambitious and long term. Transitioning a city such as Townsville towards such an aspired water sensitive future involves multiple institutions and individuals acting with common purpose.

For Townsville stakeholders to progress implementation of the strategies identified in this section, further work that goes beyond the scope of this current CRCWSC project will be required. Specific considerations may include:

1. Development of a long list of possible actions to drive the implementation of enabling strategies
2. Prioritisation of outcomes to address in the short- to medium-term, potentially drawing on the WSC Index results to inform reflection on priorities
3. Prioritisation of actions based on factors such target outcome, feasibility, benefit, and potential leverage of current or upcoming projects, initiatives or available resources
4. Action planning for prioritised actions to form the basis of an implementation plan with targets, timeframes, budgets, roles and responsibilities
5. Business case development to progress particular actions or initiatives
6. Structure and process to maintain collective momentum across stakeholders committed to implementing the strategy
7. Strategic communications and influential approaches to secure organisational support and endorsement for implementing the strategy
8. Framework for ongoing monitoring and evaluation of action implementation and transition progress

Ultimately, it is intended for this vision and transition strategy document to provide a resource for Townsville stakeholders to continue collaborating through these next strategy implementation stages.

The CRCWSC has been working with other cities to support their implementation planning and can offer guidance to Townsville through the provision of tools, strategic advice, facilitation of further processes, and sharing of lessons from other places.

6. Conclusion

Townsville's dramatic natural climate cycles and regional context have historically created a challenging environment for meeting the community's evolving water needs. As the climate continues to change and social values shift, there is an opportunity to take proactive steps to preserve and enhance Townsville's liveability, productivity, resilience and sustainability.

To explore this opportunity, leaders and strategic thinkers from across Townsville's water, planning and development sectors came together for this CRCWSC-led project to understand Townsville's unique water story, envision a future water sensitive Townsville and develop strategies that will be required to achieve their vision. The results of this process form a transition strategy, which provides a framework for prioritising and designing strategic action across the range of organisations and disciplines that will need to work collaboratively to facilitate Townsville's water sensitive city transition.

The insights presented in this transition strategy show that Townsville has a strong foundation to build on as it pursues its envisioned water future. The city's appetite for innovation and experience in trialling new water solutions, the dedication of individual champions at various levels of seniority and across organisations, and the existing collaborative platforms that can be drawn upon reflect an enabling environment that will help local stakeholders advance their water sensitive city vision.

In addition, Townsville City Council's scale of operation from catchment to coast, along with its functions and responsibilities across water supply, catchment management, sewerage, stormwater and floodplain management, waterways, open space and environment; provide a promising base for enabling the integration and collaboration needed to deliver water sensitive outcomes.

Participants in this project agreed on shared aspirations for Townsville, with the vision themes of urban liveability, ecosystem health, sustainable resource use, and engaged and educated communities receiving unanimous support. Throughout the group discussions, it became apparent that 'liveability' needed to be defined for the local dry tropical context, as creating green, lush spaces is more challenging for Townsville compared to many other Australian cities. These conversations highlighted the pride felt by Townsville residents for their unique context and its dramatic climate cycles, and the importance of embracing these elements in defining their future aspirations.

Among Townsville's water sensitive champions, there is an encouraging awareness of the direction in which water planning and management practices needs to shift. While traditional silos are still present within Council and externally, the importance of breaking down these silos is increasingly realised. It is now critical for Townsville to broaden and strengthen its network of champions in order to engage all of the disciplines, organisations and stakeholders necessary for delivering integrated and collaborative solutions. To this end, there are many existing opportunities in Townsville that can be leveraged to create a platform for broadening people's perspectives and the scope of water sensitive solutions that need to be pursued.

Another critical focus area for advancing Townsville's transition includes meaningfully engaging with the community to understand their water values and how these values can be incorporated into water planning and decision-making. Platforms for engaging with communities already exist and provide a strong foundation to build upon, however they will need to be expanded in scope to include the full suite of Townsville's water sensitive city aspirations. More meaningful engagement approaches that go beyond standard consultation processes will empower residents to make informed contributions.

Perhaps most importantly, the benefits of a water sensitive city need to be understood and appreciated throughout Townsville's broad community and stakeholder network. This understanding requires a compelling narrative of the value of Townsville's water sensitive future to be developed in order to give stakeholders, decision-makers and the community focus and clarity around their priorities and aspirations for the city.

The project participants demonstrated openness, motivation and commitment for water sensitive outcomes and collective action. Building on this momentum and broadening industry and public support will put Townsville in a strong position to accelerate its ongoing transition to achieve its water sensitive city vision.

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Appendix A: Transition Dynamics Framework

This Appendix presents the framework and methodology applied to analyse Townsville's transition progress in Section 5.

Transitions theory is a body of interdisciplinary research that studies how transitional changes are driven and enabled over time. CRCWSC research has drawn on this knowledge base to develop the Transition Dynamics Framework (Brown, Rogers and Werbeloff, 2016; Brown, Rogers and Werbeloff, 2017). This Framework identifies six distinct phases of change during a city's water sensitive transition (Figure 1).

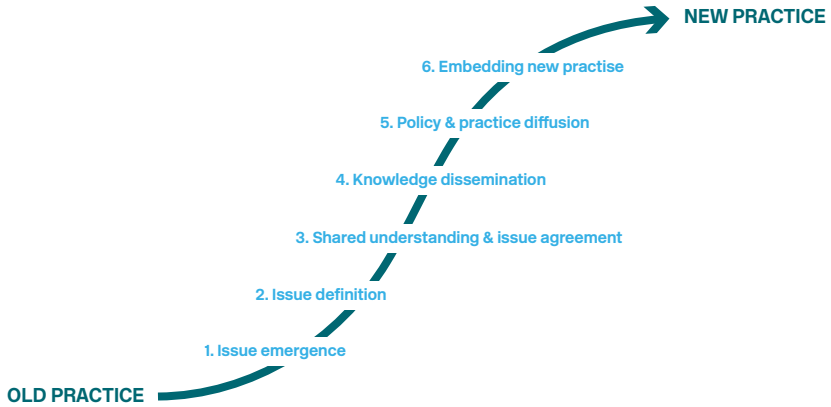

Figure 1. Six phases of change during the transition to a new practice

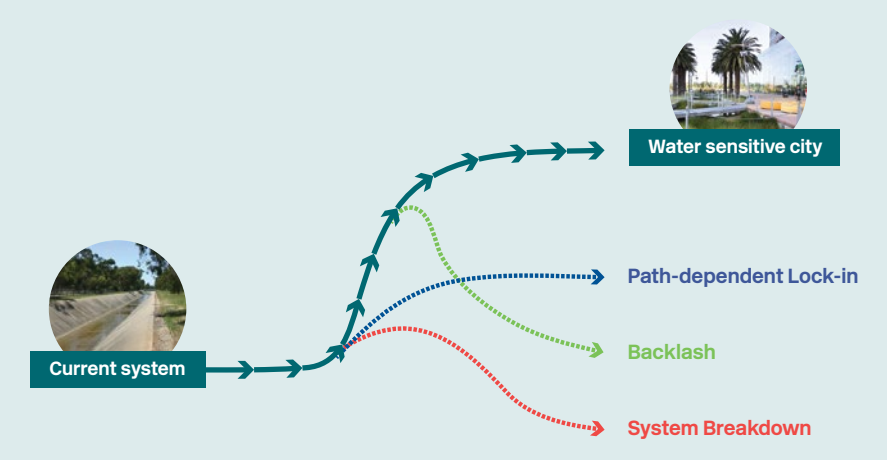

Figure 2. Transition pathways: Successful transition, lock-in, backlash and system breakdown

As a city moves through each phase sequentially, enabling conditions are established to support its trajectory towards its WSC vision and avoid the risk of change pathways that reflect lock-in, backlash or system failure patterns (Figure 2). Actions to orient and drive change towards a city's envisioned water sensitive future need to progressively establish these enabling conditions. Actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current phase of change to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

The CRCWSC's Transition Dynamics Framework sets out five types of enabling factors that need to be present throughout a transition: champions, platforms for connecting, science and knowledge, projects and applications, and practical and administrative tools. Together, these five factors create an enabling environment for a WSC transition and, mapped against the six transition phases, they create a matrix (Figure 3) for a deeper understanding of the current transition phase for each vision outcome.

	Transition Phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
Desktop review	1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
	2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
Participant reviews	3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
	4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
Benchmarking discussions (WS1)	5. Policy and practice diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learing	Early regulation and targets
	6. Embedding new practice	Multi-stakeholder network	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Figure 3. Transition Dynamics Framework (adapted from Brown et al., 2016; Brown et al., 2017)

The Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Townsville's aspired change in practice as it advances towards its water sensitive city vision. A range of desktop and engagement activities provided data on Townsville's enabling environment to apply the Framework.

The Framework provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

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