CRCWSC Research Synthesis
Discussion Paper | CRC for Water Sensitive Cities

IDEAS FOR TOWNSVILLE

Greening the public realm in a dry tropics city

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CRC for Water Sensitive Cities

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Table of Contents

Shaping future growth in Townsville – an opportunity for water sensitive thinking **4**
Workshop objective 4
Part One – Introduction **5**
About this document 5
About the Workshop 6
Project context 8
Townsville action learning partnership 10
Townsville's water story 11
Townsville's deep structure 15
Townsville's growth story 18
Part Two – The problem to be solved **21**
What should future growth look like? 21
Problem definition 22
Part Three – Gaining inspiration **23**
Supporting research 23
Changing development approaches in Townsville over time 24
Part Four – The Ideas **36**
Creating line of sight from vision to implementation: TDesign 36
Design elements for streets 38
Applying the design elements in a master plan 51
Opportunities **59**

Shaping future growth in Townsville – an opportunity for water sensitive thinking

Over the next 20 years and beyond, Townsville will face a number of water-related challenges. Choices will need to be made about how to respond to future water security, drought and flood cycles, urban greening and urban heat, and the health of waterways and coasts.

These choices will directly influence the shape and design of urban development. They also provide an impetus for a new approach to better integrate urban and water planning.

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) and Townsville City Council (TCC) partnered to deliver a collaboration workshop to consider what these choices could look like.

Workshop objective

To develop:

- water sensitive greenfield development options relevant to Townsville
- water servicing options for these development areas that make Townsville more liveable, resilient and sustainable.

Part One — Introduction

About this document

This report synthesises the outcomes of a workshop held on 8 October 2019 with TCC and its stakeholders.

The workshop aimed to redefine what good urban development in Townsville would look like, when considered with water management in mind. It reflected the need to consider Townsville's water context in the dry tropics, experiencing major floods and droughts, which influences the community's experience. It was also driven by a sense that business-as-usual approaches to development would not achieve the future to which TCC and the community both aspire.

By exploring the current water and development approaches in Townsville, with added perspectives from the CRCWSC's researchers, workshop participants discussed what good development could look like. These discussions coalesced into ideas for an 'urban forest'.

These ideas are useful in the context of both Townsville's City Plan and its infrastructure planning to manage water services. That is, they can help to shape how growth is managed by:

- urban planners,
- water engineers, and
- developers

who ultimately share a common goal of sustainable and liveable communities.

"Ideas that could collectively be described as an urban forest were the result of discussions about what good urban development looks like in Townsville"

The ideas themselves are conceptual, and could be further developed alongside current options and approaches in the planning cycle(s). Their purpose is to demonstrate the range of development and infrastructure possibilities that can be achieved through an integrated approach to water and urban planning.

About the workshop

The workshop encouraged collaboration between water and urban planning practitioners, because this is where the opportunity for change lies. To this mix, it added the research of CRCWSC research.

The tangible output of the workshop is a series of ideas for establishing an urban forest that suits Townsville's climatic and landscape context.

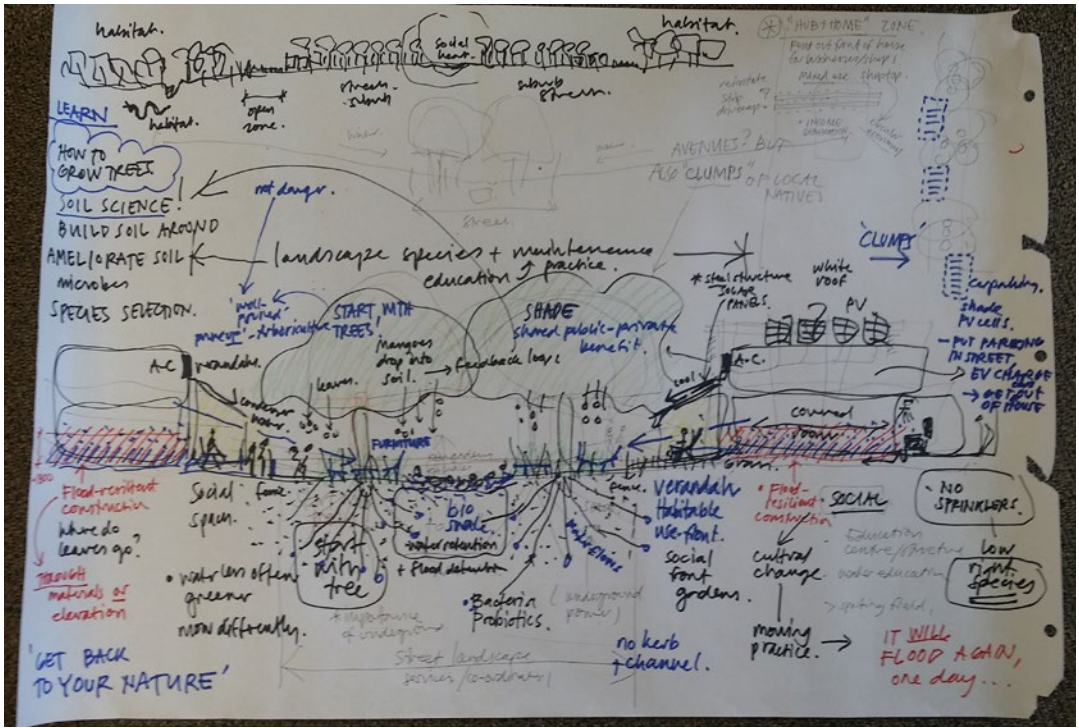
These ideas address fundamental challenges facing the city: How to attract new people to the region? How to create a liveable city? How to future proof the urban population against a changing climate? How to manage water without detriment to the region's natural assets?

Workshop participants from a range of disciplines collaborated and applied their technical knowledge to find novel ways to create an urban forest in greenfield developments.

The workshop approach included:

- sharing local perspectives of urban growth in Townsville, considering water services, population growth, development trends and legacy infrastructure
- inviting CRCWSC researchers to share water sensitive city research findings and thinking
- using group work to develop a shared understanding of Townsville's current water context and to identify ideas to enhance a greenfield development case study (Stockland's North Shore development)
- focusing on greening the streets. The opportunity for greening is the public realm where Council has greater control, rather than the private realm. Streets are the logical, local scale for this attention.

"The battle ground for greening Townsville is the public realm."



Workshop outputs reflecting the complexity of ideas and opportunities for creating an urban forest

Who was there?

Project context

This project continues the CRCWSC's partnership with TCC.

In 2017, the CRCWSC facilitated a series of workshops to create a vision for Townsville's future, and to articulate water's role in achieving that vision. This process included stakeholder interviews, benchmarking current water performance using the Water Sensitive City Index and a literature review to understand the context for water management in the region.

The result was a vision for a water sensitive Townsville that provides a 'framework for orienting and coordinating strategic action' (Hammer et al., 2018). It was intended that this vision strengthen relationships between the stakeholders who needed to work together, and guide the next steps of implementing a vision in practice.

Ideas for Townsville continues these discussions. It reunites these stakeholders and researchers to develop the strategic and operational actions to implement the vision.

The process

Research synthesis is a facilitated design process that combines emerging research with local expertise to develop practical ideas that address urban challenges. Using a workshop format, participants explore problems and agree on the shared parameters and language. Together, the participants arrive at tangible propositions for solving the problem, with benefits clearly defined. The collaborative nature of research synthesis helps to break down barriers between disciplines and develops new insights that can be applied in a practical way.

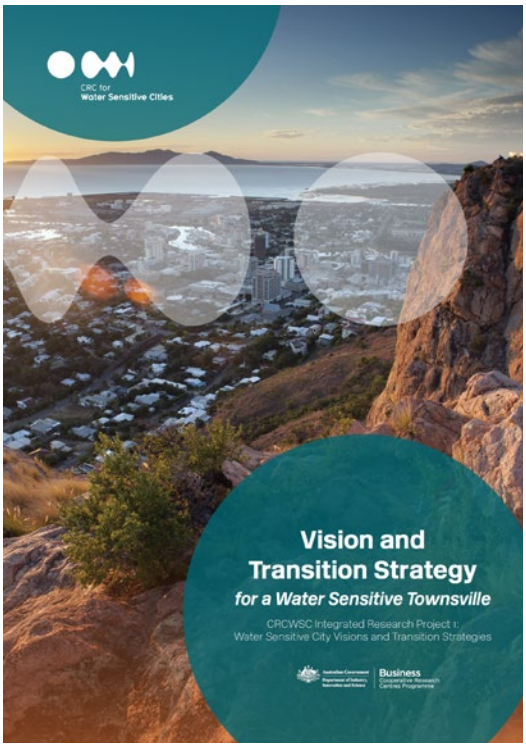
Stockland's Northshore development was used as a workshop case study

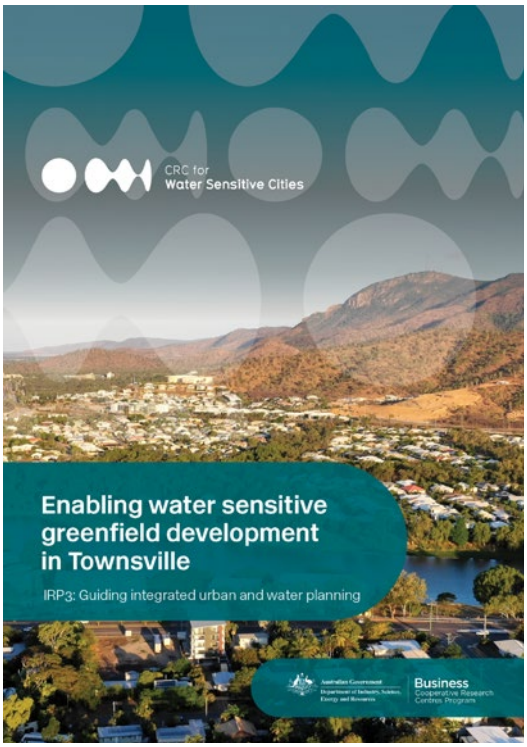
Townsville action learning partnership

Past research suggests that Townsville has generated strong momentum towards achieving its vision of a future water sensitive city, but is at risk of stagnation if critical enabling conditions are not established. Progressing the transition will require a strategic focus on overcoming the barriers to on-ground delivery, particularly translating the long-term aspiration described in the vision into projects on the ground.

This report picks up where the *Vision and Transition Strategy for a Water Sensitive Townsville* left off. TCC recognised that to make advancements towards their vision of a water sensitive Townsville, further attention needs to be given to strengthening integration between water management and urban planning. Accordingly, the Townsville action learning partnership was established in July 2019 between the CRCWSC and TCC to focus on the systems governing urban growth.

In addition to exploring a range of ideas to redefine what good urban development could look like (this document), the partnership also considered the institutional arrangements, particularly planning and service delivery functions, which can pose a barrier to water sensitive urban development practices (Tawfik et al., 2020). They identify 14 opportunities to strengthen Townsville's planning and governance systems to advance its water sensitive agenda. These pathways present three opportunities for implementation: strategic leadership at the state and local levels, urban planning at the City Plan level, and council functions at the operational level.





Hammer, K., Rogers, B.C., Chandler, F. and Chesterfield, C. (2018). Vision and Transition Strategy for a Water Sensitive Townsville. *Melbourne, Australia: CRCWSC. (Left)*

Tawfik, S. Smith, B., and Chesterfield, C. (2020). Enabling water sensitive greenfield development in Townsville. *Melbourne, Australia: CRCWSC. (Right)*

Townsville’s water story

Being located in the dry tropics, and on a major floodplain, water is one of the key natural elements that shapes Townsville’s community, standard of living and environmental footprint.

Although Townsville has had a plan for water for many years, recent events such as drought and floods have tested this and suggest that new approaches should be considered.

In 2017, the CRCWSC led a process to establish a 50-year vision for a water sensitive Townsville: “a 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" (Hammer et al., 2018).

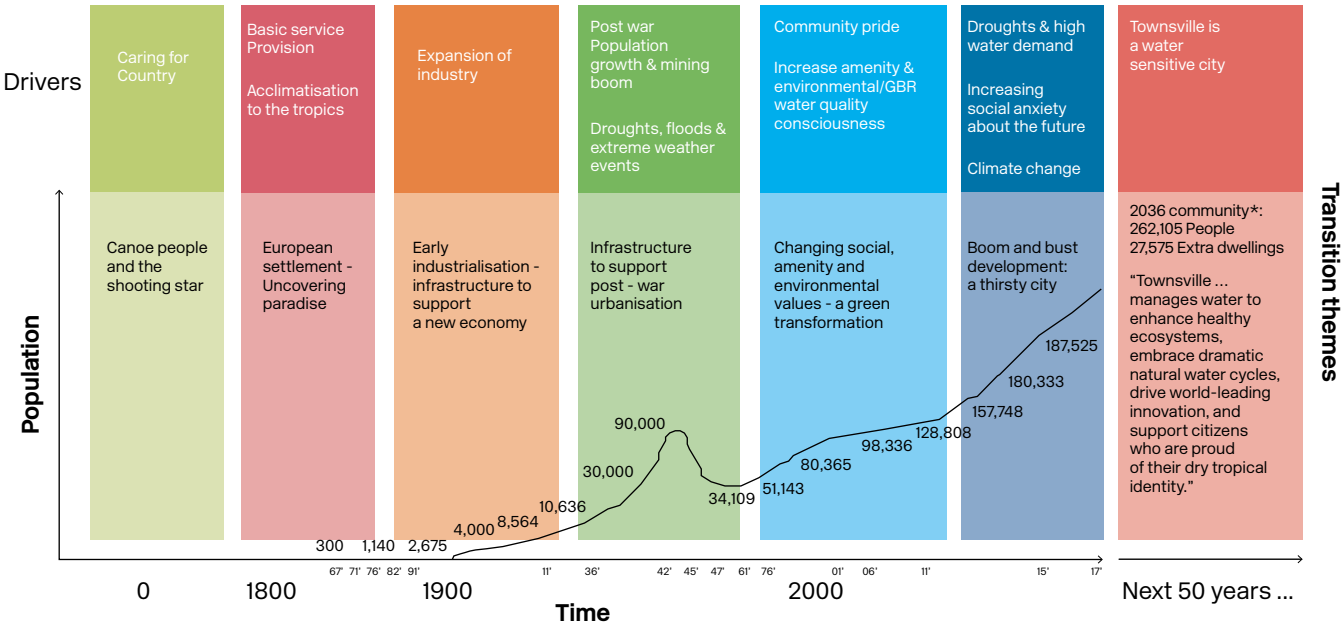
Over this same period, the priorities for water management in Townsville have shifted: the challenge is not about the amount of water that is needed, but instead about the reliability of water supplies and the impacts of water that runs off Townsville to natural environments.

Water management in Townsville is transitioning to managing cycles of floods and droughts, protecting the health of waterways and the Great Barrier Reef, and establishing an urban forest to combat the urban heat island effect.

Townsville's water context presents unique challenges but also opportunities for innovation. The vision for a water sensitive Townsville provides a shared understanding of the outcomes, in terms of water based ecosystems, urban liveability and of the water in Townsville’s sustainability and prosperity.

Urban growth is one mechanism to get there. The investment in new services, suburbs and houses provides an opportunity for innovation if the vision can be clearly defined at this scale. Urban growth is usually viewed as a threat to sustainability and community values. But when the scale of investment is viewed as a pathway to reconfigure a city’s infrastructure, urban growth can be an opportunity. Many in Townsville recognise this and want to see change. They identify current growth planning as delivering assets that are ultimately unsustainable and unaffordable for communities.

Townsville's vision for a water sensitive city



Adapted from: Hammer, K., Rogers, B.C., Chandler, F. and Chesterfield, C. (2018). Vision and Transition Strategy for a Water Sensitive Townsville. *Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.* *Queensland Statistician's Office, 2020, Projected dwellings, by series, by local government areas, Queensland, 2016 to 2041, accessed at www.qgso.qld.gov.au

Water Sensitive Urban Design

Water sensitive urban design (WSUD) is a broad concept referring to the integrated delivery of water outcomes through the planning and development process. WSUD is commonly applied in stormwater and drainage aspects of urban development where it symbolises intervention at the local and precinct scale to manage stormwater. This approach is now being scaled up to cover other aspects of the urban water cycle, and at scales from lots to catchments. Councils, including TCC, are often are the forefront of applying WSUD on the ground.

Water supply

Water is supplied from Ross River Dam. This dam was originally constructed for flood mitigation, and was designed to be shallow and wide. It was later adopted as a water supply source, but its design means a large volume of water is lost each year to evaporation.

TCC is currently augmenting the supply into Ross River Dam by duplicating the Haughton pipeline. This will increase the dam's water supply yield, and increase the reliability of supply for the city. TCC is also constructing a recycled water scheme to supply water for irrigation.

Townsville faces unique water challenges, but is typical of other cities in asking of itself: what does a sustainable approach look like?

Groundwater is another source of water used in Townsville, although there are gaps in the understanding of the amounts extracted. Some areas of the region are 'protected' from further bore construction. In effect, the groundwater in these protected areas is reserved for future users.

Townsville has several development areas which are difficult to service because of the elevation of houses, which have been constructed above the flood line.

Recent drought has reminded many that water is a scarce resource. However, many in the community expect the solution to water supply issues is to increase supply through further dam building.

Wastewater

Townsville has a complex sewer system that is the result of legacy planning decisions. Examples can be cited of development built over sewers, sewers that experience inundation during high tides resulting in backflow into houses, and sewers that cannot easily be maintained because of the system's design.

In addition to these network issues, there is also pressure to continually improve the environmental performance of wastewater discharges to the Great Barrier Reef. Standards for discharge are regularly reviewed, although the scope for further improvements in the treatment process is diminishing.

The reuse of wastewater as recycled water is a recent initiative that will reduce discharge volumes and loads.

Flooding

Townsville is situated on the floodplain of the Ross, Black and Bohle Rivers. This landscape has been shaped for thousands of years by cycles of floods. As communities are drawn to the lifestyle and employment opportunities Townsville offers, there is a need to protect life and property from flooding.

Living on a floodplain can be harsh. Floods are interspersed by long dry periods when the river retreats within its banks; wetlands and billabongs progressively dry up; and the landscape becomes dry and brown. When floods return, the floodplain becomes a source a of great biodiversity and biological productivity: full of different species, sounds and new growth. This is true of all floodplains, but the dry phase is particularly pronounced in a dry tropical climate. Life that survives on floodplains is adapted to these cycles.

Besides flood event management, urban planning could ensure that new estates are designed with flooding, and the floodplain landscape, in mind.

Drainage

WSUD is used to design the drainage for most new development in Australian cities. Using its principles, stormwater is managed by encouraging water to soak into soils and by using plant-based treatment systems such as wetlands and bio-basins to remove pollutants before runoff enters creeks and rivers. In effect, the drainage system mimics natural processes.

While numerous WSUD approaches have been tested in Townsville, it is comon to hear of issues when designs from other cities are used. Plant-based systems need to be irrigated during the dry months to ensure they continue to function. The storm intensity in a dry tropics climate can also test these systems with high runoff rates scouring out natural systems. In some parts of Townsville, the sodic soils present further issues that destabilise drainage infrastructure, creating erosion. As with all cities, there is a tension between using highly localised water quality treatment systems for individual streets or houses, compared with regional systems such as wetlands located at outlets of regional drainage networks.

Townsville's deep structure

Australian cities were established in the modern era and embraced the technological benefits that exploded during the min-late nineteenth and twentieth centuries.

Townsville was established as a port in the 1860s. This was a peak time globally for industrial-scale engineering of natural water environments such as draining swamps and wetlands, filling and reclaiming shallow water bodies, damming rivers, and channelling and diverting creek systems. Townsville followed this approach by implementing flood protection measures including dams, river alignments and levee banks.

While these actions served a distinct primary purpose (e.g. establishing a reliable drinking water supply), the modifications to natural systems had other, consequential effects on the function of the region's water cycle. As seen elsewhere in the world, these consequences often only become visible during extreme events. The February 2019 Ross River flood is one such event. The way the river and its floodplain performed was affected by urbanisation and human-made structures. Levees and or raised ground areas for urban development acted together to reduce the storage capacity of the natural floodplain and divert flood waters elsewhere.

A water sensitive approach to urban development begins by gaining knowledge and developing understanding of this underlying or 'deep' natural physical structure of a place. Often this requires historical research and thinking outside the boundaries of the subject site, as the layers of modifications are often cumulative and undocumented.

Once it is conceptualised and represented, this underlying structure can inform development strategies that respond to, rather than resist, natural forces and tendencies of water movements and behaviours in a post-industrial or post-agricultural context.

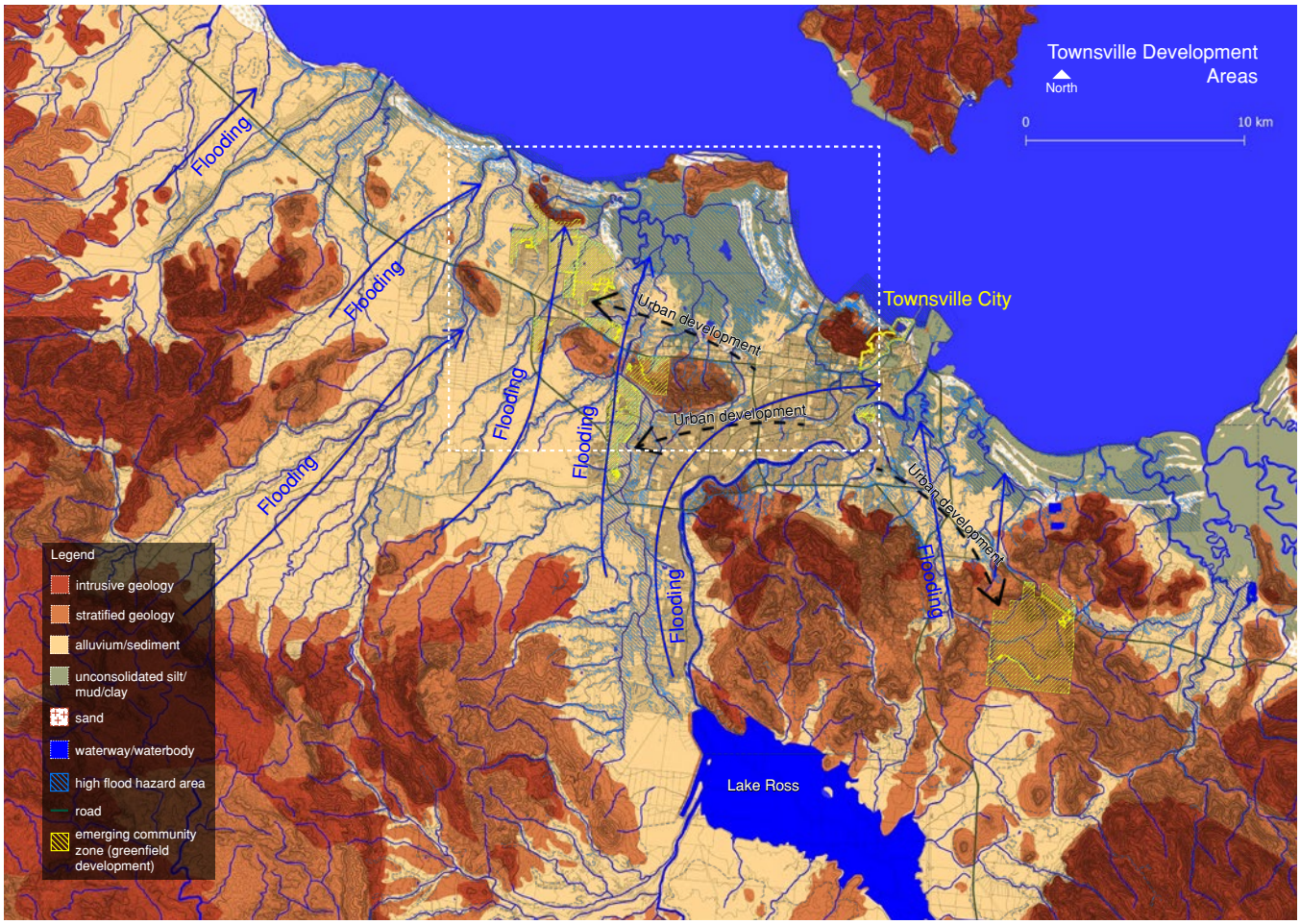
The deep structure maps in this report represent the initial, large-scale knowledge of Townsville's community and the workshop stakeholders. By using this deep structure as a basis, planners and water managers can actively seek out ways in which urban development can take steps to support, repair and enhance a damaged or degraded structure found in a site's 'existing condition'.

Townsville Development Areas 1 : 150 000

The Townsville local government area lies predominantly within a coastal lowland defined by topographic division from inland highlands that comprise a variety of igneous, metamorphic and stratified geology. Prevailing topographic drainage therefore carries water down into these coastal lowlands resulting in largely alluvial or poorly consolidated sedimentary deposits.

Map sources and datasets:

Flood extents - Townsville City Plan, Schedule 2.5 Overlay Maps, Development Constraints Overlay Maps, Flood Hazard OM-06.2
Townsville City Council - Open Source Data
Data.qld.gov.au - Open Source Data
Queensland Spatial Catalogue - Open Source Data
Geoscience Australia - Open Source Data



Townsville Development Areas-Detail 1 : 50 000

The large floodplain of the Bohle, Ross and Black Rivers provides an expanse in which water can spread out, and in doing so recharge the landscape. Planning for greenfield development begins with understanding this floodplain landscape and how its hydrology and geomorphology influence the city. This helps planners and water managers to create water and green infrastructure connections between the development front, the existing CBD and features of the floodplain, such as major waterways.

Map sources and datasets:

Flood extents - Townsville City Plan, Schedule 2.5 Overlay Maps, Development Constraints Overlay Maps, Flood Hazard OM-06.2
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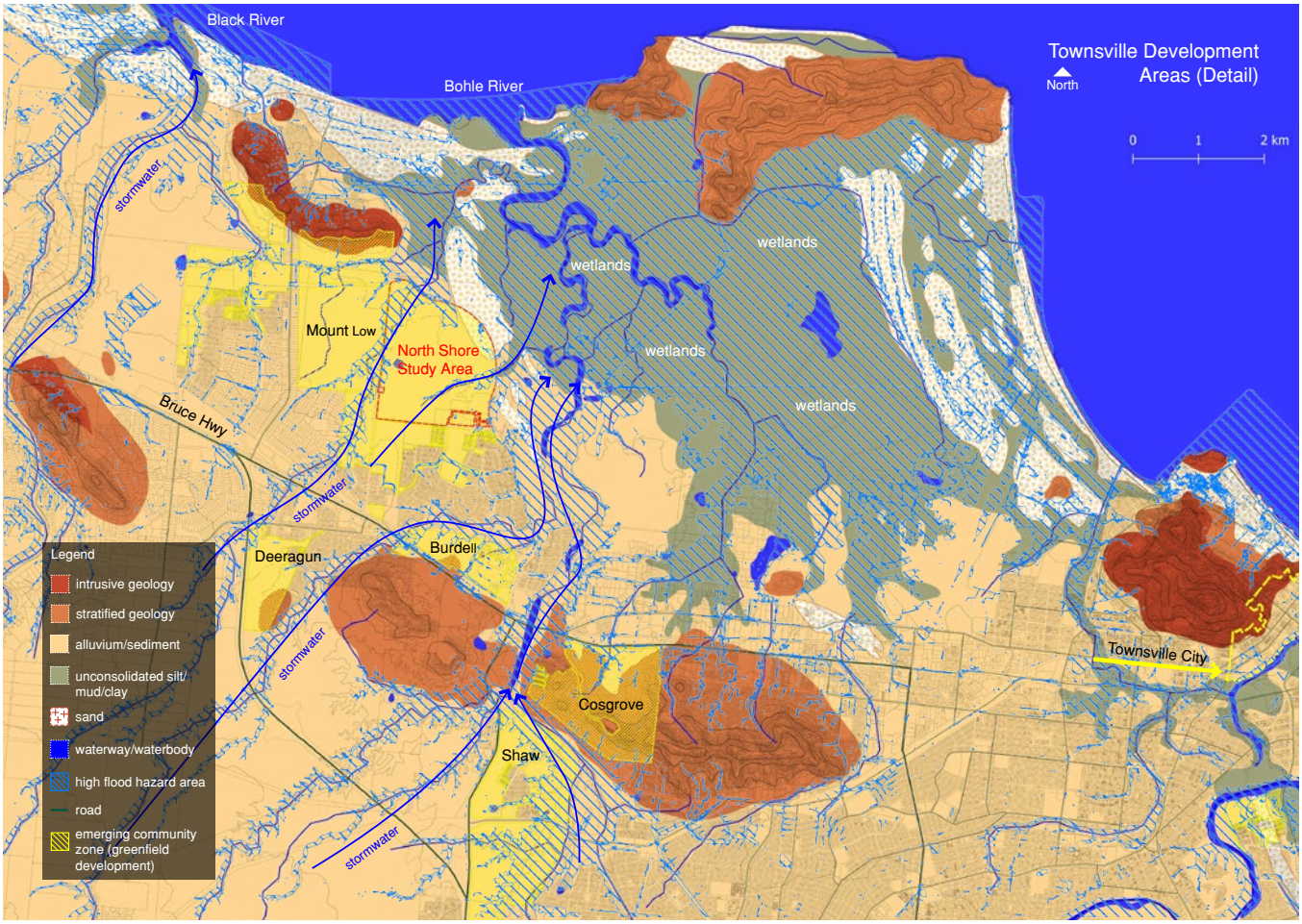


Townsville's growth story

Townsville's population is increasing. To accommodate these new residents, Townsville will see a mix of greenfield development that increases the city's urban footprint, and infill development that increases the density of selected areas of the city

Townsville has significant appropriately zoned urban land to accommodate development rates to 2036 and beyond.

Development in Townsville, by the numbers

374,200 ha
Land area

194,072
2018 Population

0.52 persons/ha
Population density

+ 68,033
Population increase by 2036 for the region

+ 27,575
Extra dwellings required by 2036

Source: Queensland Statistician's Office, 2020, Projected dwellings, by series, by local government areas, Queensland, 2016 to 2041, accessed at www.qgso.qld.gov.au

City Plan

Townsville City Plan outlines the future direction of growth for the city. While current population growth rates are low (around 0.8% per year), there are expectations for an additional 68,033 people by 2036.

The City Plan outlines how the city will accommodate for this growth. It represents a single planning scheme for all of Townsville, sets the vison and standards for growth, and articulates what success looks like.

The City Plan is designed to guide consistent and integrated action across council. Planning for infrastructure growth, provision of open space and design of services are all guided by the City Plan.

In Townsville, land supply currently exceeds demand. This allows TCC to consider objectives other than land release to drive the patterns and pace of development. As such, the City Plan distributes growth between infill and greenfield development to get the most out of the existing infrastructure and to protect the region's natural assets.

Protecting the natural environment is a high priority objective in this process. Environmental overlays in the City Plan establish ecological corridors at the macro scale, based on retaining existing ecological corridors. This thinking could be adapted to establish new green / ecological corridors supported by tree canopy targets, street typology hierarchies or street tree designs.

The City Plan also provides an opportunity to address community water efficiency. The City Plan process enables conversations about greening, provision of irrigated open space and the adoption of novel water sources to maintain a green landscape year-round.

The development trends

Townsville's population target requires building an additional 1200 dwellings per year. This is an increase from historical averages of around 1100 per year. In recent years, construction has fallen to around 300 lots per year (UDIAQ-Townsville, pers comm).

The barrier to development in Townsville is not land availability. Unlike many other cities, a sufficient land bank exists to service growth. Instead, development is limited by market forces, with economics and employment, as well as lifestyle, being the major market drivers.

The market is also influenced by the split between investor and owner-occupied buyers. Previously, investors have driven the market, with a corresponding demand for smaller lots and more affordable housing styles. More recently the demand has swung back towards owner-occupiers who want larger lot sizes and premium design (UDIAQ-Townsville, pres comm).

This has an impact on greening. With smaller lots, clearing is usually widespread across a development with the developer providing communal green spaces. With larger lots (1000-2000m^2), trees are usually retained during the initial civil works to allow the owner to determine how each lot will be designed.

Stormwater treatment

Buyers and developers are interested in sustainability and water solutions - provided it is feasible and cost effective (UDIAQ-Townsville, pers comm).

In delivering this, there is a tension between on-site and end-of- pipe stormwater treatment. Numerous lot scale and street scale systems in Townsville are now irrigated to maintain the vegetation, counteracting the intended sustainability benefits.

Local soils also mean that smaller scale systems can be easily overwhelmed with sediment, and are eroded during large storms.

In contrast, end-of-pipe solutions tend to use wetlands situated on the river floodplain. There are examples of these wetlands reverting to self-sustaining natural systems.

Soils as a challenge

Like some other areas in Australia, Townsville has sodic and acid sulphate soils in some areas which present practical challenges to local stormwater treatment systems. The disturbance of these soils creates myriad water quality and asset management issues, requiring careful design and construction methods. This report acknowledges this challenge but does not aim to present any new research or approaches to deal with the matter. Current investigation into sodic and acid sulphate soil responses in Townsville should continue and be incorporated with the design principles and elements of this report where practical.

Part Two — The problem to be solved

What should future growth look like?

Workshop participants' perspectives

Development would ...

- reduce demand for drinking water for outdoor uses by reconsidering the design and use of private open spaces
- reinforce the value and conservation of water through the design of new estates. Urban design and water services work together to foster water sensitive behaviours
- foster partnerships between TCC, community and developers to deliver sustainability. Developers will deliver estates at a high standard, and community and TCC will ensure this outcome is as affordable and practical as possible. The standards to be met are integrated across services and regionally consistent.
- showcase new technology to improve water sensitivity. Smart systems and water sensitive technologies become the norm.
- ensure open spaces become a key community asset. Water sensitive activation of public open space is a priority objective.

Because ...

- being water sensitive will 'future-proof' Townsville, ensuring the city remains affordable for future generations
- responses to the 'water security challenge' are uncoordinated and we have yet to integrate technologies, regulations and business cases to transform current practice
- the way we plan for growth does not make the best use of existing infrastructure. Underutilised assets are difficult and costly to maintain.
- urban development provides a practical way to demonstrate action on sustainability. There is an appetite to adopt more innovative and tailored development products.
- water sensitive development will make Townsville more liveable. This will draw people and businesses to the City to support growth targets.
- water sensitive development builds community understanding. This in turn leads to political ownership of new approaches.

Problem definition

How can we use streets in greenfield areas to establish an urban forest?

Practitioners want urban development to be more liveable, resilient and sustainable – to reduce its environmental impact. They want these improvements to provide tangible benefit to local communities.

At a city level, Townsville already has the basic water and urban forest elements (waterways, parks, foreshore, Ross River, Cleveland Bay, Castle Hill) in place.

The policy framework exists to manage water sustainability, and the technical solutions are (generally) available.

For new development there is an opportunity to offer suburbs that allow people to 'live with nature'. In addition to managing water, vegetation and urban heat, such an approach will encourage sustainable behaviours by residents.

These problems came together into a common question for the workshop: How can we use greenfield growth as a way to create a sustainable urban forest in Townsville?

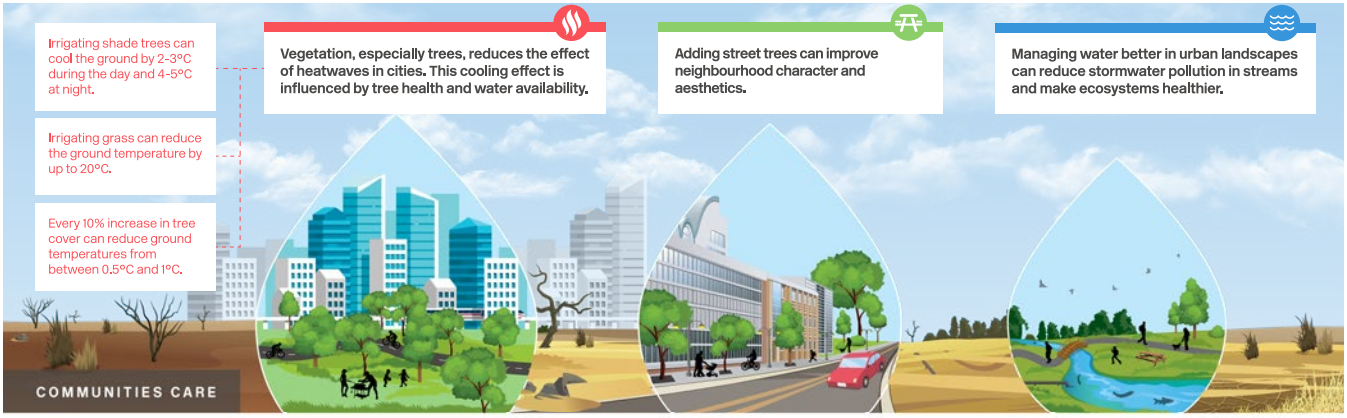
The problem was further focused onto the local scale public realm: parks, streets and roads. Adding greening to the private realm is more difficult when residents are concerned about the impact of trees and damage during cyclones.

"We need to think about the planning scale: we need policy, community engagement and buy-in from industry. We need proper species selection and maintenance. We need different water sources to irrigate trees. We need to think about the long-term operational costs and who gets the benefits, to inform conversations about who should pay. We need a holistic approach" (workshop participant).

Part Three — Gaining inspiration

Supporting research

Water's role in creating liveable urban communities



Heat

- People are willing to pay for projects that reduce peak summer air tempreatures by at least 2°C.
- Heatwaves are Australia's most deadly natural phenomenon. Even decreasing high temperatures by 1-2°C can save lives.

Urban Amenity

- People are willing to pay up to 16% more for a house with greater access to green spaces.
- >50% of people support the installation of raingardens in their street.

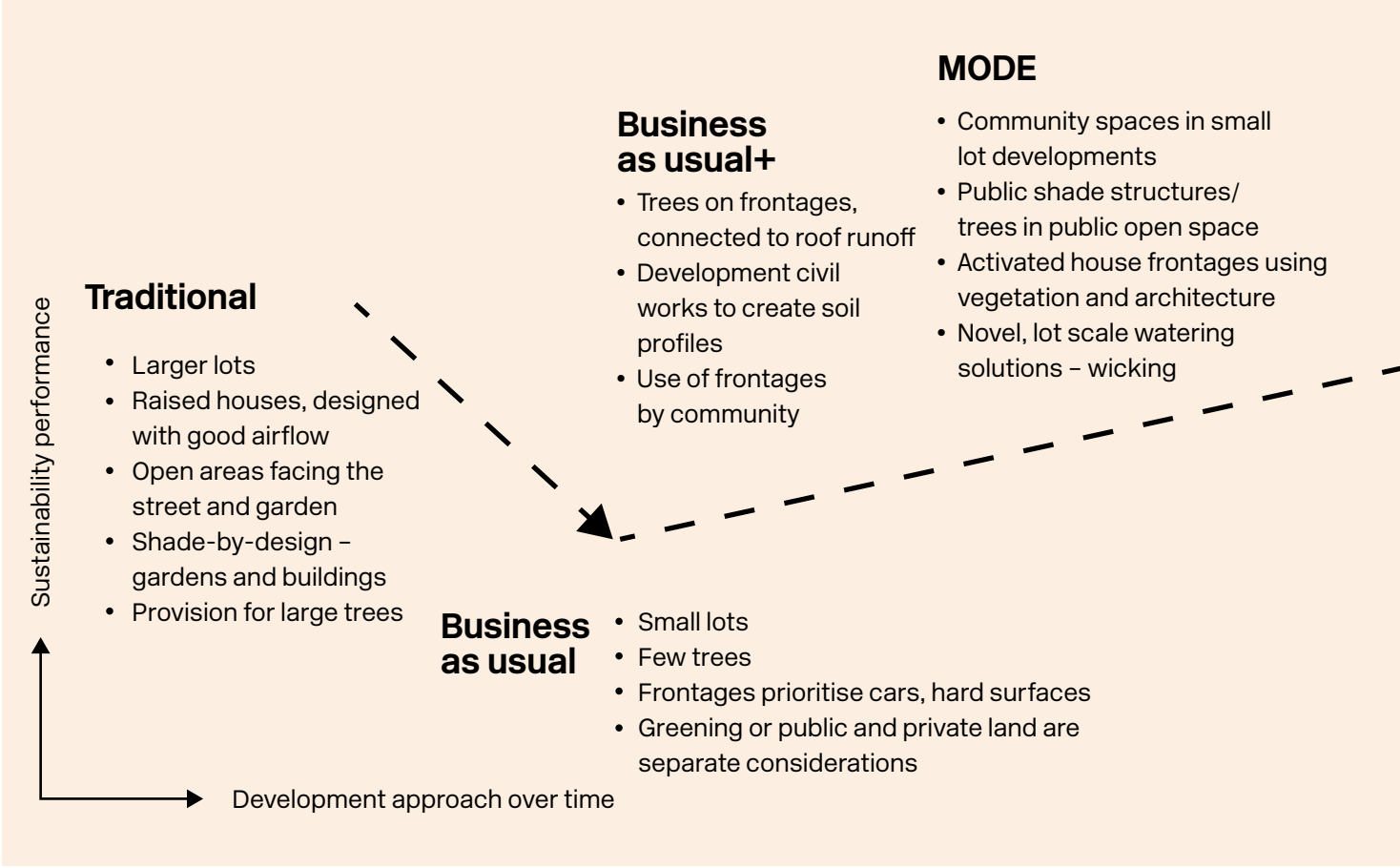
Waterways

- Communities place a very high value on projects that improve the health of local waterways.
- People are willing to pay more for a house close to a healthy waterway.

Source (and link to references): https://watersensitivecities.org.au/content/waters-role-liveability/

Changing development approaches in Townsville over time

Townsville displays a range of approaches to urban planning which directly influence the urban forest and water management. Beyond norms and expectations associated with irrigating open space, factors such as lot size, street layout, street cross-section and housing typologies influence the way that the community design and use their local spaces. While simplistic, the range below illustrates the range of approaches already in use in Townsville, when viewed through a water and urban forest lens. This range considers the approach to planning as well as the outcomes it delivers. It can inform principles for planning future infill and greenfield development areas.



Natural public open space

- Combined natural and irrigated public open space areas

Water sensitive

- Shade and ventilation are part of house design
- Lot design incorporates pervious areas, green setbacks, large trees
- Frontages activated
- Extensive, connected canopies on-lot (many connected trees vs single trees with large canopy)
- Some street car parks given over to trees
- Community maintains public green streets
- Trees are climate appropriate – natural template and/or proven species selection

Traditional

Characteristics

The traditional Queenslander style home was designed with the climate in mind. Its environmental footprint reflects this design. Examples can be found throughout Townsville.

These homes have a compact footprint and lightweight timber construction. They are elevated above the ground for airflow and to stay dry during floods. Ventilation, shade and flood resilience are all elements of this style. The (typically) open verandah provides an outdoor space facing the street, enabling social interaction. This effect is often enhanced by the picket or wire front fences that provide additional permeability between public and private spaces. While there is a clear ownership boundary, the green of the garden merges with the verge providing visual permeability and greatly contributing to the street character.

Gardens sometimes extend onto the verge and are maintained by homeowners. In some instances, asphalt has been removed from the street to enable tree planting or growth, representing a 'greening' of otherwise hard landscape elements.

Irrigation is often used to maintain garden quality, with residents benefiting from the shade and evapotranspiration.

Traditional Queenslanders in Townsville are often accompanied by larger blocks that have tall trees to provide additional shade to the buildings and large permeable areas allowing water infiltration. The combination of shade, greenery and airflow creates an attractive microclimate.

Where this design is lacking is in aspects such as material choice for insultation, and in accessibility.

Performance

- Good airflow
- Minimal obstruction to overland flows
- High quality amenity, social activation
- Extensive shade
- Large canopy trees and areas for stormwater infiltration

Business as usual (BAU) greenfield development

Characteristics

BAU development in Townsville is similar to that in many other Australian cities, with some exceptions.

There are large front verges, and wide streets. But like many recent developments, there is limited shade in streets, creating a hot and harsh environment. The scarcity of trees is based on a perceived need to park boats and other vehicles on verges.

Dwellings are a generic house product with limited adjustment to Townsville's climate or flooding issues. Houses tend to have large impervious surfaces (double concrete driveways) and small eaves, but pleasingly have adopted white roofs as a response to urban heat island effects. Front lawns are large and well irrigated, but generally not actively used.

How the buildings are used is where differences lie. For instance, garages seem not to be used for cars (which tend to be parked in front of the garage door). Instead garages are used as flexible indoor-outdoor space for hobbies, storage, home gym, drying clothes, or as a shady outdoor space.

Performance

- Hot urban environment
- High evapotranspiration
- Little street level community interaction
- Sustainability via features such as white roofs – but water performance is not considered

BAU Improved (BAU+)

Characteristics

A number of streets and houses show advances on the standard BAU development typology. These houses face towards a water retention pond/ wetland/ landscape area and have embraced this vista. Residents have begun to actively use their front yards for social activities (as evidenced by installation of chairs and lights for instance). These additions demonstrate a willingness to use the front of house space when adjacent public realm has been activated.

What follows is a response in the streetscape. This highlights the possibility and desire for greater social possibilities for the streetscape and interaction between neighbours which is key to a liveable suburb.

It also suggests possibilities to contribute to an urban forest. Trees already provide shade to the house and gardens are embellished. This vegetation could be further maintained by directing roof downpipes to establish a raingarden – a simple retrofit or design change.

Performance

- Greater street activation and community connection
- Increased passive surveillance
- Initial behaviour changes creates opportunity to influence further sustainability behaviours


13

Mode development

Characteristics

MODE is a recent greenfield estate in Townsville. In this estate the developer, Stockland, has invested in high quality central public space featuring moveable furniture, cyclone proof shade installations, different seating types and trees.

MODE also features compressed small footprint housing types: boundary construction, single-storey terraces that are affordable due to their size, but still high quality. Each house features a basic but appropriate front yard including a treatment of permeable gravel, concrete stepping stones and some fencing. MODE residents have renovated or added to this with their own planting, small decks, seating areas facing the public space and recognising its amenity. Further, garages seem not to be used for cars, but instead form a shady outdoor room facing the semi-public street/shared space. As a result, the main external useable space is at front of block rather than rear. This adds to the social life of the suburb and creates passive surveillance and interaction.

Performance

- Passive cooling
- Street and community activation
- Airflow

MODE- terrace housing facing a common public area. This was a high amenity area that encouraged residents to use their frontages in a different way. Stockland invests heavily into its parks. The intent is that the parkland becomes the entertaining area of houses. Feedback suggests that this creates a community buzz, which is further supported by Stockland with community events.

Natural (dry) public open space

Characteristics

Townsville's natural vegetation provides cues to sustainable landscape design. Being a floodplain, the landscape dries off and becomes harsh in the dry months. Vegetation is brown and tree canopy from remnant vegetation is sparse. Such areas have been preserved in development areas, and provide a balance to the built form and the irrigated public open space.

These areas are seen with adjacent edge areas that are lush, irrigated areas. This combination provides a choice to community – the lush Townsville urban environment is maintained, but in the context of the natural landscape. The community is free to move between the two.

Performance

- Reduced irrigation demand
- Habitat to maintain biodiversity
- Provides cues to the community about water use, as an alternative to the 'always green' perspective

Part Four — The ideas

Creating a line of sight from vision to implementation: TDesign

This report demonstrates how to integrate water and urban planning to create an urban forest. This structure includes:

- integrated planning as a principle
- individual design elements to translate this principle on the ground
- master planning to organise the design elements spatially and/or functionally

The components of this structure are introduced here, and further expanded in the following section.

Integrated planning

Growth planning encapsulates multiple dimensions. Conventional practice sees services such as water, and outcomes such as healthy communities, respond to the urban form that is firstly created through development planning.

If these functions are viewed together, and with a common objective of creating an urban forest, an understanding of how each can be translated into each dimension of planning becomes apparent.

Design elements

The design elements provide a palette of planning options that water managers and urban planners can use when considering how to service growth areas.

These design elements intentionally focus on the local scale and highlight 'decentralised' options. The design elements are not mutually exclusive. They can be mixed and matched to suit specific circumstances.

It is anticipated that conventional urban water servicing options will also be considered, and that all options will be evaluated for their costs, performance and practicality. The aim of this report is to expand the list of options that are included in this process, and to guide the process of evaluation.

Master planning

Master planning provides a conceptual organisation of a suburb that coordinates and organises how development will occur. It can include both infrastructure as well as non-infrastructure considerations, such as financing, scheduling and phasing.

Here, master planning is used to highlight the influence of spatial layout, connectivity and distribution of design elements, which will directly influence their cumulative community benefit.

A role for a TDesign guide

QDesign (Queensland Department of Housing, 2018) is set of planning principles developed by the Queensland Government to guide the planning and design of the state's urban environment.

A similar 'TDesign' for Townsville could be used to define what an urban forest looks like for the dry tropics and to deliver this through the City Plan.

A key strategy is to focus on the public realm where the opportunity for control over outcomes is more certain; and streets emerge as the priority land use to target if the emphasis is on local scale outcomes.

Read more about QDesign here:
https://www.hpw.qld.gov.au/__data/assets/pdf_file/0022/4837/qdesignmanual.pdf

Aspects of integrated planning for an urban forest that could be guided by a TDesign Guide.

Network planning

- Growth and network planning
- Water supply
- Wastewater
- Drainage
- Flooding
- Roads
- Other services

Development planning

- Density and value uplift
- Open space
- Street configuration
- Green grids
- Zoning
- Lot sizing
- Built form

Water quality
(Local waterways and the Great Barrier Reef)

- Pollutants: nutrients, sediment
- On-site or end-of-pipe treatment
- Diffuse and point source
- Multiple benefits infrastructure

Healthy, liveable communities

- Amenity
- Passive and active recreation
- Tree canopy
- Active transport

Design elements for streets

Design elements are landscape, water servicing and other features that can be incorporated into master plans, streetscapes and lot designs.

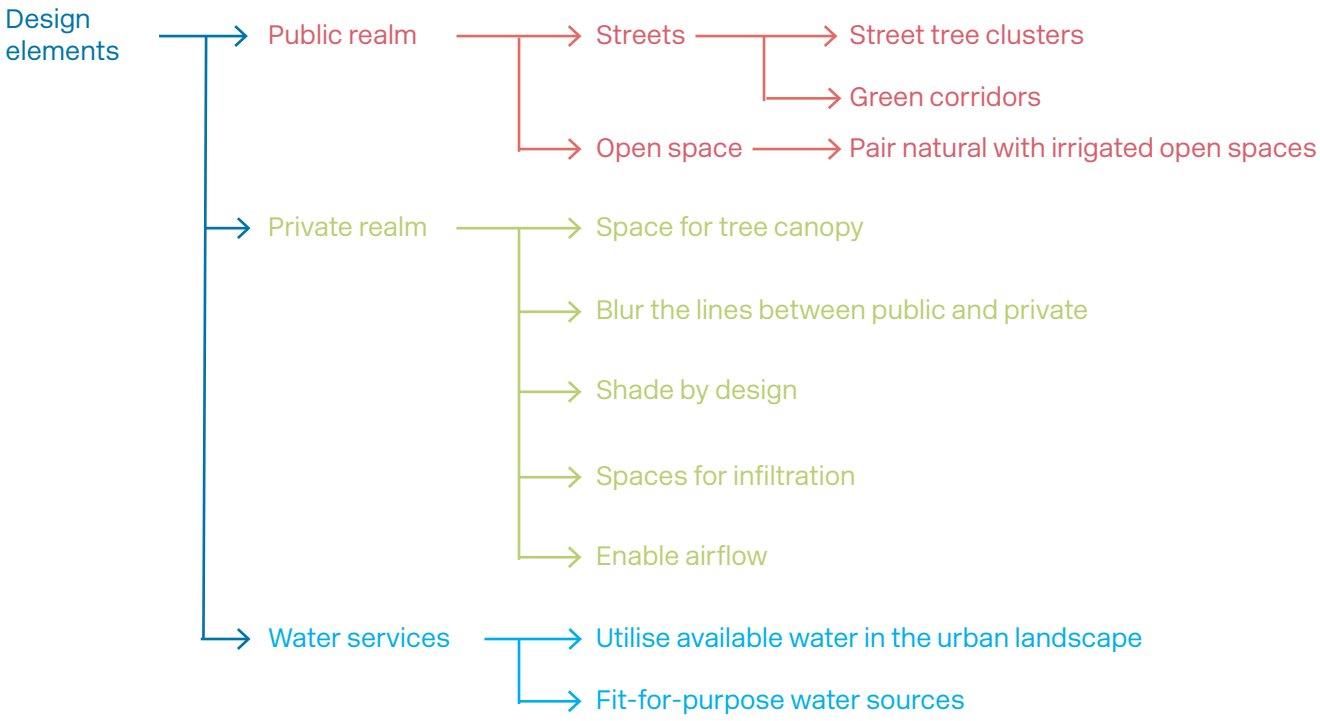
If these elements can be consistently incorporated across Townsville's growth areas, they will have a cumulative effect of developing a water sensitive urban forest.

The design elements are informed by:

- existing development typologies in Townsville.
- ideas generated at the workshop.
- research evidence and case studies.

These design elements can be loosely grouped for application to the:

- **public realm** of the street corridor, encompassing local parks and verges
- adjacent **private realm**, such as building design or open space design
- provision of **water services** to support green infrastructure at the local level.



1. Street tree clusters

- Green streets are typically thought of as boulevards. While effectively providing shade and amenity, boulevards are not particularly natural, and should not be the only form that green streets take.
- In Townsville, trees are observed in clusters in the natural landscape, providing individual trees with protection against wind, heat and floods.
- This natural template provides an alternative street design, by clustering large and small trees together to provide canopy cover.
- Where used in Townsville, verge lawns can also extend into the street profile to further reduce impervious surfaces.
- This approach can be applied using breakouts interspersed with car parking spaces and cross overs.
- Clusters provide areas to direct and concentrate road runoff, offering effective WSUD and passive tree irrigation.
- If the objective is canopy cover, species other than natives should be considered in the mix.

2. Streets as green corridors

- Streets are a key structure to host and link green fragments in urban areas. These green fragments include pervious areas, tree canopy, green corridors, and parks.
- When viewed as linkages, streets can be used to establish continuous 'cool lines' between 'first' (home), 'second' (work) and 'third' (parks, cafes, shops) places. These cool lines enable citizens to navigate the public realm in a more protected manner, against the sun and heat, while also providing a treatment to a major land use category (roads) to reduce the overall impact of the heat island.
- Green streets also increase buyer appeal.
- When designed as green corridors, local streets may:
  - have contiguous tree canopy
  - be wider to allow for placement of green spaces, trees and services without conflict
  - provide critical drainage and floodways during the wet season, by acting in unison with other green areas to infiltrate or temporarily store stormwater and floodwater
  - use the grade and cross fall can help to direct road runoff to green areas and passively watered streets trees.

3. Space for tree canopy

- Trees are key to shade. But this is only possible if trees remain healthy and have the opportunity to grow to full size. Healthy trees need sufficient space. Currently, trees compete with above and below ground services for space, resulting in landscape design in new development reverting to shrub species that do not provide shade.
- Above ground space includes air space that the tree canopy can fill over time, while below ground allows for adequate root growth. Trees with structural cells help to support watering instead of just installing root barriers. The key is to provide the right growing conditions for large shade trees.
- It also includes multi-layered canopy using upper and mid storey vegetation to provide shade.
- In Townsville it is important to first ameliorate the soil, to promote deep root growth. This will allow trees to become effective pumps to put rainwater back into the soil.

4. Pair natural with irrigated open space

- This refers to a more sustainable landscape approach that intentionally uses natural areas that brown-off in the dry seasons.
- Natural areas are integrated with irrigated space facing high traffic areas or other community infrastructure.
- The community continues to enjoy the high quality space it is accustomed to, with the ability to interact with the natural areas.
- During the wet season, the natural areas provide flood storage and infiltration, and will 'come alive' as water regenerates the vegetation and other biota.

5. Blur the lines between public and private

- Approaches from the MODE development can be adopted and scaled up. The private open spaces at the front of lots are actively used by MODE residents and merge with the street to create a single experience.
- In a master planning approach, this emphasises the value of smaller and distributed pocket parks that provide 'communal backyards'.
- The approach is often associated with a cul-de-sac street design which has lower car traffic, but could be adapted to some linear roads if verge or median space is provided.
- An intended outcome is that the public realm immediately in front of a house is valued and seen as an extension of private spaces, and as a result is adopted by residents who water and maintain it.

6. Shade by design

- Shade can be provided in numerous ways. The urban forest can be complemented by shade created by the built form, including car parking shade structures (which may incorporate sustainability features such as solar PV) or houses with verandahs and other shade features. Constructed window shading on houses for instance allows windows to be open but shaded for the afternoon breeze.
- In this way, the placement of green and grey together can provide complementary shading. An example of such an approach is to bring the 'green' and shade right up to houses, or to encourage shade trees on private land which also provide shade over high frequency pedestrian routes in the street.
- A development manual for new estates could reference these designs.

7. Spaces for infiltration

- Impervious spaces at lot level are critical for managing stormwater impacts and combating the urban heat island effect. Simple design approaches that consider materiality (e.g. driveways) and layout (e.g. green easements and setbacks) provide practical options. On-lot green corridors are provided (for parking or other uses) through house siting on the block.
- A strip driveway is a return to older styles. As a greening element, it is affordable and practical and could feature in design guidelines for new estates.
- Curb and channel in streets can adopt permeable pavement technologies.

8. Enable airflow

- House designs with garages and front yards that can be opened up as secondary living spaces, allowing natural airflow into the house and social interaction with the street.
- Flood freeboard creates airflow.

9. Utilise available water in the urban landscape

- Wherever possible, harness water that already exists in local landscapes to help maintain the health of green infrastructure. These sources will be supplementary to other, formal irrigation, but contribute to the aggregated supply.
- Examples may include:
  - roof runoff directed to gardens
  - road runoff directed to tree roots and swales
  - air conditioner condensate directed to gardens
  - harvesting drainage base flows from local and regional drainage assets. For instance at North Shore there is a permanent trickle of water from the green spine into the wetland which is recirculated to irrigate the green spine itself.

10. Fit-for-purpose water sources

- The concept of fit-for-purpose water will be key to keeping Townsville green and achieving its sustainability outcomes.
- By matching the water quality of a source with an appropriate end use, it is possible to keep the highest quality water for critical drinking needs, without sacrificing outcomes due to water availability. This is achieved by reusing sources such as recycled water wherever possible.
- In addition to water security, this approach can reduce the discharge of wastewater and stormwater to the Great Barrier Reef and help meet evolving water quality regulations.
- Many cities find it difficult to begin a large scale recycled water scheme because they do not have a pre-existing demand to justify the investment. In Townsville, the urgency of the water security challenge, together with the community expectation of a green landscape, largely addresses this challenge.
- Recycled water from the Mount Saint John Wastewater Treatment Plant provides such an opportunity.
- Rainwater may also be used in a strategy to retain rainwater to take the peaks off storms, with water reuse as a bonus. If stormwater discharge can be distributed over 48-72 hours, peak flows can be reduced and the size of end-of-line stormwater systems can be reduced.

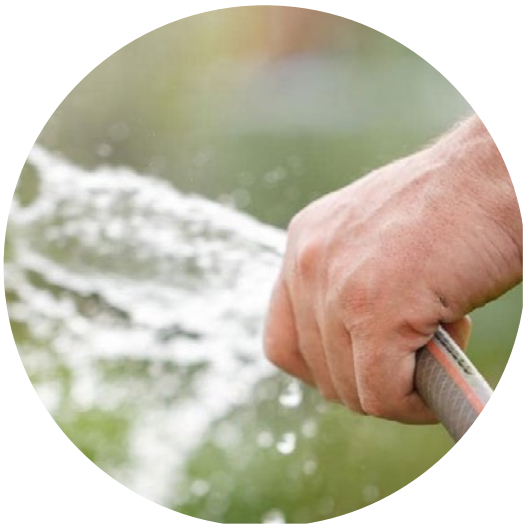


Image credit: Townsville Bulletin.

Rainwater tanks to delay stormwater peaks – Aquarevo Case study

Aquarevo is an urban residential development located in Melbourne.

The development includes 460 residential dwellings on a 42 ha site that have been designed as a precinct scale demonstration of best practice water management.

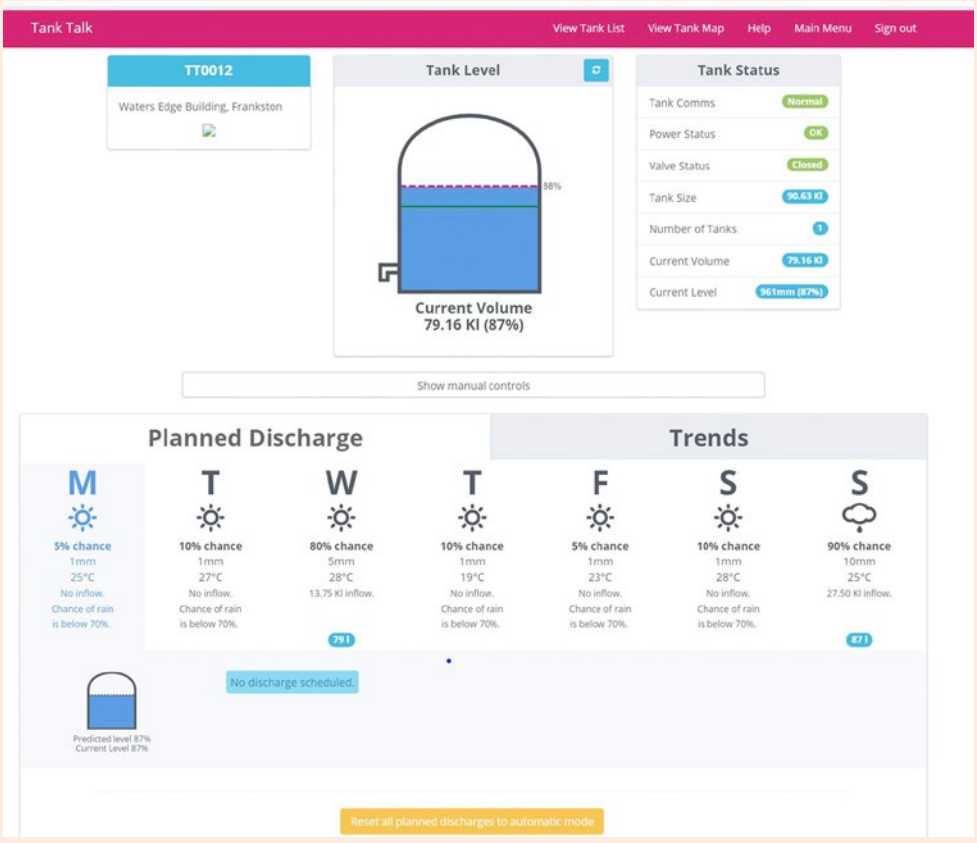
Aquarevo showcases a number of technologies developed by South East Water's product innovation arm, iota Services. These innovations include rainwater tanks with Tank Talk® technology that receives weather forecasts and then releases water before heavy rainfall.

Read more about Aquarevo here: https://watersensitivecities.org.au/content/aquarevo-case-studys-mart-model-for-residential-water-management/

In this way the entire development can 'anticipate' rainfall, so that each house's rainwater tank can be pre-emptively emptied, creating a large, cumulative storage space to capture new rainfall. This alleviates peak flows in local stormwater systems, providing flood mitigation.

As a result of this, and other initiatives, Aquarevo is planned to achieve:

- up to 70% reduction in potable water use in homes compared with the average household
- 1 million litres of rainwater storage capacity created in the network of household rainwater tanks
- 25% reduction in peak stormwater runoff flows to reduce to the risk of local flooding.



TankTalk web interface showing water levels, weather forecast and actions. Image credit – iota.com.au.

Contribution to the water sensitive Townsville vision

The following table considers the possible outcomes of each design element, and its role in achieving the water sensitive city vision for Townsville.

	Heat	Amenity	Waterways	Water Efficiency
Street tree clusters	✓✓	✓		
Green corridors	✓✓	✓✓	✓✓	
Pair natural and irrigated open spaces			✓✓	✓✓
Spaces for tree canopy	✓✓	✓✓	✓	
Blur the lines between public and private		✓✓		
Shade by design	✓	✓		
Spaces for infiltration	✓	✓	✓✓	
Enable airflow	✓		✓✓	
Utilise available water in the urban landscape		✓✓	✓✓	✓✓
Fit-for-purpose water sources			✓✓	✓✓

Ratings are qualitative, and highlight which liveability outcomes each design element provides:

✓✓ Strong contribution

✓ Partial contribution

Little to no contribution

Applying the design elements in a master plan

This approach uses the urban forest objective as a frame for a master plan, instead of basing it on a street network:

1. Use natural waterways as a template from which to begin, and make linkages to these natural assets.

2. Decide whether stormwater will be used for infiltration (into deeper soil profiles for recharge) or passive irrigation (into a sub soil layer for irrigation of local green infrastructure). This will consider local soils and availability of water supplies such as recycled water.

3. Provide additional green spaces:
   - In addition to open space requirements, develop a 'budget' for infiltration spaces, if this is your objective.
   - Diffuse the open space. Instead of one large park, use multiple smaller parks.

4. Choose locations for these green spaces:
   - Select locations based on cooling, infiltration and community access.
   - Consider water security. Main roads have easements that create opportunities for recycled water supplies.
   - Look for passive watering opportunities that direct stormwater runoff to vegetation. Master planning can enhance these opportunities by co-locating green spaces with points of stormwater concentration.

5. Connect these green spaces into a network. Enhance the linkages themselves to be multifunctional:
   - Streets are key links that can be enhanced as green corridors.
   - Design the connections to enable movement of people (active transport), biodiversity (ecological corridors) and/or stormwater (drainage pathways).
     - Active transport corridors provide connection between spaces used by the local community, as well as a hierarchy of mobility access.
     - Habitat corridors link to local or regional green and blue spaces such as river corridors or remnant vegetation areas.
     - Stormwater flow paths allow water to connect with the bigger floodplain.

6. Place medium density development next to the green spaces to achieve yield targets:
   - A benefit of greening is to facilitate a density uplift adjacent to waterways (natural or constructed), green corridors and parks.
   - This creates water reuse opportunities from roofs, rainwater tanks and air conditioners.

Local road: Greening solutions

At a local road scale, the urban forest provides a greener, cooler environment. Shade is provided for parking and walking, and to reduce the heat load on the built form.

The lines differentiating the private lot, verge and carriage way become blurred. Tree canopy is enabled by considering public and private open spaces together as a single urban landscape, and streets as part of a wider green grid. The result can be shaded, lush, 'cool lines' that provide connected shaded areas for active transport through a suburb.

House design can respond to this opportunity with facades that can be opened to the street to allow airflows and social interaction with street.

local road - water-sensitive

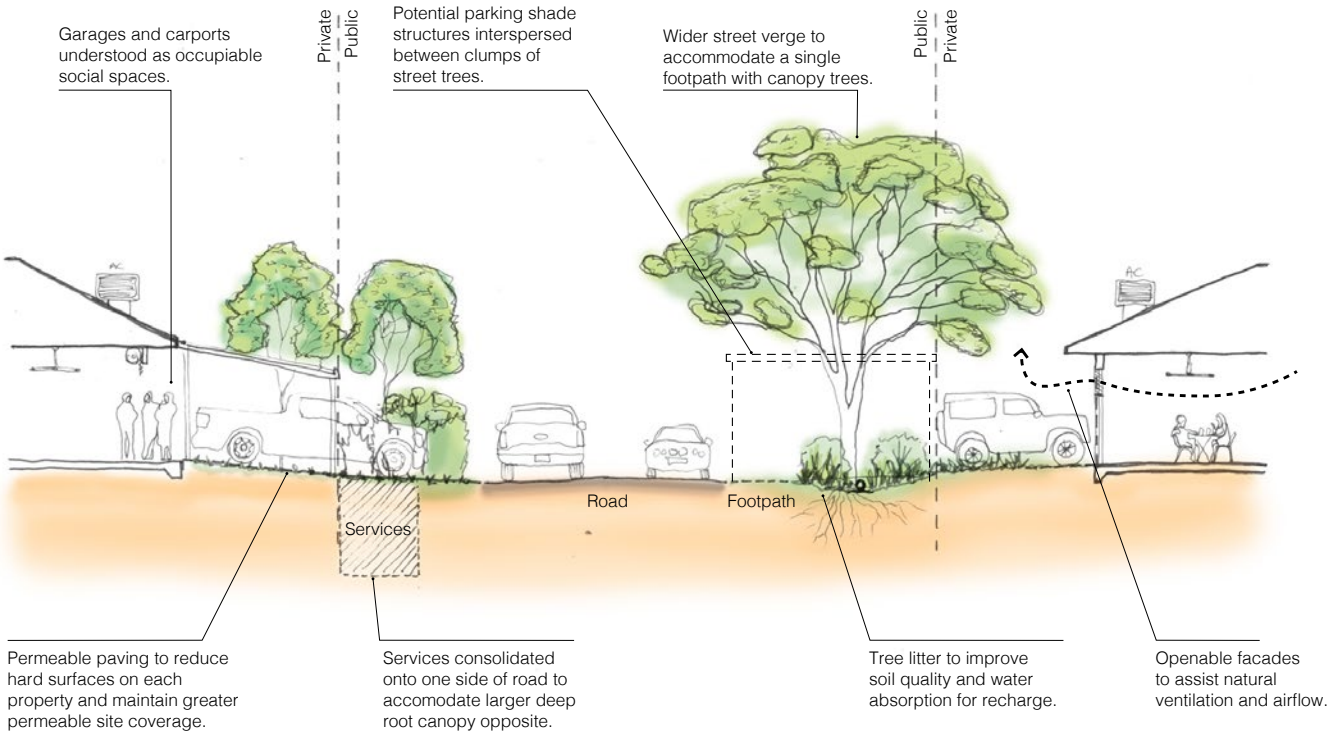


Image credit: Monash Urban Laboratory.

Plan view: Greening Solutions

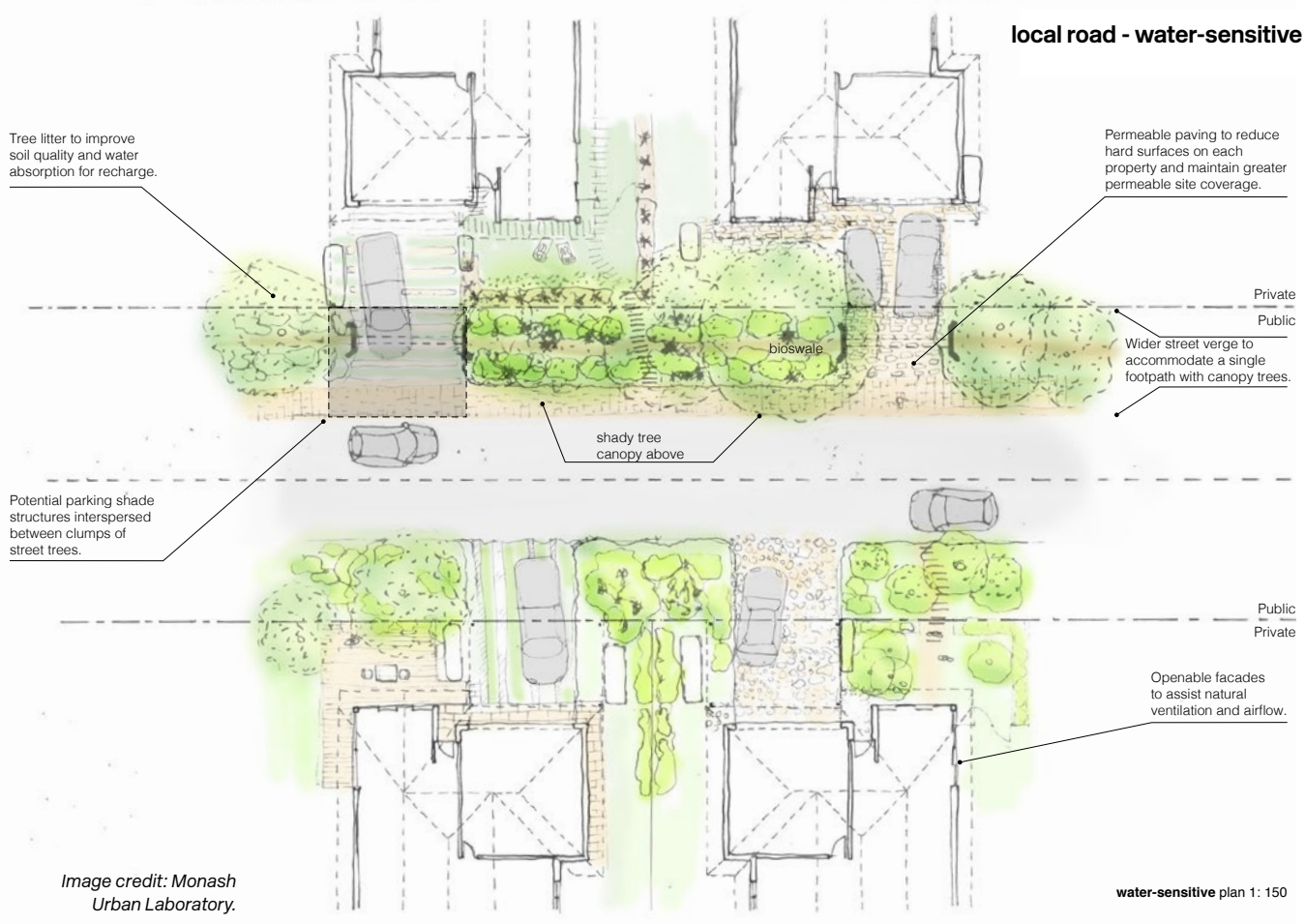


Image credit: Monash Urban Laboratory.

Local road: Water solutions

The green infrastructure requires water. In a water sensitive Townsville, where rain is highly seasonal, the urban form becomes the source. Novel sources such as roof water, base flows in the drainage network and air conditioning condensate potentially provide highly localised water sources. Together, these sources can provide, or supplement, irrigation to maintain an urban forest. This can be complemented by centralised sources, such as recycled water as required (not shown).

local road - water-sensitive

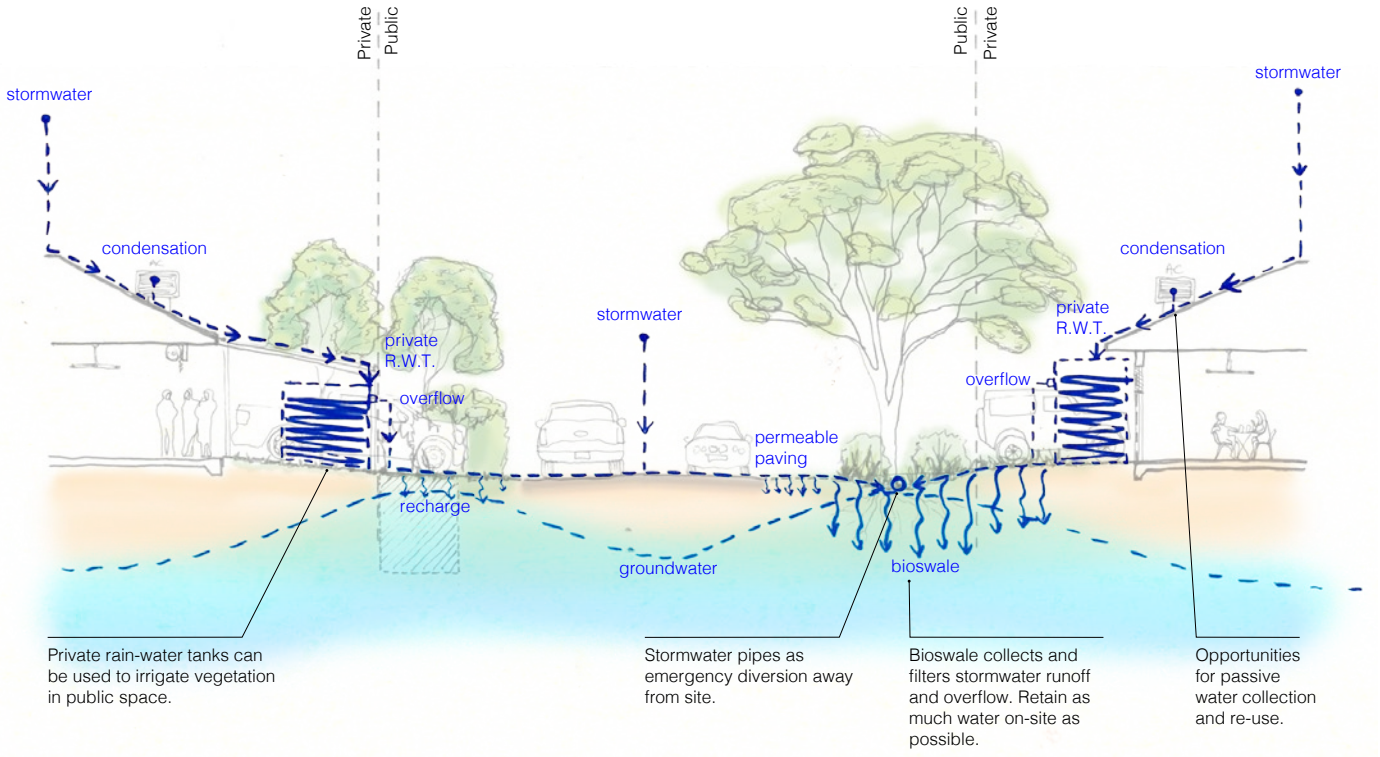


Image credit: Monash Urban Laboratory

water-sensitive section 1: 100

The new landscape also has spaces to infiltrate stormwater.

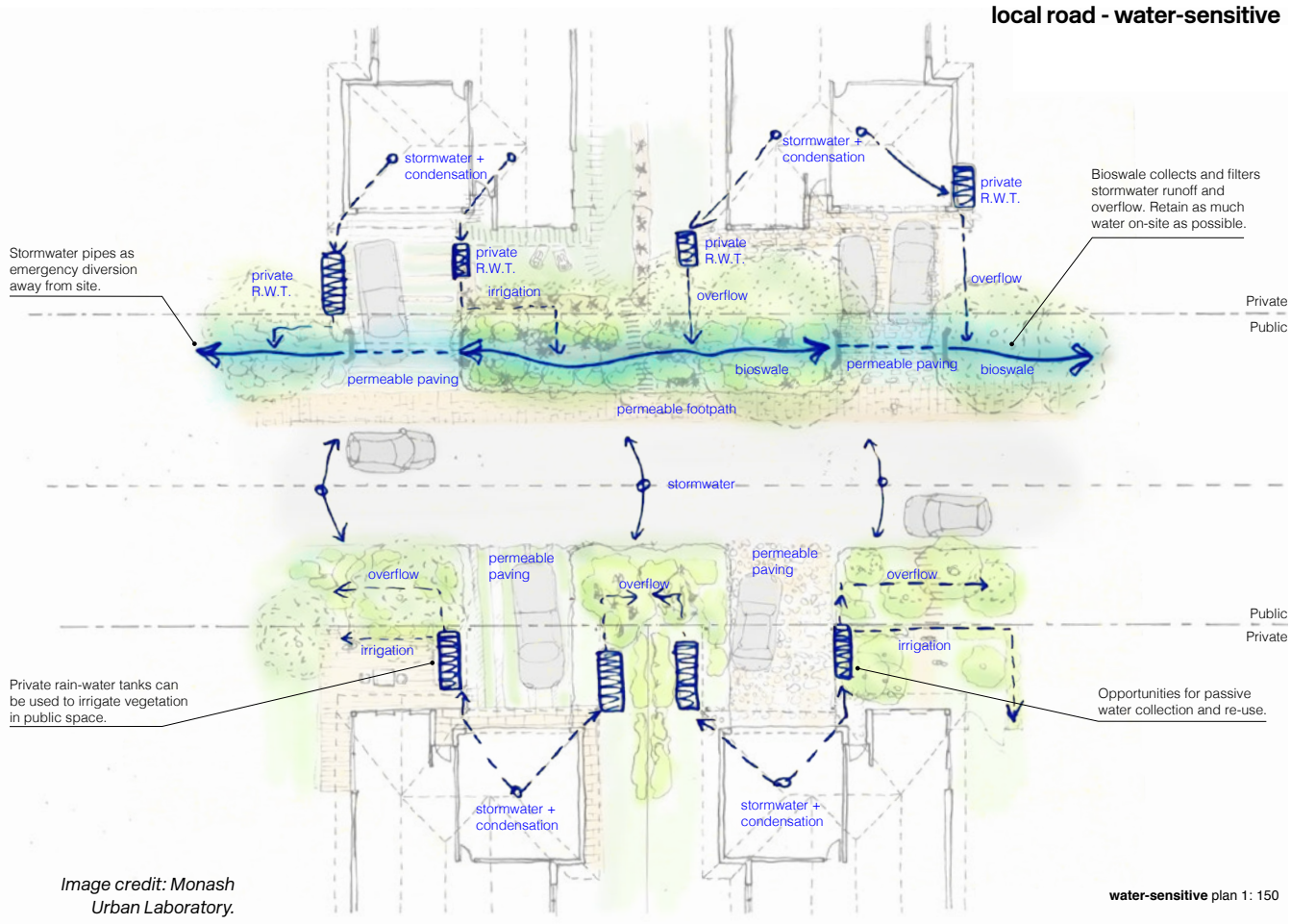


Image credit: Monash Urban Laboratory.

Plan view: Water solutions

Concluding remarks

In 2017, the CRCWSC helped Townsville develop a vision for a water sensitive future. This highlighted the opportunity to create a city that attracts new businesses and residents by being sustainable, resilient and liveable, based on a new view on water.

Managing growth will be key to achieving the water sensitive vision. Decisions made about urban development, and how this growth is serviced, will fundamentally shape the city's water footprint.

The ideas in this report demonstrate how the vision for a water sensitive Townsville can be achieved on the ground, in greenfield growth areas. It is not a comprehensive list of all the actions required. Instead the ideas focus on opportunities at the intersection of urban planning and water servicing.

The ideas demonstrate the concepts of a city as a water supply catchment (local water used to enhance liveability and sustainability), a city providing ecosystem services (using a green grid to manage stormwater and mitigate urban heat) and a water sensitive community (engaging citizens in water sensitive behaviours). These are the basic tenets of a water sensitive city.

The result can be described as an urban forest. It provides a way to manage stormwater, reduce irrigation demand for public open space and harness recycled water to reduce wastewater discharges. It also activates local streets to benefit the communities who live there, while providing resilience to emerging threats such as heat waves.

To deliver the urban forest, urban planners can provide the underlying structure for green infrastructure, locating green grids with water outcomes in mind and adopting designs that provide the water functionality (such as space for services or flood flow detention). The input of water managers follows; the urban forest is otherwise unsustainable.

The ideas that build this urban forest have been selected specifically because they are achievable in Townsville. They comprise elements borrowed from past and current practice, and then rearranged to create new ideas. Multiple examples of each element can be seen throughout Townsville. With these precedents established, the question is not whether the ideas will work, but how to get the most benefit by incorporating them as consistent design principles in water and urban planning.

Opportunities

1. A TDesign guide that includes an urban forest. As a minimum this should list an urban forest as an outcome, and ideally will provide guidance on how it could be achieved. The design approaches suggested in this document could inform this guide.

2. A TCC policy for an urban forest, including a target based on an agreed and measurable metric, that provides direction to urban planners, water managers, the development sector and community alike. This will address issues at the nexus of an urban forest such as water security, the role of natural and artificial greening and the multiple benefits that an urban forest can provide.

3. Community engagement during the development of this policy and target, primarily to understand community aspirations and priorities for an urban forest.

4. Further research and investigation into tree species selection and soil management for the dry tropics. It is possible that other regional cities in the region may collaborate in this action.

5. Collating cases studies, pilots and lessons from other cities which have implemented an urban forest strategy, accompanied by translation of these lessons to Townsville's context.

6. Develop the business case and narrative for an urban forest, highlighting the multiple benefits it can provide.

CRCWSC Research Synthesis

Discussion Paper | CRC for Water Sensitive Cities

CRC for Water Sensitive Cities

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