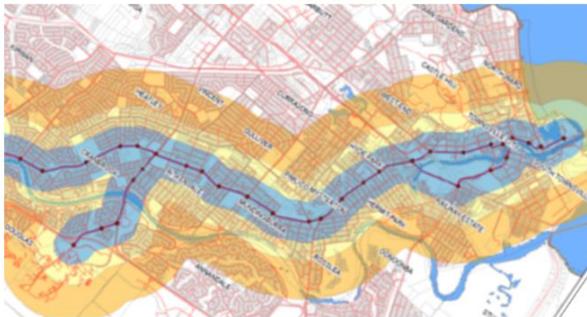


TOWNSVILLE METRO: UNLOCKING URBAN POTENTIAL THROUGH IMPROVING A KEY TRANSIT CORRIDOR



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Executive Summary

Urban centres around the world are grappling with how to adapt and respond to the interconnected challenges of climate change, economic development and social inclusion. Fundamental to the solution is the ability of citizens to move around cities to access places of employment, education, healthcare and recreation. Design responses for new centres and urban renewal projects require collaboration and co-creation across governance levels and involving partnerships across multiple parties spanning designers and developers through to end-users. In 2016, the federal government launched *City Deals* as a new partnership mechanism to create productive and liveable cities, with Townsville being the first 15-year commitment involving planning, reform and investment for the city.

The Sustainable Built Environment National Research Centre (SBEnc) is working with government and industry partners to enquire into procurement strategies and technologies that enable urban renewal in Australian cities. Through *Project 1.62 – Sustainable Centres of Tomorrow*, a place-making evaluation framework has been developed to inform project-specific business cases as they may arise through a City Deal or other ventures. Using the framework, trackless tram technology is being evaluated in several case study sites around Australia (Melbourne, Sydney, Perth), as an emergent transport catalyst to 'unlock the urban potential' between and around urban 'nodes' (i.e. transit stops). The technology has been identified as a potential breakthrough in enabling value-uplift and developer appetite, alongside and building on efforts to improve public transport uptake. Proponents advocate features including stable-riding, solar-powered battery-operation, tight turning-circles and a capital cost at one-tenth of light rail infrastructure.

Priorities within the Townsville City Deal include *urban renewal and revitalisation*, and *delivery of new transit facilities that enhance amenity and lifestyle* towards a *prosperous and highly-liveable city for residents and visitors*. Inspired by other case study sites within Project 1.62, the Townsville Tropical Intelligence & Health Precinct (TropiQ) [earlier known as Townsville Health and Knowledge Precinct (THKP)] collaboration has joined the SBEnc research partnership to explore the potential for renewing and revitalising one of the main corridors that connects the city's residents with education, health and retail services along Flinders Street, Charters Towers Road and Ross River Road. This study forms part of Project 1.62, drawing on a range of prior investigations into urban renewal in Townsville which has created a significant foundation of local, state and federal reports on which to draw upon. The study also acknowledges ideas that have been documented and/or discussed, regarding the concepts of *Smart Link* and *Townsville Metro*.

The THKP partners are keen to evaluate the benefits of a mass transit system in the form of a transit-oriented development (TOD) corridor interconnecting the CBD and TropiQ via Charters Towers road, Ross River Road and Nathan Street. Consideration can also be given to extending along Ross River Road to Thuringowa Central.

The document structure is adapted from a methodology long-used for community consultation, known as *Collective Social Learning* (Brown, 2008; Keen, Brown, & Dyball, 2005), to report on findings and potential steps for creating people-oriented, place-based centres along the proposed TOD:

- **Section 1:** Introduction
Formal plans for the future of Townsville ('*what should be*')
- **Section 2:** Stakeholder Engagement
Existing context according to key stakeholders in and around Townsville ('*what is*')
- **Section 3:** Transport, **Section 4:** Socio-economic impact, and **Section 5:** Risk Assessment
Evaluation of possible opportunities for urban renewal ('*what could be*')
- **Section 6:** Conclusions and implications
Implications for next steps for urban renewal developments ('*what can be*')

The project acknowledges the contributions of key stakeholders in project consultation (in alphabetical order), including: Department of Defence (DoD), Department of Housing and Public Works (DHPW), Department of Transport and Main Roads (TMR), James Cook University (JCU), Stockland Retail Townsville (Stockland), Townsville City Council (TCC), and Townsville Hospital and Health Services (THHS).

In Project 1.62 the *Place-Making Framework* is being applied through several case studies in Australia. All seven principles within the Framework (Table E1, Items 1-7) have been applied to this Townsville case study to examine priority design consideration demonstrating a strong commitment to inclusive, integrated place-based planning processes. The resultant suite of priority design considerations for unlocking potential along the above-mentioned corridor are summarised below each of the principles.

Table E1: Place-Making Framework design prompts: Flinders St - Charters Towers Rd – Ross River Road TOD corridor in Townsville

| | |
|--|--|
| <p>1. Precinct safety and accessibility: <i>The development should be safe and healthy for people waiting to access transport nodes</i> [Human centred design Walkable urban design Place and movement design]</p> | |
| <ul style="list-style-type: none"> ▪ Safe and accessible connectivity to nodes ▪ Cool and comfortable (shelters, pathways) ▪ Safe, natural and open spaces | <ul style="list-style-type: none"> ▪ Frequent and integrated ▪ Resilient (supporting economic recovery) |
| <p>2. Carbon neutral - positive approach: <i>The development should aim for carbon positive, being at least zero carbon, in both power and transport</i> [Solar passive design Solar active design Carbon neutral analysis]</p> | |
| <ul style="list-style-type: none"> ▪ Solar powered with energy storage ▪ Low carbon transport approach ▪ Hydrogen fuel cell vehicles | <ul style="list-style-type: none"> ▪ Sustainable urban design ▪ Low embodied energy infrastructure |
| <p>3. Local shared mobility: <i>The development should encourage diverse local modal services to access the transit service, with defined spaces</i> [Local mobility design Feeder transport design Mobility as a service]</p> | |
| <ul style="list-style-type: none"> ▪ Modernised systems – electronic ticketing ▪ Real-time data available to all | <ul style="list-style-type: none"> ▪ Walking/jogging/bike paths that connect housing to communal amenity |
| <p>4. Property diversity: <i>The density and urban mix should contribute to urban regeneration</i> [Community engaged planning Agglomeration economy analysis Financial modelling]</p> | |
| <ul style="list-style-type: none"> ▪ Robust and current survey data ▪ Mapped population clusters, by type | <ul style="list-style-type: none"> ▪ Long term planning considerations |
| <p>5. Property affordability: <i>The development should include diverse property options to provide affordable living as well as affordable housing</i> [Social housing analysis Life cycle assessment Sustainability operational analysis]</p> | |
| <ul style="list-style-type: none"> ▪ A mix of social and affordable housing lines (rent, purchase) ▪ Housing choice and diversity | <ul style="list-style-type: none"> ▪ Medium density residential housing |
| <p>6. Nature-loving and biodiverse spaces: <i>The development should include and connect biophilic and biodiverse greenspaces, supporting endemic species and habitat</i> [Biophilic design Water sensitive design Landscape oriented design]</p> | |
| <ul style="list-style-type: none"> ▪ Cool and comfortable ▪ Water sensitive design | <ul style="list-style-type: none"> ▪ Natural and open spaces along and connecting corridors |
| <p>7. Inclusive, integrated place-based planning: <i>Planning, design and implementation (operation, maintenance) should involve diverse stakeholders and all tiers of government, for an integrated place-based outcome</i> [Joined up governance analysis Partnership analysis Procurement option analysis]</p> | |
| <ul style="list-style-type: none"> ▪ Collaboration among key stakeholders ▪ Inclusive governance | <ul style="list-style-type: none"> ▪ Working across agencies ▪ Working in partnership with the community |

From the place-making assessment of transport and urban centres context it is concluded that trackless tram technology and the associated enhancement of stops (nodes) along the route would provide a urban renewal mechanism for helping Townsville's residents, visitors and student populations to connect with education, services and retail.

Successful adoption and uptake of the system will rely on:

- Timely delivery (by 2021) of the planned public transport improvements currently being rolled out by the Department of Main Roads, modernising ticketing and timetabling systems.
- Immediate capacity building and behaviour change work with Townsville residents and visitors to understand and improve the appetite for public transport use.
- Proactive planning (as outlined in the Townsville City Plan, 2014 and the Shaping Townsville Strategy) and approval adjustments to ensure urban development that meets the demand profile of apartment-based, high-rise living close to amenities and major public transport routes, rather than continuation of embedded patterns of low-density and isolated development within and around Townsville.
- Discussions herein with the major public transport operator in Townsville (Sunbus), with regard to future services and vehicle innovations.

From the assessment of socio-economic impact, it is concluded that there are people and place amenity opportunities, particularly considering transient population dynamics in Townsville. The Transit Oriented Development (TOD) value uplift study of land and property concludes a potential uplift in the order of 6 per cent (average), which indicates significant potential for benefits that could motivate investment in the area that has rich civic and commercial infrastructure, yet relatively low-density residential development. Such value uplift in property arising from such an activated corridor initiative could enable affordable and sustainable medium density development, providing an alternative to expensive and unsustainable urban sprawl.

In conclusion, this project provides a timely opportunity to commence next steps regarding the local context application of this innovative public transport option. A Trackless Tram System solution could: embed a reduction in energy demand; reduce private vehicle parking requirements at key destinations in Townsville; improve affordability (construction and operation); and create new land development value for investors and communities.

Considering the alignment of context to use Trackless Tram System as a catalyst for economic growth, Townsville has the potential to become a leader in evaluating this technology for integration within transport infrastructure in Australia and overseas. This could include James Cook University being part of the leadership group nationally, hosting a trial site for local evaluation of the technology and associated specifications. Such opportunities could be explored through the next steps in developing project-specific business cases that may arise through City Deals or other ventures herein.

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1. Introduction and project context

Australian cities are going through a transition, with a clear priority to make more integrated, productive, sustainable and liveable centres. Planning such people-oriented and place-based centres requires a deeper appreciation of land use mix and transport infrastructure. Key innovations around transport infrastructure such as solar, smart systems and autonomous transport technologies have emerged as mechanisms to unlock urban potential. The proposition, initially made in 2012 via the *Smart Link* concept and now through the Tropical Intelligence & Health Precinct (TropiQ) deliberations about a *Townsville Metro* system, is that a future-oriented multi modal transit corridor of high amenity could be created between the four primary centres of employment and visitation: Central Business District; Aitkenvale (retail Centre); Thuringowa Central; and Douglas (JCU, TTH and ADF).

The aim of this study is to evaluate the potential urban renewal and development benefits of – in this case a Trackless Tram System – corridor along Sturt Street, Charters Towers Road, Ross River Road and Nathan Street between the CBD bus hub and two key locations within the polycentric city: 1) the Tropical Intelligence & Health Precinct (TropiQ); and 2) Thuringowa Central. Through applying the place-making framework and a value uplift study, the study provides an opportunity to reflect on next steps towards enabling thriving urban centres, unlocking such potential in this North Australian city.



Figure 1: Trackless tram example (fully electric Irizar ie tram used on the Amentis Network for Amiens Metropole France operated by Keolis (Photo credits: Marie Verschuer)

The case study builds on previous research by the Sustainable Built Environment National Research Centre (SBEnc), which developed a *Place-Making Framework* to consider best practice principles, tools and governance models that could help accelerate the transformation of urban centres into being more people and place-oriented. This report considers the suitability of the corridor for improved transportation using this framework and seeking local stakeholders' insights regarding an integrated transit system solution. The report structure draws on the collective social learning methodology developed by Prof Brown (Brown, 2008) with the focus of each section shown in italics:

- **Section 1:** Introduction
Formal plans for the future of Townsville, drawing on the city's context (*'what should be'*)
- **Section 2:** Stakeholder Engagement
Existing capacity for development according to key stakeholders in and around Townsville (*'what is'*)
- **Section 3:** Transport, **Section 4:** Socio-economic impact, and **Section 5:** Risk Assessment
Evaluation of possible opportunities for urban renewal (*'what could be'*)

- **Section 6:** Conclusions and implications
Implications for next steps for urban renewal developments (*'what can be'*)

1.1 Background to Townsville City

Townsville is the largest city in regional Queensland and Australia's 14th largest city, with a population of approximately 190,000 (Australian Bureau of Statistics Estimated Resident Population, 2018). It is estimated that by 2041, Townsville's population will increase to approximately 282,000 people (Queensland Population Projections, 2018 edition). The city is often referred as the second capital of Queensland, and a polycentric city with multiple nodes of activity as highlighted in the Townsville City Plan (2014).

As the largest centre in Northern Australia, Townsville has a key role in administration and servicing the North Queensland Region. According to the Northern Queensland regional plan there is a significant opportunity to establish itself as the capital of the Northern Australia in the future. Its location as a well-serviced centre within the tropics, with ready access to national and international destinations, is increasingly making Townsville a preferred hub for a range of training activities and sporting and vocational pursuits for specialised employment needs. This context creates several aspirations for Townsville such as (North Queensland Regional Plan, 2019):

- **A leading economy in regional Australia:** To position the North Queensland region as a leading regional economy over the next 25 years capitalising on its diverse industry base and numerous competitive advantages.
- **A rich and healthy natural environment:** To protect and sustainably manage the region's natural assets and ecological processes that support them to maintain a unique environment.
- **A connected and efficient city:** To support region's communities and economic resources by developing resilient infrastructure and transport network that moves people and freight efficiently.
- **Liveable, sustainable and resilient communities that promote living in tropics:** To ensure growth occurs in a consolidated and connected urban settlement pattern, and to create liveable and sustainable communities that respond to the region's tropical climate and seek to increase resilience to natural hazards.

Townsville has a diverse regional economy which is supported by several industry sectors, however the majority of jobs (approximately 50 per cent of all jobs) are in four industry sectors, comprising health care and social assistance, public administration and safety, education and training, and retail trade (idcommunity, 2016). According to Economic Development Queensland (2018) the knowledge intense sectors account for almost 39 per cent of total employment with jobs in health and education increasing. Relative to Queensland, Townsville's performance in knowledge intense sectors and occupations is driven by health and education (Economic Development Queensland, 2018). The North Queensland Regional Plan highlights the importance in Townsville's traditional industries such as defence, manufacturing, and tourism in addition to the health, knowledge and renewable energy sectors (North Queensland Regional Plan, 2019).

Townsville has invested in multiple knowledge intense clusters, which are diverse in their scale and composition. Two prominent examples include the Central Business District (CBD) and the Tropical

Intelligence & Health Precinct (TropiQ)¹ (Townsville demographics and psychographics study, 2018). The Townsville Hospital and Health Service (THHS) is a major employer and economic driver in the region with one in 17 local people in paid employment working for the service. In 2018, the THHS contribution to the regional economy is in the order of AUD\$1.9 billion in output, including AUD\$958 million in wages and salaries to regional households. THHS have also supported the State Government to deliver on community objectives by completing, commencing and committing to capital projects with an estimated value of AUD\$76.5 million (Townsville Hospital and Health Service Annual report, 2018). Additional knowledge intense clusters are also identified at the Garbutt/Townsville Airport and Hyde Park and Pimlico.

This clustered approach to developing Townsville builds on its existing polycentric character noted above. Polycentric city planning can drive significant benefits when nurtured as an ecosystem of collaborative or complementary clusters. However polycentric city planning, and design can be detrimental if clusters are isolated or adversarial. Improving physical connectivity, particularly transport connectivity is a major factor in achieving successful polycentric city outcomes. Furthermore, and as a connected narrative, overcoming low-density dispersed land use forms is a major factor in enabling polycentric land use patterns, particularly in regional centres (Townsville Health and Knowledge Precinct, 2018).

1.2 Key future-looking reports

Considerations relating to unlocking urban development potential in Townsville are summarised here, noting relevant key findings and recommendations that span national, state and local agencies. These reports are then referred to in the following section on *Applying the Place Making Framework*:

Federal Reports

- **Townsville City Deal Annual Progress report (Australian Government, Queensland Government and City of Townsville 2019)**

The City Deal 2018 Report highlights progress of the Australia’s first City Deal to deliver its Smart Cities Plan, across the three levels of government and the local community. By 2030 the Townsville City Deal (TCD) intends for Townsville to become: Innovated and Connected City (Economic Analysis to Support the Health and Knowledge Development Strategy for Townsville City Deal). In addition to the now-completed Stadium, it notes key achievements in 2018 (Table 1).

Table 1: Key achievements under the City Deal in 2018 (Townsville City Deal Annual Progress report, 2019)

| Initiative | Brief description |
|---|--|
| Launch of the Townsville Smart City Plan – Smart Townsville | Implementing the initial steps of smart Townsville. |
| Commencement of construction on Stage 1 of the Haughton Pipeline | Delivery of the Final Report of the Townsville Water Security Taskforce, and funding secured for Stage 2 of the Haughton Pipeline subject to the outcomes of a business case assessment. |
| Funding confirmed for the Port of Townsville Channel Capacity Upgrade | Construction of the \$193 million project approved. |
| Establishment of the Townsville Industrial Development Board | Acceleration of the State Development Area to explore opportunities for new industrial development. |

¹ The “Townsville Health and Knowledge Precinct” was renamed the Townsville Tropical Intelligence & Health Precinct (TropiQ) in December 2019.

| | |
|---|---|
| Funding confirmed for the preservation of the Townsville Eastern Access Railway Corridor. | This Report provides further details on these achievements and progress of all 16 commitments under the City Deal throughout 2018. It can be read in conjunction with the first Annual Report to provide a complete picture of progress since the signing of the City Deal. |
| Commitment 7: Public Transport Solutions of City Deal | Key achievement includes the opening of the Townsville City Bus Hub, coinciding with the introduction of a new network-wide bus timetable to facilitate more people to use public transport and travel to the CBD. Townsville City Bus Station was opened in May 2019. The CBD Bus Hub aims to enhance public transport to and from the city, provide better pedestrian access to the city heart and link the new North Queensland Stadium. |

A significant future outcome targeted for delivery through this City Deal include a Health and Knowledge Strategy for Townsville. The intent is to increase investment in Townsville and the region's knowledge, health and education economy, capitalising upon Townsville's existing assets and institutions.

- **Vision and Transition Strategy for a Water Sensitive Townsville (Australian Government, 2018)**

The CRC water sensitive cities report provides insights on establishing platforms that will support collaboration across diverse stakeholders to drive new solutions for a range of issues associated with water sensitivity.

- **Townsville Queensland Solar City Final Report 2006-2013 (Australian Government, 2013)**

The Solar City project established that by encouraging behaviour change and energy efficiency, customers could enjoy the same lifestyle while reducing costs and having a smaller impact on society's resources – doing more for less.

State Reports

- **North Queensland Regional Plan – Draft (Queensland Government, 2019)**

The draft North Queensland Regional Plan is a 25-year strategic, statutory planning document for the local government areas of Burdekin, Charters Towers, Hinchinbrook, Palm Island and Townsville. This report highlights the importance of strengthening support for improvement to the high-frequency transport link between the Townsville CBD, Townsville University Hospital and JCU, and support for local governments in their planning with the state government on key infrastructure projects for the region. In addition, it notes that significant redevelopment of the Townsville CBD is being driven within the Townsville City Waterfront Priority Development Area (PDA) which includes the stadium.

- **Northern Queensland Regional Transportation Plan (2020)**

This plan covers all modes of transport with a focus on the networks and services in the region, and the inter-regional and international connections that are vital to the region's social and economic prosperity.

- **Townsville State Development Area Development Scheme (2019)**

This scheme highlights the importance for the Townsville State Development Area to support economic development and job creation in a way that addressed environmental, cultural and social issues as well as considering existing industry and surrounding infrastructure within the region.

- **Department of Housing and Public Works Annual report (2017-2018)**

This report highlights the importance of safe, secure, affordable and accessible homes to promote property diversity and affordability in Townsville. In addition, improving housing assistance, delivering tenant engagement and support, reducing homelessness, delivering regulatory services and reform are considered as key priority areas to offer inclusive housing solutions for the local community.

- **Queensland Housing Strategy 2017-2027 (Queensland Government, 2017)**

This strategy provides a 10-year framework for driving key reforms and targeted investment across the entire housing continuum. The Housing Strategy is a long-term plan to embrace innovation and a commitment to make meaningful changes that lead to better long-term housing outcomes for Queenslanders.

- **Department of Transport and Main Roads (Annual report (2017-2018))**

This report summarises state-wide planning, managing and delivering an integrated transport network across road, rail, air and sea for the state. This includes the state-wide transport modernising plan which includes Townsville, extending and enhancing services to regional communities such as smart ticketing and access to real-time data.

- **Advancing our cities and regions strategy (Queensland Government, 2016)**

This strategy presents an innovative approach to renewing and repurposing surplus and underutilised state property to deliver better community outcomes, create jobs and drive economic growth. Two key actions related to Townsville urban renewal were highlighted as: 1) collaborating with TCC, Port of Townsville Limited and private industry to identify and drive catalyst projects within the Townsville City Waterfront PDA; 2) working with TCC, JCU and state agencies to progress the Smartlink concept. This report emphasizes significant redevelopment opportunities in Townsville.

Local Reports

- **Townsville city plan (City of Townsville, 2020)**

This plan highlights the CBD as core centre within the broad strategy and focusses on Aitkenvale, Thuringowa Central and Hyde Park, and new centres at Burdell and Julago, as major economic and community hubs. Mixed use development within these centres will enable functions to create a places to live, work, access services and recreate. New infill residential development will facilitate these targeted transitions. In addition, these changes will sustain an enhanced public and active (walking and cycling) transport network in the future. Specifically, Ross River Road will become an initial focus for public transport linking the CBD, Aitkenvale and Thuringowa Central major centres and the James Cook University-Townsville Hospital precinct. The online city plan and maps were used for the value uplift study in section 4.2.

- **Townsville City Council community insights report: Liveability study (Townsville City Council, 2019)**

This study highlights nature, open spaces and neighbourhood safety as the 'top three things' Townsville residents' value in their suburbs. Within the overarching liveability study, the Townsville City Council community insights report provides rich insights on areas of improvement (i.e.: active transport, public transport infrastructure, private vehicle infrastructure, accessibility). The results from the survey have given Council a clear way to prioritise investments and deliver works that align with what the community values (Townsville Liveability study, 2018).

- **Mobility in Townsville (Townsville City Council, 2019)**

TCC is committed to providing infrastructure that is accessible by all. To gather feedback on existing infrastructure, TCC in partnership with Spinal Life Australia, completed a 'Navability project' in August 2019. With modern mapping technology, an accessibility rating system was provided. The mobility maps show the effort required to navigate the route. The effort maps are relevant to the elderly, frail and walkers, as well as users of wheelchairs, strollers and mobility scooters.

- **Townsville Retail Information Sheet (2015)**

Townsville is positioned as the retail hub for North Queensland. The city provides extensive offerings to the direct population and services the high end and speciality needs of broader regional centres including the Burdekin, Charters Towers, and Hinchinbrook. With Townsville's population set to reach 300,000 within the next 20 years and high household income levels, further regional growth will drive demand for new shopping attractions.

- **Townsville Integrated Transport Plan (2019)**

Key findings of the travel survey indicate that Townsville has one of the highest private vehicle mode shares, at 84 per cent. This is generally consistent with the 89 per cent mode share recorded by TMR's Household Travel Survey for Townsville in 2010. Active (walking and cycling) and public transport modes accounted for a combined 15 per cent of total mode share, with active rather than public transport currently considered to be more suitable for travelling around Townsville. The top five travel destinations on a weekday were identified as 1. Townsville CBD; 2. Aitkenvale; 3. Kirwan; 4. North Ward; and 5. Garbutt.

- **Energy Transformation Townsville report (2015)**

Through the energy transformation Townsville project TCC have accomplished significant increase in energy efficiency across a range of sites and within the community through success energy initiatives.

- **TropiQ Townsville Tropical Intelligence and Health Precinct: Economic Impact Assessment (AEC Group 2019)**

TropiQ is an AUD\$5.9 billion development of a tropical intelligence and health precinct, housing JCU, THHS and range of other health, education research and innovation enterprises. These entities significantly contribute to the North Queensland economy by AUD\$3.5 billion economic output and approximately 16,000 jobs. This report provides an analysis of the direct and flow-on economic impacts of The Precinct's construction and operations to the Townsville LGA economy and identifies the supporting economic activities.

- **Townsville City Waterfront Priority Development Area (PDA)**

Development of the Townsville City Waterfront PDA will facilitate through a partnership between the Queensland Government, the Port of Townsville Limited and Townsville City Council with planning and development assessment responsibilities shared between the State Government and council.

1.3 Applying the Place-Making Framework

The SBEnrc's *Place-Making Framework for Sustainable Centres of Tomorrow*, has been created to assess how urban regeneration development projects can realise people and place-based design outcomes. This framework will be applied to four different urban fabrics, through case studies in Australia. All seven principles outlined in the table were applied for the Townsville case study to examine priority design consideration demonstrating a strong commitment to inclusive, integrated place-based planning processes. The Place-Making Framework comprises seven principles (in bold) and 21 practices (italicised):

1. Precinct safety and accessibility

Safe and healthy for people waiting to access transport nodes

Human centred design | Walkable urban design | Place and movement design

2. Carbon neutral – positive approach

Carbon positive, being at least zero carbon (power and transport)

Solar passive design | Solar active design | Carbon neutral analysis

3. Local shared mobility

Diverse local modal services to access the transit service, with defined spaces

Local mobility design | Feeder transport design | Mobility as a service

4. Property diversity

Density and urban mix should contribute to urban regeneration

Community engaged planning | Agglomeration economy analysis | Financial modelling

5. Property affordability

Diverse property options to provide affordable living as well as affordable housing

Social housing analysis | Life cycle assessment | Sustainability operational analysis

6. Nature-oriented space and inclusive

Include and connect biophilic and biodiverse greenspaces, supporting endemic species and habitat

Biophilic design | Water sensitive design | Landscape oriented design

7. Integrated, place-based planning

Involve diverse stakeholders and all tiers of government towards integrated place-based approach.

Joined up governance analysis | Partnership analysis | Procurement option analysis

In the following table (**Table 2**), this place making framework has been used to distil regenerating opportunities within the Townsville study area, extracting statements and vocabulary from the key reports summarised above. A detailed analysis of the reports is provided in **Attachment 2**. An abridged version is provided in the Executive Summary (**Table E1**).

Table 2: Place Making Framework applied to the Townsville corridor

| |
|---|
| 1. Precinct safety and accessibility |
| 1.1 Safe and accessible connectivity to nodes – Create a place that is safe and accessible for all people |
| 1.2 Cool and comfortable (shelters, pathways) – Provide cool and comfortable shelters and pathways which elevates the quality of public space |
| 1.3 Safe, natural and open spaces – Include natural and open spaces that ensure personal safety |
| 1.4 Frequent and integrated – Deliver a seamless personalised journey |
| 1.5 Resilience (supporting economic recovery) – Design, maintain and operate a resilient network |
| 2. Carbon neutral - positive approach |
| 2.1 Solar powered with energy storage – Use renewable energy for power and transport in the precinct |
| 2.2 Low carbon transport approach – Design transport solution to be more resource-efficient, have lower emissions and is ultimately more sustainable |
| 2.3 Hydrogen fuel cell vehicles – Incorporate clean energy solution that can provide secure jobs, new industries and export earnings It is important to note that that hydrogen is sourced through renewable energy (solar, hydroelectric) |
| 2.4 Sustainable urban design – create the ability of communities and wider urban systems to minimize their impact on the environment |
| 2.5 Low embodied energy infrastructure – reduce energy consumption by all of the processes associated with the production of an infrastructure (mining and processing to manufacturing, transport and product delivery) |
| 3. Local shared mobility |
| 3.1 Modernised systems – Ensure availability of electronic ticketing to user friendly platforms |
| 3.2 Real-time data available to all – Enable people to easily plan their travel (schedules and timetables) |
| 3.3 Walking/jogging/bike paths that connect housing to communal amenity – modify infrastructure assets to accommodate local mobility |
| 4. Property diversity |
| 4.1 Robust and current survey data – Ensure availability of accurate data for evidence-based decisions |
| 4.2 Mapped population clusters, by type – use modern mapping technology to evaluate current conditions, gaps and to identify opportunities to improve mobility |
| 4.3 Long term planning considerations – Include long term modelling to ensure stronger and smarter solutions, delivering more productive economies and connecting communities |
| 5. Property affordability |
| 5.1 A mix of social and affordable housing lines (rent, purchase) – Include safe, secure and affordable housing enables people to fully participate in, and contribute to, the wellbeing of Townsville |
| 5.2 Housing choice/ diversity – Increase the supply of diverse housing through improved housing design and renewed neighbourhoods with a greater choice about where they'd like to live, grow, raise a family and retire |
| 5.3 Medium density residential housing – Include medium density residential designs to provide an alternative, as a more affordable housing option |
| 6. Nature-loving and biodiverse spaces |
| 6.1 Cool and comfortable – Provide more comfortable waiting space for customers and better pathways through the Townsville CBD |
| 6.2 Water sensitive design – Develop quality urban space solutions supported by water sensitive design principles |
| 6.3 Natural and open spaces along and connecting corridors – Create conditions conducive for natural environment (natural features, views, vegetation, topography, water, wildlife etc.) and public open space (street trees, footpaths, parks etc.), improved shading to address the urban heat island effect |
| 7. Inclusive, integrated place-based planning |
| 7.1 Collaboration among key stakeholders – Embed genuine collaboration and partnership between the government and the local community to achieve significant outcomes |
| 7.2 Inclusive governance – Embed inclusive governance structures to enable integration, collaboration, innovation and collective leadership |
| 7.3 Working across agencies – Embed inter-agency collaboration to maximise the benefits of investment in transport |

2. Stakeholder engagement

This section documents stakeholder insights gathered through the project, regarding their appreciation of the existing context, priorities, and opportunities and challenges related to the transport infrastructure, accessibility and connectivity in Townsville. Interviews were undertaken (ensuring anonymity of each participant) to explore stakeholder perspectives on unlocking urban potential, in accordance with Griffith University Human Research ethics approval (GU Ref No: 2019/701).

Potential participants were invited to participate in semi-structured interviews through a method of snow-ball sampling, whereby interviewees were invited to nominate other potential stakeholders. Invited participants included management and operations personnel with experience, from academic institutions, health services, councils and state government organizations. Interviews were conducted in person on a date and time of participant's choice and convenience. Where one-on-one discussion was not possible and to cross-check key messages, the researchers have used documents from the literature review phase of the project, and discussions from interactions during the 2018 community workshop in Townsville. Stakeholder entities included James Cook University, Townsville Health and Hospital Services, Department of Transport and Main Roads, Department of Defence, Stockland Retail and Townsville City Council.

2.1 A summary of perspectives on project priorities

A summary of stakeholder perspectives are summarised in Table 3 (see [Attachment 2](#) for detailed notes), using language provided by the stakeholders. Documents suggested by the stakeholders were also reviewed to support the discussion points.

Table 3: Key considerations according to the stakeholder groups (alphabetical order)

| Stakeholder | Key considerations |
|--|---|
| Department of Defence | <p>The need to improve connectivity of the base with the CBD and surrounding retail centres:</p> <ul style="list-style-type: none"> Improving connectivity as a nodal base for residents' recreational interests Improving facilities to enable better mobility for the workforce |
| James Cook University | <p>The need to improve the recruitment and retention of students and staff at James Cook University:</p> <ul style="list-style-type: none"> The need for better public transport, specifically targeting after-hours service, more frequent services, and additional routes for outer suburbs Improved public transport conditions (see above point) will enable students (who don't own cars) to access the university <i>and</i> do part-time jobs in other sub-centres in Townsville Improved connectivity with surrounding suburbs will enable students and staff to spend more time on campus, while living closer to/ in the CBD |
| QLD Department of Housing and Public Works | <p>The need to provide housing that addresses current and future demand in Townsville:</p> <ul style="list-style-type: none"> The current local government and community resistance to following planning scheme recommendations on suburban medium-density and apartment-style housing solutions The opportunity for CityDeal to catalyse urban renewal and revitalisation The need for affordable and diverse housing solutions that are well connected to recreation, education and health services |
| QLD Department of Transport and Main Roads | <p>The need for creating an environment conducive for public transport:</p> <ul style="list-style-type: none"> The requirement to triage priorities for funding across the state, with this corridor performing comparatively well The need to complement efforts underway (completed by 2021) to modernise the transport system (e-ticketing and real-time data to the customer) The opportunity to begin enabling change of behaviour towards using active transport systems (currently very low usage) |

| Stakeholder | Key considerations |
|---|--|
| | <ul style="list-style-type: none"> The opportunity for Townsville (via the City Deals network) to help build the evidence base for using this technology in Queensland |
| Stockland Townsville | <p>The need to improve accessibility from retail centres to surrounding and outer suburbs:</p> <ul style="list-style-type: none"> The need to improve neighbourhood safety The opportunity to create the business case and planning context for future development |
| Townsville City Council | <p>The need to enable a variety of opportunities for unlocking urban potential:</p> <ul style="list-style-type: none"> The need to improve housing affordability and work connectivity The opportunity to use mobile but steady, and resilient public transport infrastructure that integrates with work already done on the CBD bus terminus The attraction of nodes enabling local attractive destinations and multi-modal connections The potential for a low cost solution for high impact problem |
| Townsville Health and Hospital Services | <p>The need for employees and patients to have easy accessibility and mobility to the Precinct:</p> <ul style="list-style-type: none"> These conditions will enable enhanced patient care, accessibility, and acute service delivery These conditions will also maintain and sustain medical officers as a part of a maturing city Improved connectivity with the CBD will help activate the city with those working in the Precinct |

From these distilled messages, it is apparent that there is strong mutual interest in creating a more integrated, productive, liveable city, focused on three key themes:

- 1) Housing affordability and work connectivity;
- 2) Easy accessibility and mobility; and
- 3) Low cost infrastructure.

Key challenges with the proposition of a trackless tram system were identified as follows, with notes on how other stakeholders addressed the challenge:

- A lack of smart ticketing systems and easy real-time access to transport schedules – this challenge is currently being addressed by the Department of Transport and Main Roads, with anticipated completion within 18 months (end 2021).
- A lack of information (evidence) regarding the performance of trackless trams in the local conditions (i.e. dry tropics) – James Cook University is in discussions with the SBEnrc regarding future trial sites and research opportunities for testing, evaluating, and reporting on performance.
- A lack of current public transport participation – there was discussion by several stakeholders of the precedent set on the Gold Coast, where upfront behavioural change initiatives were implemented to ready the public for using the new public transport system (in this case light rail).
- A lack of cool comfortable infrastructure facilitating public transport – there was discussion by several stakeholders about the clear message from more than a decade of research into what Townsville residents desire – ‘cool’ and ‘comfortable’ connections would need to be part of the solution as the corridor would not be successful without such an integrated approach.
- Resistance to following planning scheme recommendations on suburban high-rise/medium-density and apartment-style housing solutions

Key opportunities were identified as follows:

- The potential to consolidate and improve current surveying of Townsville public transport use (in collaboration with Department of Transport and Main Roads and Council), enhancing questions and

undertaking data analytics to better understand travel patterns to major nodes as well as experiences, expectations and aspirations of key places within the city

- The potential to conduct land use transport modelling to better understand the scenarios and predict changes in public transport patterns etc.
- The potential for ToD technology trial/s in Townsville, providing the University with educational and research opportunities for students and researchers
- The opportunity to develop co-ordinated communications and branding strategy for Townsville that articulates its competitive strengths and its place-based opportunities
- The potential to develop Thuringowa Central as a major retail and lifestyle hub, servicing rapid population growth in Townsville’s north-western suburbs
- Opportunity to investigate “Park & Ride” sites within the CBD and the THHS / JCU that allow workers to park all day and commute between employment nodes using the Future High Frequency Public Transport Corridors C1 & C2 routes as shown in the TMS Corridor Map.
- Opportunity to investigate “Park & Ride” at North Shore that provides connectivity to C12 & C6.
- Opportunity to neighbourhood planning in the infill locations

2.2 Examples of partnerships and local capacity

During consultation, multiple stakeholders referred to the groundwork that Townsville City Council has already done over the last two decades, building the community capacity to take on innovation within the City. Table 4 highlights key projects referred to by stakeholders during discussions, demonstrating capacity and precedent to address the challenges and opportunities noted above.

Table 4: Key initiatives demonstrating proof of capability in Townsville City

| Innovation track record | Key links to project websites/ reports |
|--|---|
| <ul style="list-style-type: none"> ▪ Australia’s first Solar City (Federal government program), building on Council’s solar city groundwork | http://www.townsvillesolarcity.com.au/ |
| <ul style="list-style-type: none"> ▪ Project partner, CRC Water sensitive cities | https://watersensitivecities.org.au/content/vision-and-transition-strategy-for-a-water-sensitive-townsville/ |
| <ul style="list-style-type: none"> ▪ First city to roll-out hybrid taxi fleet in Townsville, including solar charging station (Airport) | http://www.tcq.org.au/media-release/ |
| <ul style="list-style-type: none"> ▪ World leading white roof campaign (2006-2013) - Townsville Reducing Energy Demand (TRED) | http://www.townsvillesolarcity.com.au/BeyondtheProject-CEEP/tabid/196/Default.aspx |
| <ul style="list-style-type: none"> ▪ Early provider of capacity building resources for sustainable housing: Sustainable Housing Guide (currently being refreshed) | https://www.townsville.qld.gov.au/water-waste-and-environment/sustainability/sustainable-housing |
| <ul style="list-style-type: none"> ▪ Australian leader in renewable energy supply for industry - Solar farms | https://www.townsville.qld.gov.au/_data/assets/pdf_file/0024/32928/Large-scale-solar-farms-information-sheet-Planning-Service-March-2019.pdf |
| <ul style="list-style-type: none"> ▪ Landsdown industrial precinct development | https://www.townsville.qld.gov.au/building-planning-and-projects/council-projects/landsdown-industrial-precinct |
| <ul style="list-style-type: none"> ▪ Townsville City Waterfront PDA (with Economic Development Queensland) | https://www.townsville.qld.gov.au/building-planning-and-projects/council-projects/priority-development-area |
| <ul style="list-style-type: none"> ▪ Ross River Cycle Network | https://www.townsville.qld.gov.au/_data/assets/pdf_file/0024/5586/Ross-River-Parkway-map-p1.pdf |

3. Transport and urban centres features

In this section the socio-economic and geographical context is provided for the proposed corridor. This includes a discussion of destinations and origins, and other considerations going forward.

3.1 Socio-economic context

Townsville's median age is 34, which is relatively young compared to Queensland (37) and Australia (38). There is a relatively high proportion of Aboriginal and Torres Strait Islander people (7%) compared to Queensland as a whole (4%). Despite the younger population, there are fewer people with university degrees (15.7%) compared to Queensland (18.3%) and Australia (22%). Townsville has a lower proportion of migrants, with 78.6% of people born in Australia compared to Queensland (71.1%) and Australia (66.7%). (ABS Census, 2016)

Socio-economically, Townsville has higher levels of unemployment (just under 9%) than Queensland and Australia; but household income (AUD \$1,424 per week) is higher than Queensland and similar to Australia as a whole (ABS 2016, Census data). This might reflect employment in relatively high paying industries such as mining, or the relatively more youthful population (meaning more people are working). The top five industry subdivisions of employment for Townsville (C) LGA comprise of Food and Beverage Services (6.5%), Preschool and School Education (6.4%), Defence (6.4%), Hospitals (5.9%), Other Store-Based Retailing (5.0%). Within Townsville (C) LGA 14.6% of employed persons worked in Health care and, social assistance industry, 13.7% of employed persons worked in Public administration and safety industry (economyid, 2018).

An analysis of the jobs held by the local workers in the Townsville City Council in 2018/19 shows the three largest industries were: 1) Health Care and Social Assistance (14,482 people or 14.8%); 2) Public Administration and Safety (12,885 people or 13.2%); and 3) Retail Trade (10,464 people or 10.7%). In combination these three fields accounted for 37,831 people in total or 38.7% of the local workers. Analysis of the method of travel to work of the resident workers in the Townsville City Council shows that 1.6% used public transport, while 79.0% used a private vehicle, compared with 7.0% and 71.2% respectively in Queensland (economyid, 2018).

Townsville has a high level of natural amenity, including waterfront, riparian area and Castle Hill, a 286m high granite hill in the middle of the city, a significant attraction for many residents and tourists who drive, hike or run up the hill. Offshore is Magnetic Island which not only is a tourist destination, but is also home to many, who use the regular ferry service to go to the city. The majority of major shopping centres (including supermarkets, cinemas and other large retail) are within 2km of the proposed corridor.

Townsville has two major universities including James Cook University (JCU) and Central Queensland (CQ) University within 2km of the corridor. JCU has a student population of approximately 22,000 across all campuses, wherein Townsville has about 13,000 students, of whom 31% are international (6,886) and 1,182 of this international cohort are based in the Townsville campus. The majority of these students come from Singapore, China and India. CQ University's Townsville campus is located on the banks of the Ross Creek in the Townsville CBD and is home to over 1000 students (ABS 2016).

The city is comprised of predominantly Australian born with young families purchasing 3-4-bedroom family home with a mortgage (ABS, 2016). Townsville has a high workforce participation rate with the employment ration above Australian average (ABS, 2016).

Townsville City Council, 27.7% of households were made up of couples with children in 2016, compared with 28.7% in Queensland. 32.6% of households have a mortgage and a higher percentage are renting 36%. In 2016, 10,492 people in the Townsville City Council were attending university. This represents 5.6% of the population, compared to 5.0% in Australia (idcommunity, 2016). Figure 2 presents a map with key attributes of centres and sub-centres around the proposed corridor.

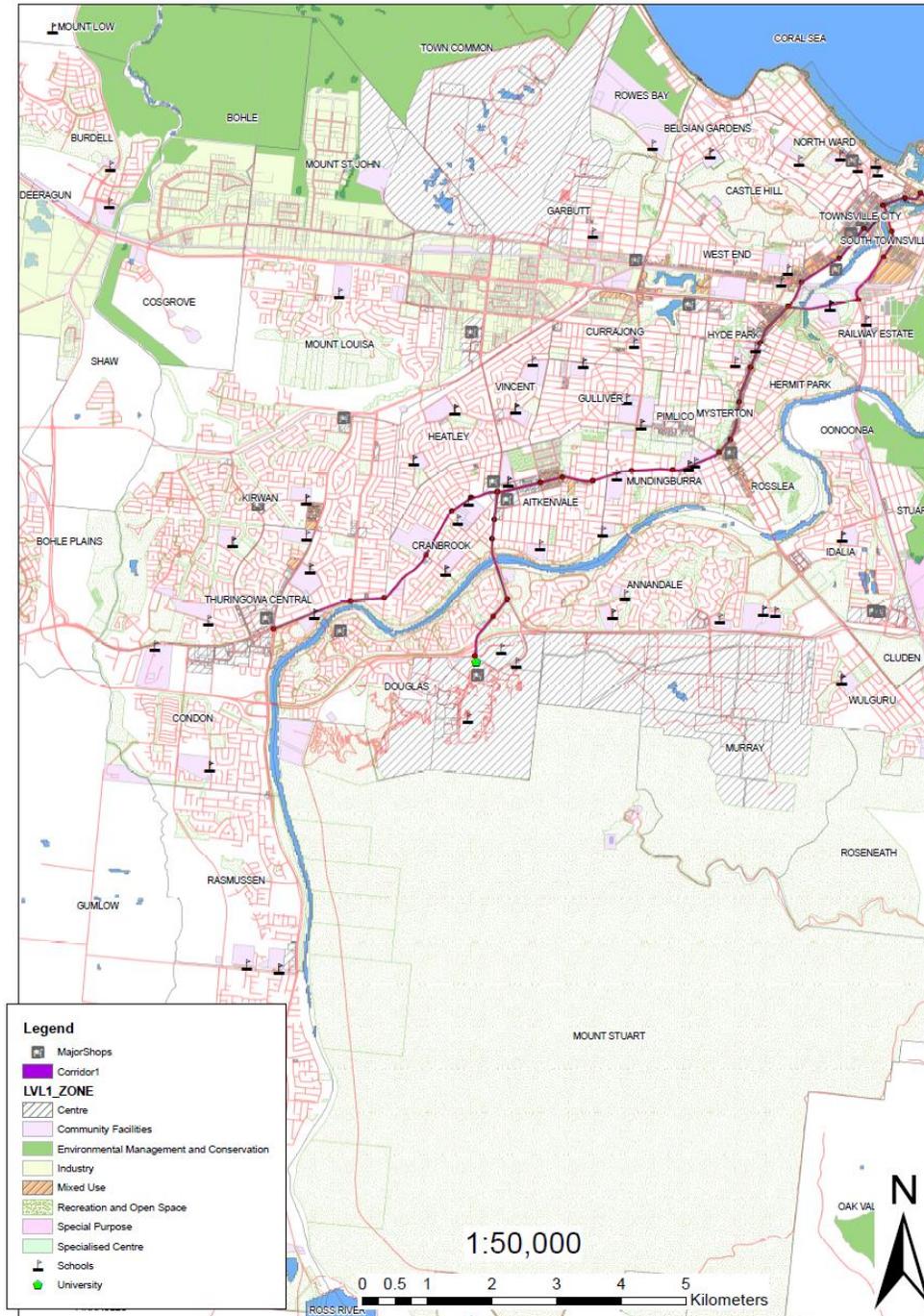


Figure 2: Townsville map with key attributes of centres and sub-centres

3.2 Proposed destinations and origins

The proposition, initially made in 2012 via the Smart Link concept and now through Townsville Metro is that a future-oriented multi modal transit corridor of high amenity be created between the four primary centres of employment and visitation: Central Business District; Aitkenvale (retail Centre); Thuringowa Central; and Douglas (JCU, TTH and ADF). This transit-oriented development (TOD) corridor aims to connect the CBD to abovementioned four centres via Charters Towers road, Ross River Road and Nathan Street. This corridor of high amenity will be created between the four primary centres of employment and visitation in relation to Defence base. Further to gathering stakeholder perspectives on priorities, and considering the socio-economic context discussed above, the assessment was undertaken for an extended route from the CBD bus hub through to the Casino area, connecting the ferry terminal, ANZAC park, Reef HQ Aquarium, and the Stadium as shown in **Figure 3**.

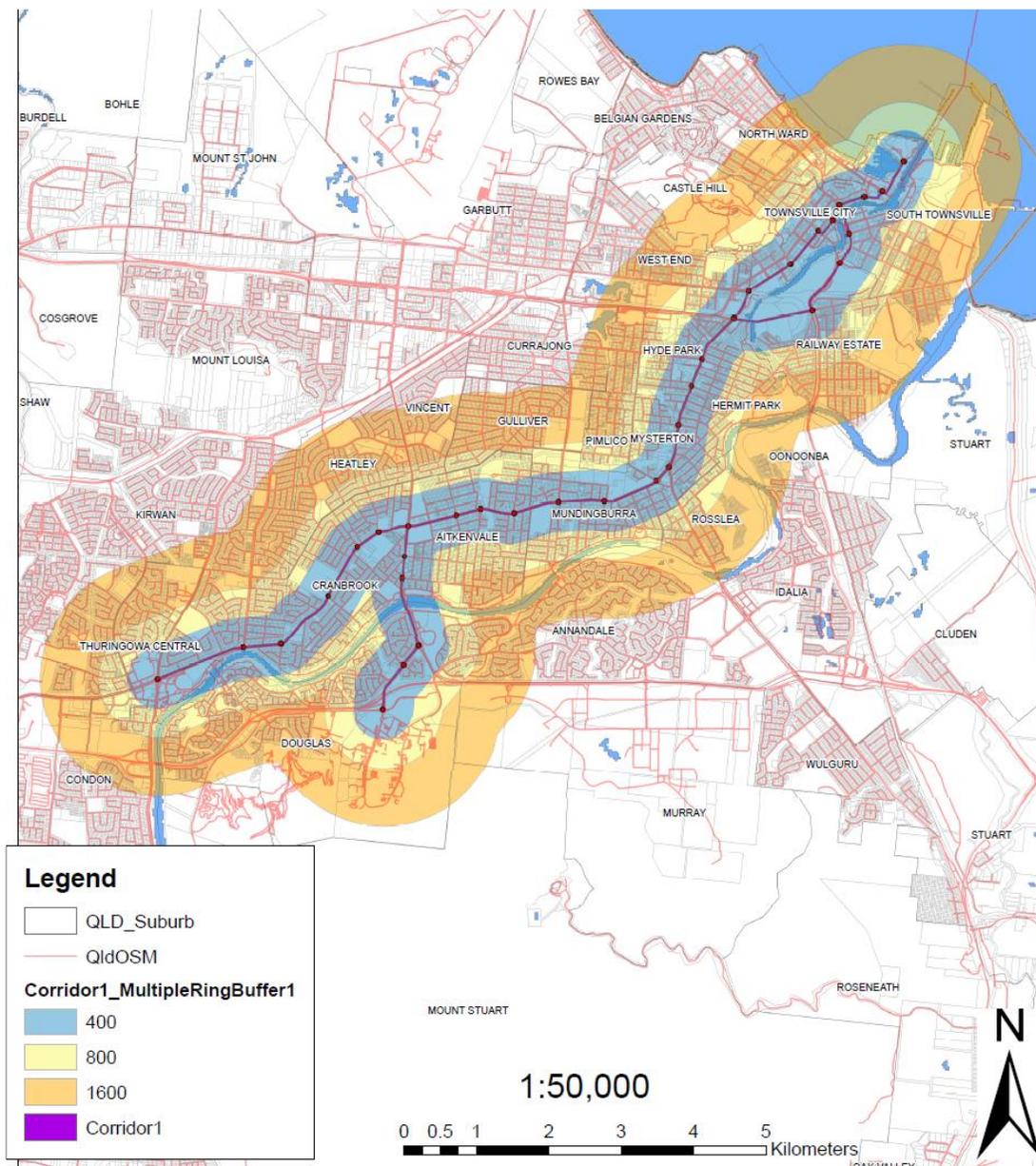


Figure 3: Proposed metro route in Townsville

A key consideration in this proposed metro route was the unlocking of diverse social and economic land uses along this route. Traditionally, a low density residential with neighbourhood strip and 'big box' retail precinct. More recently, the proposed route has witnessed a diversification of retail, service providers and community services. Professional services (financial, health and private hospitals) and community services (education, libraries and churches) have emerged adding to the economic regeneration along the route. Additionally, new development along the route and diversification of the service providers will continue to result in increased activity, especially in the areas between Hyde Park and Aitkenvale. Potential nodes include the Mater Private Hospital (two sites), TAFE Pimlico and Central Queensland University. The TAFE in Pimlico, for example, is located in proximity to the corridor and could be connected to encourage active transport. It is also important to note that there is an opportunity for future link to Townsville Airport (via North Ward).

4. Assessment of socio-economic impact

This section describes the people and place amenity with supporting impact analysis. It then provides commentary on transient population dynamics in Townsville City. Property data sets for the Townsville LGA including locations, property types, suburb, price and listing type were obtained from CoreLogic for the years of 2014, 2016 and 2018. Additional demographic data were procured from key stakeholders including the James Cook University and Townsville City Council to support this analysis.

4.1 Transient population dynamics

The transient population is identified based on the movement patterns between a pair of locations or while away from their base location. Exploring the extent of residential movement helps in understanding the key risk factors associated with transience for adults as well as youth. Frequent residential relocation is often associated with adverse socio-economic outcomes related to education, health and wellbeing. This population can be further identified as transient and vulnerable transient based on based on the risk characteristics and nature of risk of being transient or vulnerable transient (Jiang, Pacheco, & Dasgupta, 2019).

The socio-economic status in the Townsville housing market provides rich insights into Townsville's transient population. Tenure data indicates if there are private renders that would attract young singles or couples who are likely to be transient. Conversely, concentration of full homeowners indicates a more settled nature with matured families and empty nesters (idcommunity, 2016). Within the Townsville context Overall, 22.1% of households fully owned their dwelling; 32.6% were purchasing, and 36.2% were renting. When compared to Regional QLD data of 29.2% % of households with fully owned dwelling, 29.1% purchasing and 31.4% renting, Townsville indicates lower number of fully owned dwellings and higher percentage of rentals (idcommunity, 2016).

Three key factors including migration, births and deaths influences the local population change. Within Townsville a 45.2% of people did not change their address and 43.1% shifted from elsewhere in Australia. It is evident that the levels and types of migrations (overseas, interstate, within state) contribute to the sedentary and transient population in Townsville (idcommunity, 2016). Data indicates that people aged 25 – 35 are the most active migrators with a movement of 14,907 people between 2011 and 2016. There is a high proportion of in migration in the 18 – 24 age group (this may be attributed to the university drawing in young people from neighbouring regional towns). About 1,943 migrated from Brisbane to Townsville between 2011 and 2016; 1,470 migrated from Cairns to Townsville; and 1,153 migrated from Mackay to Townsville (idcommunity,2016).

Creating capacity for new housing in the right locations requires clear criteria for where capacity is to be located. Accommodating homes needs to be linked to local infrastructure (Transit corridor) – both to optimise existing infrastructure and to maximise investment in new infrastructure. Opportunities for capacity that aligns with infrastructure can be realised by urban renewal, local infill developments and land release areas.

Considering the Townsville's health care and social assistance, public administration and safety, education and training, retail trade and defence sectors the following sections describes how different type of populations have demonstrated characteristics of transient population with predominantly more focus on education. This has caused a major challenge in talent attraction and retention.

Education and training

International students bring many benefits to the regions in terms of social and cultural vitality and diversifying regional economies. International students deliver a raft of social, cultural and strategic benefits to Townsville through increased cultural capital and diversity and greater international collaboration and idea sharing. The Queensland Government recognises the importance of regional study organisations, such as Study Brisbane, Study Gold Coast and Study Cairns in supporting further growth of international education and training in the regions. In 2015, the regional economic contribution of student related expenditure (outside Brisbane) was AUD\$937 million (The State of Queensland, 2016). Queensland's regions also gain significant indirect benefits as a result of increased demand for goods and services and tourism visits from international students based in other centres, or interstate, and their visiting friends and relatives (The State of Queensland, 2016).

International Education was identified by numerous stakeholders as a key opportunity area to drive knowledge intense employment and regional exports. In 2017, Australia hosted approximately 786,000 international students, which was estimated to have contributed approximately \$30.3 billion to the Australian economy. Queensland's share of the international education market was approximately \$4.4 billion. The vast majority (97%) of international students are enrolled in metropolitan areas, leaving only 24,128 international students enrolled in regional areas (see **Table 5**).

Table 5: International student enrolments by region in 2017

| State / Territory | Region (SA4) | Enrolments | Regional Share |
|-------------------|----------------|---------------|----------------|
| TAS | Hobart | 6,702 | 27.8% |
| QLD | Cairns | 2,685 | 11.1% |
| NT | Darwin | 2,423 | 10.0% |
| QLD | Toowoomba | 2,086 | 8.6% |
| QLD | Townsville | 1,944 | 8.1% |
| NSW | Richmond/Tweed | 1,458 | 6.0% |
| TAS | Launceston | 1,385 | 5.7% |
| NSW | New England | 1,351 | 5.6% |
| VIC | Ballarat | 1,029 | 4.3% |
| VIC | Geelong | 416 | 1.7% |
| TOTAL | | 24,128 | |

Source: Department of Education and Training (2018) International Students in Regional Areas, May 2018

There were three Queensland regions represented in the top ten regions for international student enrolments. Notably, Cairns had the most significant share of international students in regional locations (2,685 enrolments or 11.1%). Townsville on the other hand represents 8.6% of regional international student enrolments, or some 1,944 international students. The differences in international enrolments between Cairns and Townsville are despite the relative strength of the education offer in Townsville relative to Cairns (e.g. Townsville is the main campus of JCU). JCU has a total student number of 21,927 with about 11,500 based in the Townsville campus (JCU, 2020). While not all international students attend higher education and JCU is not the only university present in Cairns and Townsville, the difference in international student enrolments across these two regions is especially stark when considering JCU. Townsville has more than three times the number of total student enrolments as JCU Cairns. In 2018 JCU employed a total of 3,426 full time, part time and casual staff, equating to 1,603 FTE employees, while THHS employed 6,413 staff equating to 5,415 FTE employees. Current operating activity within the Precinct is expected to generate the following within the Townsville economy (TropiQ, 2019).

There are also clear benefits for international students studying in the regions:

- *Liveability:* Almost half of Queensland's population live outside the capital and as a result many regional centres have developed into vibrant and exciting places, offering a safe, friendly and affordable lifestyle. Major education and training providers are located on the Gold Coast, North Queensland (Townsville and Cairns), the Sunshine Coast, Central Queensland (Rockhampton) and the Darling Downs (Toowoomba).
- *Cost of living:* Many regional centres offer part-time employment opportunities for international students which, combined in some regions with lower accommodation and living costs, makes them an attractive destination for self-funded students.
- *Student experience:* Queensland's regional international education and training providers have worked hard to enhance the student experience. Many regional centres have the resources and capacity to provide an excellent student experience, from arrival through to post-studies. Some international students have reported a more personal and welcoming experience in regional centres. They have also reported that a more positive learning experience as a result of smaller class sizes.

Within the Townsville context, most of these international students depend on public transport systems to commute to the campus and to part-time jobs. At the same time some of these international students can be considered as a captive group due to their lack of ability to drive a private vehicle. There is an opportunity for a highly reliable, frequent well integrated transit system which can provide mobility services from the university to the CBD and outer suburbs. It is important to note that JCU is positioned in the THKP and therefore a better transit corridor will be able to service not only the students but also the employees and patients visiting the Townsville hospital and health services.

Key drivers that are conducive to the growth of the JCU international student market is that the university has a positive international reputation and is capable of further consolidation and continuing to build links with Asia, demonstrates strong offerings related to tropical and marine sciences and affordable accommodation. Townsville does not have international flights which is a major consideration for international students. Due to above-mentioned considerations and other challenges related to internal connectivity in Townsville (part time job and transport) often students move Sydney/Melbourne/Brisbane after 6-12 months. They also move to Cairns campus also 20km out of town.

Even though JCU has a “Sticky Campus” vision aiming to retain students, they face challenges in increased rates of student attrition.

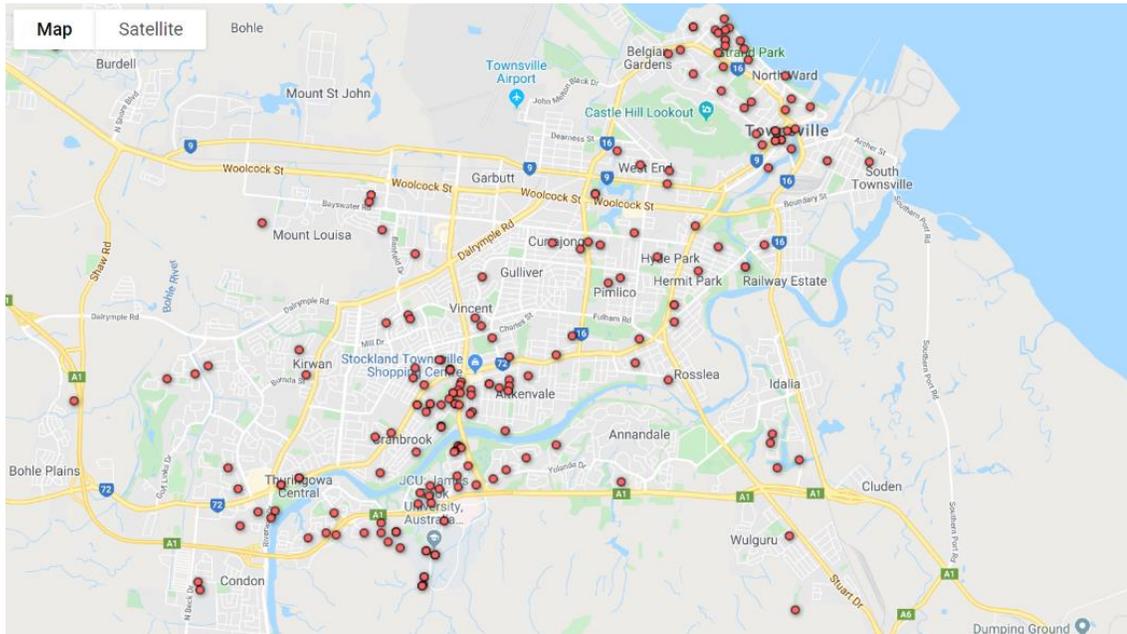


Figure 4: Distribution of JCU international student accommodation (individual houses) [Source:JCU mapping services, 2019 unpublished]

Identified potential enablers that could grow the student market include having an after-hours shuttle service, improving the local food culture, city liveability, the availability of – and access to and from – part-time jobs, and more reliable and frequent transport services.

The current international students are largely scattered around Thuringowa, Aitkenvale and CBD areas highlighting the potential opportunity for a metro system to cater to the demands of the students who are particularly public transport dependent. A potential explanation could be attributed to the relatively strong performance of nearby Cairns, in terms of international brand awareness, international access, and relative perceptions of place and lifestyle.

There is a clear opportunity for Townsville to pursue a greater share of the international education market providing brand awareness, accessibility and lifestyle requirements of international students can be met. The region’s excellence in marine and tropical sciences makes it a major attractor to students and researchers in that space. There is a growing market for tourism activities with an educational focus, ranging from international researchers pursuing specialised research projects, to families and school groups accessing the region’s research capability in marine and tropical sciences. The Queensland Government Study Queensland and its regional equivalent Study Townsville are working to develop edu-tourism strategies for the region, as well as growing Townsville’s share of the international tourism market (which could also be described as an edu-tourism initiative). The proposed Coastal Sciences Centre of Excellence represents a key project within the Edu-tourism space.

Queensland has several regional universities that offer a range of similar courses and offer different specialisations. Opportunities exist for the development of a tertiary education experience for international students to move through multiple regional campuses. In doing so, they experience Queensland’s regions and the different specialisations on offer across regional campuses.

4.2 Transit oriented corridor value uplift study

The theoretical underpinnings of value uplift, where land value increases as a consequence of improvements in accessibility, derives from the land rent theory of Alonso (1964) and Muth (1969). In essence, rents are higher for land with higher accessibility since this offers land holders greater opportunities in terms of destinations. This theory therefore underpins the notion that investments in high-capacity public transport systems will generate positive 'uplift' in land values for surrounding catchments. It is worth noting that the change in accessibility is, in theory, related to unimproved land, i.e. land with no structures on it.

This section aims to predict property value uplift for the catchment areas of the potential trackless tram system in Townsville. Since there are currently no trackless tram system in Australia, this study uses light rail as a comparison base, specifically the Gold Coast Light Rail Transit (GCLRT) is the base comparison used. The prediction process has two components. First, to construct a value uplift model for GCLRT and define the uplift value. Second, to match uplift lift results from GCLRT for the Townsville trackless tram case by using the Propensity Score Matching (PSM) method. The following sections introduce the uplift model and PSM method, respectively. Finally, match results are reported.

Value uplift model: Difference-in-Differences Model

The objective of this section is to evaluate the incremental effects of accessibility to a light rail network on residential property values over time. The difference-in-differences (DD) model contains an interaction term that is the product of the group and time indicators, with the DD indicating as a difference in the differences between groups across time (Puhani, 2012).

The DD model in this study is specified as:

$$\ln(p_{it}) = \beta_0 + \beta_1 X_{it} + \beta_2 N_{it} + \beta_3 LR_{it} + \beta_4 T_{is} + \sum \theta_t LR_{it} \cdot year_{it} + \varepsilon_{it} \quad (1)$$

where, p_{it} represents the transaction price of property i at time point t ($t=1996, 2002, 2006, 2011, 2016$) which is predicted by a vector of observable attributes. The observable attributes include X_{it} , a vector of property attributes for property i in year t ; N_{it} , a vector of neighbourhood attributes for property i in period t ; LR_{it} is an indicator variable that equals to 1 if property i is in the GCLRT catchment area of the LRT station and 0 otherwise; T_{is} is a seasonal time series variable over the period between 1996 to 2016 capturing quarterly seasonal time trends for property i in the quarter running from 1 (first quarter 1996) to 83 (third quarter 2016); $year_{it}$ is an indicator variable that equals to 1 if property i sold in year t ; and ε_{it} is the error term for property i in year t . The term $\beta_4 T_{is}$ controls for general increases in price due to inflation and seasonal variation. The interaction of LR_{it} and $year_{it}$ is the difference-in-difference estimator, and the estimated parameters can be tested to investigate whether there is a difference in property sale price change over year among the properties that located within different GCLRT catchment areas (treatment) and those not (control), for the different time periods discussed above: θ_t is therefore the coefficient of interest.

Propensity score matching method (PSM)

In this section, GCLRT catchment areas are matched with the trackless tram catchment areas in Townsville. The catchment areas are 2km from the GCLRT station and trackless tram. This paper uses the method first proposed by Billings (2011) which involves first estimating a probit model using the neighbourhood areas as the unit of analysis. The dependent variable is an indicator variable for a neighbourhood being located within 2km of the rail stations with the independent variables including measures on various

neighbourhood characteristics. The PSM method uses the Statistical Area Level 1 (SA1) as the base geographical unit to do the matching process. In this study, this included transport variables, amenity variables, and census variables as follows:

- Transport variables: distance to bus stops along the proposed route; and distance to junctions with major road junction (any road designated on Open Street Map as Motorway, Trunk or Primary, in essence the Bruce Highway, Ring Rd and other major roads such as Woolcock Street).
- Amenity variables: urban parks (junction of roads and open space designated in the Townsville Planning Scheme as parkland or similar); schools (point); major shopping centres (point from Open Street Map (OSM)); major tourism sites (point, OSM); major sports facilities (point); James Cook University (point) and Townsville CBD (point, GPO used a proxy).
- Census Variables: total population; proportion of older population (aged over 65); proportion of Indigenous people; proportion of married; proportion of English only speaking; proportion of unemployed; proportion of students; and household income.

Matching results

From the uplift modelling, we have used the model proposed by Yen et al. (2018). The model indicates that GCLRT would have 17% (for 0-100m from the GCLRT station), 17.3% (for 101-400m from the GCLRT station), and 18.7% (for 401-800m from the GCLRT station) increments of property value in 2016 if compared to the base year (i.e., 1996). Based on this uplift pattern, we then use PSM match to Townsville.

Figure 5 shows the SA1s that correspond with Townsville: first, Townsville SA1s were matched with Gold Coast SA1s using the PSM method. Second, the average uplift was calculated for the matched SA1s. Dark blue indicates SA1s with that were matched with the Townsville with an average uplift between 17.3 and 17.7%, light blue from 17 to 17.3%, and green from zero to 17%. **The average uplift level for the catchment in this study is concluded to be in the order of 6%** (see also Figure 5).

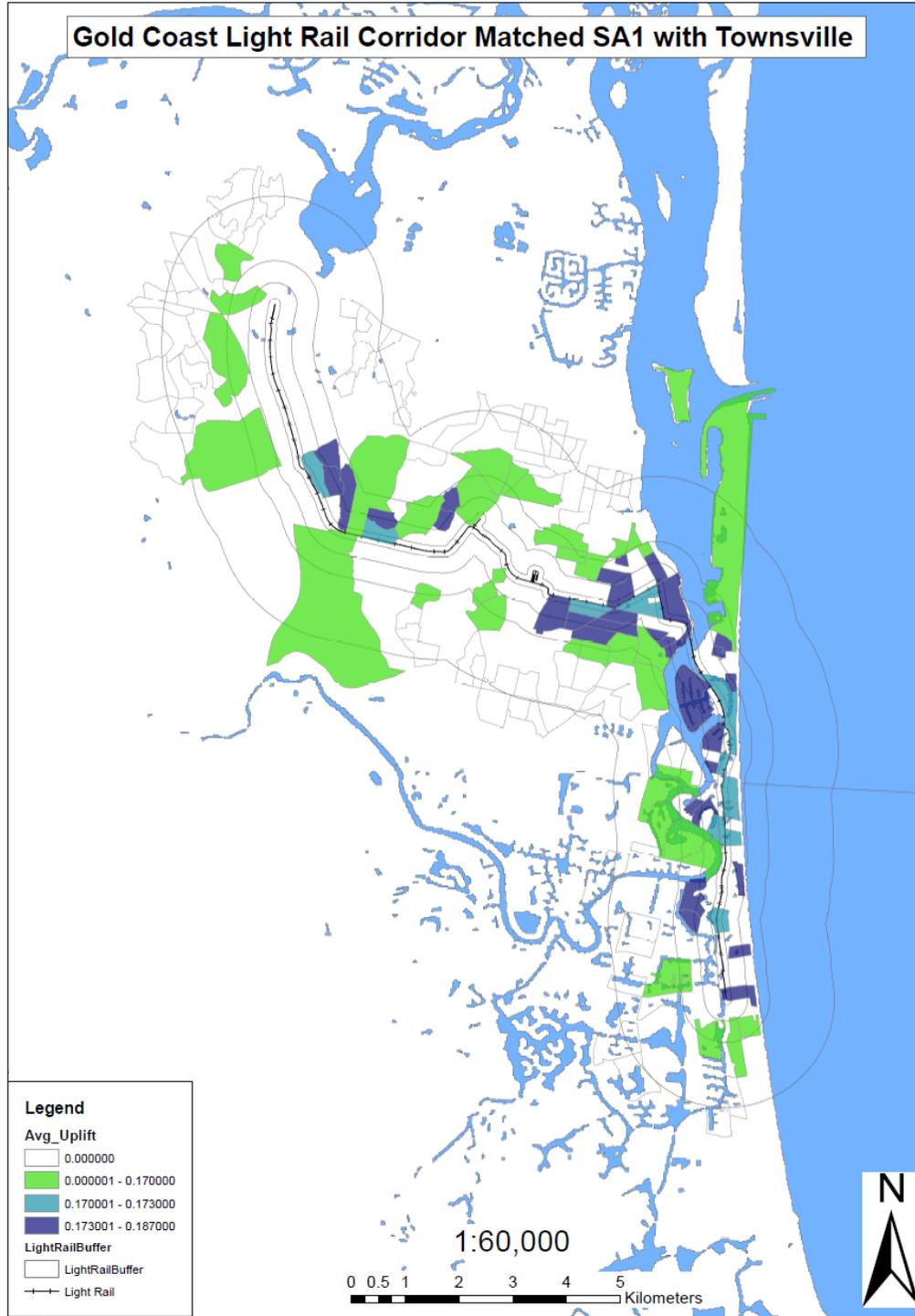


Figure 5: PSM matching results for trackless tram catchment areas in Townsville.

5. Risk assessment – Trackless Tram System technology

This section provides a summary of risk factors and implications elicited from the stakeholder engagement and socio-economic impact analysis which then informed the identification of associated risk in building a transit-oriented development (TOD) route in Townsville. The risk assessment steps were inspired by AS/NZS ISO31000:2009 (risk management framework), previously used in SBEnrc studies.

5.1 Stakeholder Engagement – risk factors and implications

It was evident that there is emerging consensus around the need for a well-integrated, connected people-oriented city. This aligns well with the Department of Transport and Main Roads’ (TMR) vision related to mobility as a service and associated modernising plan for creating conditions conducive to transit oriented development. Plans for modernising the existing transport system (ticketing, real time data access, bus stop improvements) could uncover pathways to catalyse positive behaviour in customer and unlock urban potential through better infrastructure development which could even inform achieving the City Deal aspirations related to a productive and liveable city.

However, it was also identified that some of the existing conditions may not be conducive for introducing a trackless tram technology, given climate characteristics and existing acceptable performance of the route being considered according to TMR indicators including congestion and time of travel. For the department, Townsville is not viewed as a high-priority city to introduce/ roll-out an autonomous transit technology based on performance, but there is the potential for the technology to be considered from a broader perspective of catalysing other benefits. There was discussion about using trackless tram as a technology trial within university premises and demonstrate its functions and gather public opinion on it. Some stakeholders viewed this as an opportunity to shift public perceptions and view on public transport as a comfortable, convenient way to commute with in the city. Table 6 summarises the potential implications of introducing trackless tram technology into Townsville, considering social, environmental, economic and governance factors.

Table 6: Social, environmental, economic and governance – positive implications

| Social | Environmental | Economic | Governance |
|---|--|---|--|
| <ul style="list-style-type: none"> • Flow-on benefits from the growth of education and health functions include inward skilled migration • Connecting people from the outer suburbs to the main corridor using alternative modes of transport and reduced congestion • Providing Australian data on the suitability of this technology, in collaboration (e.g. local university – government – industry), including specifications and | <ul style="list-style-type: none"> • Enabling multipurpose uses for transit technologies, including mass movement of community in times of crisis (e.g. evacuation purposes) • Increased flood immunity due to ability to re-route around congestion or flooded roads • Use of renewable energy for | <ul style="list-style-type: none"> • Attract inbound investment for business and tourism • Port redevelopment could facilitate increase in ocean-faring visitors (e.g. cruise boats) • Tourism development particularly along Palmer street. • Opportunities for patients visiting from Asia for specialist treatment | <ul style="list-style-type: none"> • Opportunities for new development that directly supports health functions • Aligned interests for investment to connect and rejuvenate this corridor • Potential mechanism to support Public Housing efforts for to increase in medium-density residential development along |

| Social | Environmental | Economic | Governance |
|---|--------------------------------|---|---|
| compliance with legislation and standards etc. • Harness momentum of the current modernising efforts | operations (solar and battery) | • Appealing accessibility for trainee doctors, foreign doctors and consultants. | major transport corridors and close to existing centres • Strong precinct wide governance precedents |

5.2 Socio-Economic risk factors and implications

As noted earlier, Townsville is a unique city with a distinctive demographic profile. Through the analysis of CoreLogic RP data of property pricing (highlighted in Figure 6), it was evident that pricing is stagnant for houses, land and units over the last 6 years. There is an overall decline in business property prices which is evident through existing commercial assets in the Strand area which demonstrates a very low level of commercialisation and a few small-scale restaurants which was also evident through the site observations. There is a beautiful parkland area (along the Strand Park) which has more potential to be developed as a commercial and lifestyle hub.

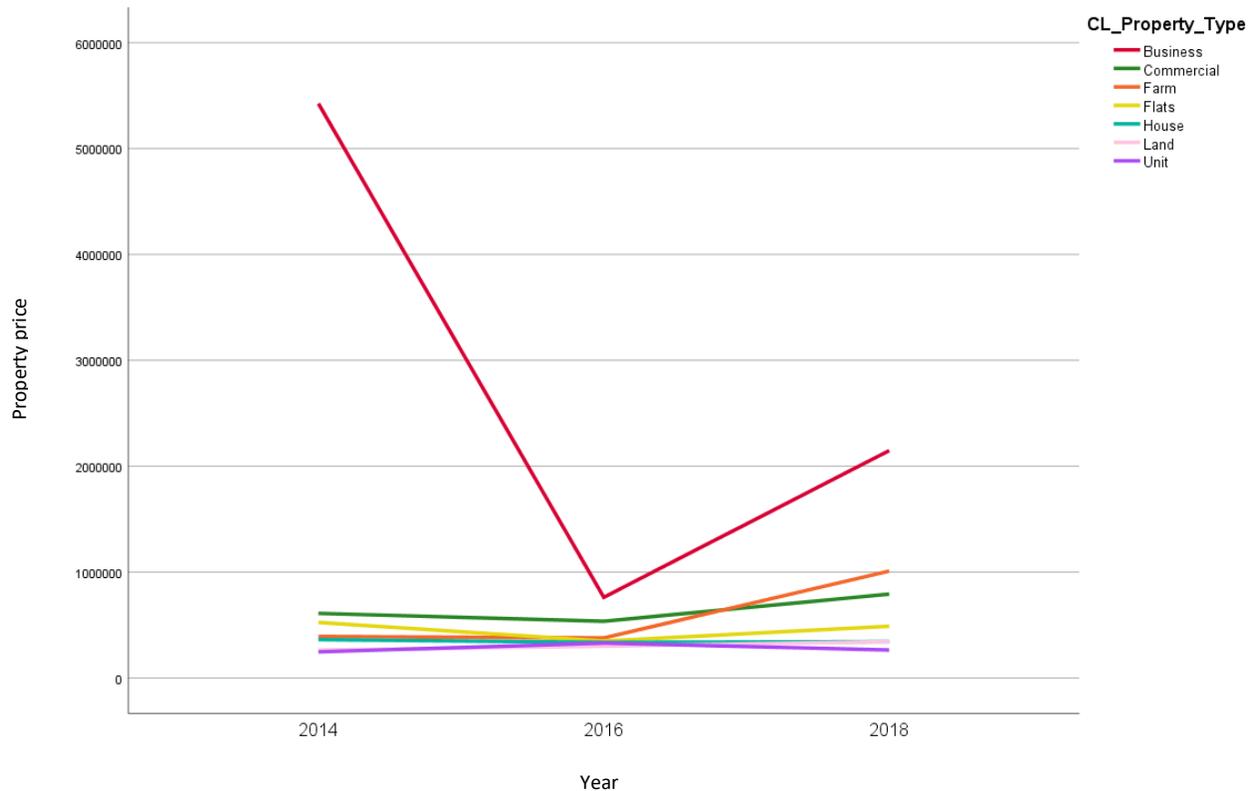


Figure 6: Property pricing trends in Townsville from 2014-2018 (CoreLogic RP data, 2019)

According to Figure 7 most of the properties consists of houses and units. The current housing along the proposed corridor is very low in density, aging housing stock, comprising single-dwelling households in large residential blocks.

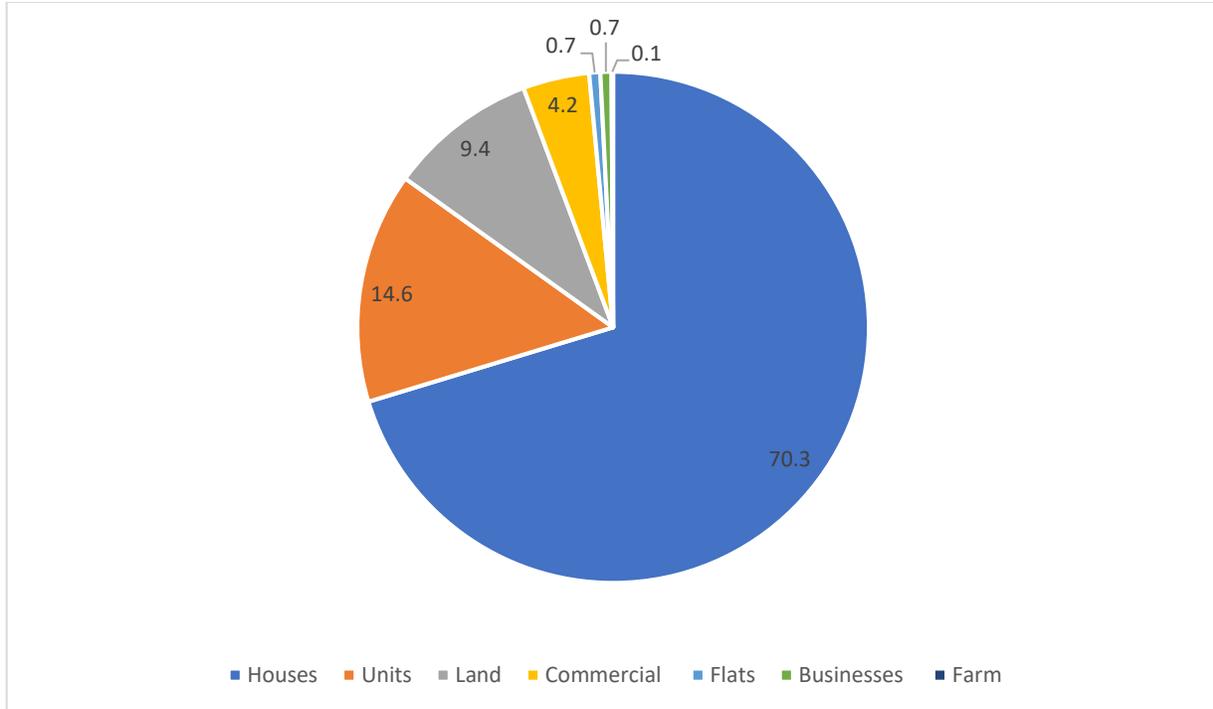


Figure 7: Property types in Townsville LGA in 2018 (CoreLogic RP data, 2019)

As per the photographs shown in Figure 8, 70.3% of properties consists of houses. Only 4.2% comprise of commercial properties and it was also observed through the field visit by the authors that there were many commercial properties vacant and advertised *for lease* highlighting an opportunity to boost up the economy through property diversity. There is land that has already been approved for residential redevelopment in the North East, South and West, accounting for another 50-60 years of residential supply, of similar typology. According to our stakeholder consultation with Department of Housing and Public Works it was noted that a recent attempt by the Department of Public Housing to integrate apartment-style development in Aitkenvale was unpopular with existing communities, despite accordance with planning scheme. Considering the transient population in Townsville including international students, professionals working in healthcare placements, or academics in the education sector on visiting appointments, renting is popular.



(a)



(b)

Figure 8: Observed (a) commercial and (b) housing properties along the proposed corridor

There are number of socio-economic challenges currently being addressed in Townsville including increasing incidents of crime, and the presence of squatters in open land (e.g. Stockland retail area). The local development market is skewed toward local developers, with current marketing sales distribution networks limited in attracting external developers.

Townsville is largely perceived as a car dependent city with sprawling density. There is currently a neutral to negative public perception about using the exiting public transport system, with reference to it being unreliable (late) and inconvenient (cash based, limited hours and intermittent). There is a low awareness of projects underway by the State Government to modernise the fleet through cashless ticketing and real-time data access for customers. There are calls for a more efficient and effective public transport service through a very low-density and geographically expanding community. Students, employees in the Tropical Intelligence & Health Precinct (TropiQ) in particular are desiring better public transport access.

5.3 Risk identification

This section identifies associated risk in building a transit-oriented development (TOD) route in Townsville to enhance the current public transport system. The risk assessment steps were inspired by the AS/NZS ISO31000:2018 for risk management framework which has been previously used in SBEnrc study (Figure 9).

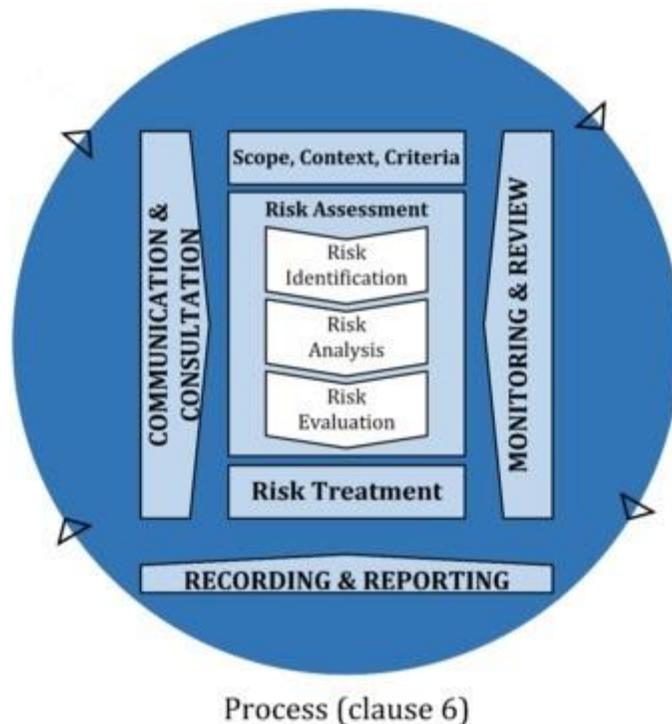


Figure 9: AS/NZS ISO31000:2018 for risk management (Source: ISO, 2018)

There seven categories of risks identified for this study including design risk, regulatory risks, social, financial, environmental, operational risks and property risks as outlined below.

Design risk

- Limited ability has been demonstrated in terms of meeting Australian design standards (with the increase of load/capacity)
- Inaccurate consideration of physical accessibility to TOD facilities via existing pedestrian routes (i.e. pathway connections)

Regulatory/ Legislative risks

- Townsville's current exclusive contracts with Sunbus to provide public transport services
- The Department of Transport and Main Roads ability to dispense funds through triaging the redevelopment need for assets in the state

Social risks

- Unpredictability on the uptake of the new transit technology
- Pre-empted lack of demand of public transport
- People's preference for cool and comfortable environments
- Lack of safety for public transport infrastructure and drivers in certain disadvantaged suburbs
- High dependency on cars due to scattered nature of local dwellings
- High crime rates and presence of squatters in open land which would pose a risk to passengers and drivers
- Low awareness of projects underway by the State Government to modernise the fleet through cashless ticketing and real-time data access for customers
- Lack of international flights servicing Townsville continues to be a major factor that subdues the attractiveness of Townsville for international students

Financial risks

- Design, construction, and extra cost involved in building a resilient system
- High costs involved with development of lanes and transit nodes

Environmental risks

- Tropical hot weather non conducive to create appropriate conditions for the trackless tram
- Current land use patterns and landforms non conducive for the trackless tram
- Potential flood hazards (during the 2019 monsoon events part of the proposed corridor-Charters Towers Road were particularly flooded)

Operational risks

- Poor battery performance in tropical climate
- Lack of interconnected virtual and physical environment assets
- Lack of supportive infrastructure for multi-modal transit system from outer suburbs
- Lack of Lane allocation and bus stops
- Removal of some bus stops and implementing few nodal stops
- Sufficient car parking
- Road networks not congested
- Scheduling and frequency of service

Property risks

- Possible property price decline or increase skewing if rest of the market
- Most commercial properties being advertised to be leased (based on field observations)

- Local development market is skewed toward local developers,
- Current marketing sales distribution networks limited is less appealing for external developers
- High percentage of transient population

To further quantify the magnitude of risks and its impact quantitative risk analyses process, simulation tools and statistical analysis could be adopted. It is generally more time consuming and needs high-quality data to conduct a detailed analysis of highest priority risks in this proposed ToD route project. Moving forward there are several next steps that could be implemented to conduct a comprehensive risk assessment. These steps include:

- Developing database of risks and mitigation measures in ToD (by storing the knowledge and information gained from past relevant ToD projects regarding risks and mitigation measures,
- Results of a large number of ToD simulations- (i.e.: GC light rail project),
- Simulations to be carried out using several prototypic roads that represent entire building stock of a climate zone and different transport scenarios,
- Specific information should be gathered for the risk associated with the trackless tram technology and other transport technology options, to develop risk mitigations measures

6. Conclusions and implications for urban renewal

This study has considered the establishment of a well-integrated transit-oriented development (TOD) route, between the CBD and two key locations within the polycentric city: 1) the Tropical Intelligence & Health Precinct (TropiQ); and 2) Thuringowa Central to enhance amenity and lifestyle towards a prosperous and highly-liveable city for residents and visitors.

Considering stakeholder perspectives, the socio-economic context of Townsville and the assessment of positive socio-economic impact of a potential trackless tram solution for the corridor of interest, it is concluded that such technology that enables the creation of focal-point stops (nodes) along the route would provide a novel and engaging urban renewal mechanism for helping Townsville's residents, visitors and student populations to connect with education, services and retail. It provides a timely opportunity to commence next-step studies into the local context application of this innovative public transport option.

The value uplift modelling result of an uplift in the order of 6% (average) for the corridor indicates a range of social, economic and environmental benefits to be realised. Key benefits include a creation of an easy access and mobility, creation of jobs, improvement of land use productivity, labour productivity, and economic diversity, increase in surrounding property value. The Trackless Tram could be proposed as the end point of a sustained transition from the old and unpopular to a modern, and well utilised transit system. When compared to alternative systems such as Light Rail which has to be delivered in one hyper expensive tranche by its nature, the trackless tram system can be built incrementally.

6.1 Renewal potential - implications

The majority of major shopping centres as defined and zoned under the Townsville City Plan (including supermarkets, cinemas and other large retail) are within 2km of the proposed corridor, in addition to JCU.

The liveability of city's residents could be enhanced with associated benefits for education, health and retail services along Flinders Street, Charters Towers Road and Ross River Road as follows:

Residents (owners and renters) - Housing & CBD activation: Through the analysis of CoreLogic RP data it is evident that the property pricing over the last six years has been stagnant for houses, land and units. This highlights an opportunity to boost up the economy through property diversity and affordability:

- Introducing residential blocks into CBD, including a mix of different occupants, commercial, residential and retail services; and
- Enabling strata titling apartment complexes to facilitate service apartments, facilitating rent to owner occupied properties and tourism.

Visitors - Tourism: Townsville is host to World Heritage-listed national parks and lush tropical gardens - it is important to leverage such natural landscapes and attractions to increase tourism operations. Townsville also has a deep-sea port in proximity to the CBD:

- Port redevelopment could facilitate increase in ocean-faring visitors (e.g. cruise boats);
- Addition of international flights direct into Townsville;
- Tourism development particularly along Palmer street.

Residents & Tourists - Transport: While taking advantage of the three-year roll-out of modernising ticketing and timetabling systems already being implemented by TMR, due for completion in 2021 Townsville could explore opportunities of using emerging technologies to unlock urban potential:

- Connecting people from the outer suburbs to the main corridor using alternative modes of transport;
- Enabling multipurpose uses for transit technologies, including mass movement of community in times of crisis (e.g. evacuation purposes); and
- Providing Australian data on the suitability of this technology, in collaboration (e.g. local university – government – industry), including specifications and compliance with legislation and standards etc.

Education & Research: There are number of associated opportunities to improve edu-tourism in the region, complementing JCU's reputation for marine and tropical sciences offerings:

- Improving the JCU international ranking regarding accessibility, with the tertiary education sector-international student market focussed on international ranking;
- Addition of international flights directly into Townsville to attract more international students; and
- Staging a pilot site on the JCU campus, engaging with other research institutions such as the Great Barrier Reef Marine Park Authority, Department of Agriculture, Fisheries and Forestry, the CSIRO and Australia's largest Defence Force community.

Health – Townsville Health and Hospital Service (THHS): Understanding that Townsville city is the main centre for government administration outside Brisbane, in addition to regional health services provided by the Townsville University Hospital:

- There are opportunities for patients visiting from Asia for specialist treatment; and
- There is an appealing choice of workplace for trainee doctors, foreign doctors and consultants.

6.2 Building the business case - implications

The next steps towards Townsville's renewal and revitalisation, could include building conditions conducive to an upswing in development along the proposed corridor, alongside the three-year roll-out of modernising ticketing and timetabling systems already being implemented by TMR (due for completion in 2021):

- Consider the best collaborative investment next step to demonstrate strong alignment of three levels of government through city deal - strong precinct wide governance would enable THKP to harness best urban renewal outcomes in Townsville
- Discuss with Sunbus, with regard to future services and vehicle innovations - Smart and resilient transport solutions considering climate, geography, socio-economic conditions
- Advocate to be one of Australia's first trial sites for local evaluation of the technology and associated specifications with the support of SBEnrc
- Develop strategies to improve conditions, addressing coolth and comfort of connecting corridor multi-modal routes
- Incorporate disaster recovery response strategies using the same infrastructure
- Improve accessibility for students at JCU and patients in Townsville Heath and Knowledge Services area, through on-campus mobility options

6.3 Creating the evidence base

While a detailed cost and benefit analysis was beyond the scope of this study, the results provide a framework for subsequent evaluation. This includes the following analysis to demonstrate public benefit and feasibility:

- Land use transport modelling - better understand travel patterns to major nodes as well as experiences, expectations and aspirations of key places within the city (e.g. CBD, -TropiQ).
- Transport use survey – Adapt the existing UQ transport survey as a possible feed in to TMR strategies, including a Survey on car ownership and use.
- Assess the risk of proposed options, including simulation tools and statistical analysis to quantify the magnitude of risks and its impact on the project objectives.

The researchers will bring to the project findings and learnings from investigation in other case studies examined through Project 1.62 of the SBEnrc *Sustainable Centres of Tomorrow*. This will help to inform next steps with regard to commentary on physical attributes of the trackless tram systems, costing, specification testing (for Australian operations) and trial trajectories, and process and governance needs to take the initiative forward.

These next steps will occur alongside the three-year roll-out of modernising ticketing and timetabling systems already being implemented by the Department of Transport and Main Roads, due for completion in 2021. The activities could also enable discussions to begin with the major public transport operator in Townsville (Sunbus), with regard to future services and vehicle innovations. Townsville has the potential to become a leader in evaluating this technology for integration within transport infrastructure in Australia and overseas through onsite trialling and performance evaluation.

References

- Brown, V. A. (2008). *A Collective Social Learning Pattern*. Paper presented at the EuroPLOP.
- City of Townsville (2019), Liveability study. Retrieved from <https://www.townsville.qld.gov.au/about-townsville/living-in-townsville/liveability>
- City of Townsville. (2019). Mobility in Townsville. Retrieved from <https://www.townsville.qld.gov.au/about-townsville/living-in-townsville/mobility-in-townsville>
- City of Townsville (2020), Townsville City Plan. Retrieved from <http://eplanning.townsville.qld.gov.au/Pages/Plan/Book.aspx?exhibit=current>
- City of Townsville (2014), Priority Development Area. Retrieved from <https://www.townsville.qld.gov.au/building-planning-and-projects/council-projects/priority-development-area>
- 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. Retrieved from https://watersensitivecities.org.au/wp-content/uploads/2018/06/TransitionReport_Townsville_R5-WEB-FINAL.pdf
- ISO (2018) ISO 31000:2018(en)Risk management — Guidelines. Retrieved from <https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en>
- Idcommunity (2016). Townsville City Council- housing Tenure. Retrieved from <https://profile.id.com.au/townsville/tenure>
- Idcommunity (2016). Townsville City Council- Migration by age and location. Retrieved from <https://profile.id.com.au/townsville/migration-by-age-by-location>
- Idcommunity (2019). Townsville City Council- Employment by industry (Total). Retrieved from <https://economy.id.com.au/townsville/employment-by-industry>
- Idcommunity (2016). Townsville City Council- Resident workers - Method of travel to work - All industries. Retrieved from <https://economy.id.com.au/townsville/travel-to-work>.
- Idcommunity (2016). Townsville City Council- Household type. <https://profile.id.com.au/townsville/households?BMID=40>
- Idcommunity (2016). Townsville City Council- Employment status. Retrieved from <https://profile.id.com.au/townsville/employment-status?BMID=50>
- Idcommunity (2016). Townsville City Council- Education institution attending. Retrieved from <https://profile.id.com.au/townsville/education?BMID=50>
- James Cook University (n.d), Why JCU?. Retrieved from <https://www.jcu.edu.au/courses-and-study/why-jcu>
- Jiang, N., Pacheco, G., & Dasgupta, K. (2019). Understanding the transient population: insights from linked administrative data. *Journal of Population Research*, 36(2), 111-136.
- Keen, M., Brown, V., & Dyball, R. (2005). Social learning in environmental management. *London: Earthscan*.
- PlaceScore (2019), Townsville city council community insights report. Retrieved from https://www.townsville.qld.gov.au/data/assets/pdf_file/0019/75610/2019_Townsville_Nhood-CIR_1.0.pdf

- Queensland Government, Department of Housing and Public Works (2017). Retrieved from https://www.hpw.qld.gov.au/_data/assets/pdf_file/0023/8195/regionalfactsheettownsville.pdf
- Queensland Government, Department of Housing and Public Works (2018). Annual Report (2017-2018). Retrieved from <https://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2018/5618T1467.pdf>
- Queensland Government, Department of Transport and Main Roads (2019). Retrieved from <https://www.tmr.qld.gov.au/About-us/Corporate-information/Publications/Regional-Transport-Plans>
- Queensland Government, Townsville Hospital and Health Services (2018), Annual report, Retrieved from <https://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2018/5618T1705.pdf>
- Queensland Government. (2019), Townsville State Development Area 2019 Retrieved from <https://www.statedevelopment.qld.gov.au/resources/plan/cg/townsville/townsville-development-scheme-2019.pdf>
- Queensland Government (2016) Advancing our cities and regions strategy. Retrieved from <https://www.statedevelopment.qld.gov.au/resources/brochure/edq-advancing-our-cities-and-regions-strategy.pdf>
- Queensland Government (2018), Queensland Government population projections, 2018 edition: Queensland. Retrieved from <https://www.qgso.qld.gov.au/issues/2671/qld-government-population-projections-2018-edn.pdf>
- Townsville City Council (2015) Retail information. Retrieved from https://www.townsville.qld.gov.au/_data/assets/pdf_file/0026/9359/PDI0302-006-Retail-information-sheet.pdf
- Townsville City Council (2008). State of the Environment. Retrieved from <http://www.soe-townsville.org/summary/index.html>
- Townsville City Council. (2019). Community Insights Report. Retrieved from https://www.townsville.qld.gov.au/_data/assets/pdf_file/0019/75610/2019_Townsville_Nhood-CIR_1.0.pdf
- Townsville City Deal. (2018). Annual Progress Report 2018. Retrieved from <https://www.infrastructure.gov.au/cities/city-deals/townsville/files/townsville-city-deal-2018-progress-report.pdf>
- Townsville Queensland Solar City (2013), Final report. Retrieved from https://www.ergon.com.au/_data/assets/pdf_file/0010/310996/Townsville-Solar-City-Final-Report_2006_2013.pdf
- The State of Queensland (2016), Draft International Education and Training Strategy to Advance Queensland. Retrieved from <https://www.cabinet.qld.gov.au/documents/2016/Jun/IETSdraft/Attachments/DraftStrategy.pdf>
- Townsville City Council (2016) Housing Tenure. Retrieved from <https://profile.id.com.au/townsville/tenure>
- AEC Group (2019) TropiQ - Townsville Tropical Intelligence & Health Precinct Retrieved from https://issuu.com/townsvillehospitalandhealthservice/docs/tropiq_brochure_spreads
- Zou, P., Alam, M., Sanjayan, J., Wilson, J., Stewart, R., Sahin, O., Ellis-Jones, D. (2016). Managing risks in complex building retrofit projects for energy and water efficiency. International Conference on Innovative Production and Construction (IPC 2016), At Perth, WA, Australia

ATTACHMENT 1: Place Making Framework applied to Townsville (major reports)

| Place Making Framework Core Principles & Elements | Key Report (Coordinating Agency/Authors, year) | | | | | | | | | | | | | | | |
|--|--|-----------------------------------|--------------------------------|--------------------------------|--------------------|--------------------|---------------------------------------|-----------------------------|-------------------------------|------------------------|--------------------------------------|-------------------------------------|--------------------------------|----------------------------------|----------------------------|---|
| | Townsville City Deal Progress report | Townsville SDA Development Scheme | North Queensland Regional Plan | NW QLD Regional Transport Plan | DTMR Annual Report | DHPW Annual report | Queensland Housing Strategy 2017-2027 | State of Environment report | TCC Community Insights Report | Mobility in Townsville | Townsville Integrated Transport Plan | Townsville Retail Information Sheet | Townsville Solar Cities Report | Energy Transformation Townsville | Tropic Economic Assessment | Vision & Transition: Water Sensitive Townsville |
| | Nat. | QLD | QLD | QLD | QLD | QLD | QLD | QLD | TCC | TCC | TCC | TCC | TCC | TCC | TropiQ | Nat |
| | 2019 | 2019 | 2019 | 2019 | 2018 | 2018 | 2017 | 2008 | 2019 | 2019 | 2019 | 2015 | 2013 | 2015 | 2019 | 2018 |
| 1. Precinct safety and accessibility: <i>The development should be safe and healthy for people waiting to access transport nodes</i> Human centred design Walkable urban design Place and movement design | | | | | | | | | | | | | | | | |
| 1.1 Safe and accessible nodes connectivity | ● | | ● | | ● | ● | ● | | ● | ● | ● | ● | | | ● | |
| 1.2 Cool and comfortable (shelters, paths) | | | | | ● | ● | ● | | ● | | | | ● | | ● | ● |
| 1.3 Safe, natural and open spaces | | | | | | | | | ● | | ● | | | | | ● |
| 1.4 Frequent and integrated | | | ● | ● | ● | | | | ● | ● | ● | | | | | |
| 1.5 Resilience (economic recovery) | | ● | ● | ● | ● | ● | | ● | | | ● | | | | | ● |
| 2. Carbon neutral - positive approach: <i>The development should aim for carbon positive, being at least zero carbon, in both power and transport</i> Solar passive design Solar active design Carbon neutral analysis | | | | | | | | | | | | | | | | |
| 2.1 Solar powered with energy storage | ● | | ● | | | | ● | | ● | | | | ● | | | |
| 2.2 Low carbon transport approach | | | ● | ● | ● | ● | | | | | ● | ● | | | | |
| 2.3 Hydrogen fuel cell vehicles | | | ● | | ● | | | | | | | | | | | |

| Place Making Framework Core Principles & Elements | Key Report (Coordinating Agency/Authors, year) | | | | | | | | | | | | | | | |
|--|--|-----------------------------------|--------------------------------|--------------------------------|--------------------|--------------------|---------------------------------------|-----------------------------|-------------------------------|------------------------|--------------------------------------|-------------------------------------|--------------------------------|----------------------------------|----------------------------|---|
| | Townsville City Deal Progress report | Townsville SDA Development Scheme | North Queensland Regional Plan | NW QLD Regional Transport Plan | DTMR Annual Report | DHPW Annual report | Queensland Housing Strategy 2017-2027 | State of Environment report | TCC Community Insights Report | Mobility in Townsville | Townsville Integrated Transport Plan | Townsville Retail Information Sheet | Townsville Solar Cities Report | Energy Transformation Townsville | Tropic Economic Assessment | Vision & Transition: Water Sensitive Townsville |
| | Nat. | QLD | QLD | QLD | QLD | QLD | QLD | QLD | TCC | TCC | TCC | TCC | TCC | TCC | TropiQ | Nat |
| | 2019 | 2019 | 2019 | 2019 | 2018 | 2018 | 2017 | 2008 | 2019 | 2019 | 2019 | 2015 | 2013 | 2015 | 2019 | 2018 |
| 2.4 Sustainable urban design | | | | ● | | | ● | | ● | | | | ● | | | |
| 2.5 Low embodied energy infrastructure | | | | | | | | | | | | | | | | |
| 3. Local shared mobility: <i>The development should encourage diverse local modal services to access the transit service, with defined spaces</i> Local mobility design Feeder transport design Mobility as a service | | | | | | | | | | | | | | | | |
| 3.1 Modernised systems e-ticketing | | | | | ● | | | | | | | | | | | |
| 3.2 Real-time data available to all | | | | ● | ● | | | | | | | | | | | |
| 3.3 Paths that connect communal amenity | | | | ● | | | | | | ● | ● | | | | | |
| 4. Property diversity: <i>The density and urban mix should contribute to urban regeneration</i> Community engaged planning Agglomeration economy analysis Financial modelling | | | | | | | | | | | | | | | | |
| 4.1 Robust and current survey data | ● | | | | | ● | ● | | ● | | | | | | ● | |
| 4.2 Mapped population clusters, by type | | | | | | | | | | ● | | | | | | |
| 4.3 Long term planning considerations | ● | ● | | ● | ● | | ● | | | | | | ● | | ● | |
| 5. Property affordability: <i>The development should include diverse property options to provide affordable living as well as affordable housing</i> Social housing analysis Life cycle assessment Sustainability operational analysis | | | | | | | | | | | | | | | | |

| Place Making Framework Core Principles & Elements | Key Report (Coordinating Agency/Authors, year) | | | | | | | | | | | | | | | |
|---|--|-----------------------------------|--------------------------------|--------------------------------|--------------------|--------------------|---------------------------------------|-----------------------------|-------------------------------|------------------------|--------------------------------------|-------------------------------------|--------------------------------|----------------------------------|----------------------------|---|
| | Townsville City Deal Progress report | Townsville SDA Development Scheme | North Queensland Regional Plan | NW QLD Regional Transport Plan | DTMR Annual Report | DHPW Annual report | Queensland Housing Strategy 2017-2027 | State of Environment report | TCC Community Insights Report | Mobility in Townsville | Townsville Integrated Transport Plan | Townsville Retail Information Sheet | Townsville Solar Cities Report | Energy Transformation Townsville | Tropic Economic Assessment | Vision & Transition: Water Sensitive Townsville |
| | Nat. | QLD | QLD | QLD | QLD | QLD | QLD | QLD | TCC | TCC | TCC | TCC | TCC | TCC | TropiQ | Nat |
| | 2019 | 2019 | 2019 | 2019 | 2018 | 2018 | 2017 | 2008 | 2019 | 2019 | 2019 | 2015 | 2013 | 2015 | 2019 | 2018 |
| 5.1 A mix of housing lines (rent, purchase) | ● | | | | | ● | ● | | | | | | | | | |
| 5.2 Housing choice/ diversity | | | | | | ● | ● | | | | | | | | | |
| 5.3 Medium density residential housing | | | ● | | | | | | ● | | | | | | | |
| 6. Nature-loving and biodiverse spaces: <i>The development should include and connect biophilic and biodiverse greenspaces, supporting endemic species and habitat</i> Biophilic design Water sensitive design Landscape oriented design | | | | | | | | | | | | | | | | |
| 6.1 Cool and comfortable | | | | | ● | ● | ● | | ● | | | | ● | | ● | ● |
| 6.2 Water sensitive design | | | | | | | | | | | | | | | | ● |
| 6.3 Along and connecting corridors | | | | | | | | | ● | | ● | | | | | ● |
| 7. Inclusive, integrated place-based planning: <i>Planning, design and implementation (operation, maintenance) should involve diverse stakeholders and all tiers of government to provide an integrated place-based approach</i> Joined up governance analysis Partnership analysis Procurement option analysis | | | | | | | | | | | | | | | | |
| 7.1 Collaboration among key stakeholders | ● | | | | | | | ● | | | | | | | ● | |
| 7.2 Inclusive governance | ● | | | | ● | ● | | ● | | | | | | | | ● |
| 7.3 Working across agencies | | | ● | ● | ● | ● | | | | | | | | | | |

ATTACHMENT 2: Stakeholder Consultation Notes (by interviews and document analysis)

| Stakeholder | Key priorities | Key perceived barriers to corridor urban revitalisation | Key perceived opportunities with corridor improvements |
|--|---|---|--|
| Department of Defence* | <ul style="list-style-type: none"> An attractive and functional destination for its employees and their families | <ul style="list-style-type: none"> Predominantly a private vehicle situation for getting around in Townsville Lack of reasons to stop along the corridor, more of a thoroughfare to get to the CBD and Strand | <ul style="list-style-type: none"> Enhanced amenity for its employees and their families Improved sense of connectedness with Townsville |
| James Cook University | <ul style="list-style-type: none"> JCU has a growth plan for attracting a significant number of international students especially for courses related to marine science The University is seeking to enhance its international reputation, continuing to build links with Asia The University is working on student retention beyond first year, to keep students at JCU rather than students transferring to southern universities The University aspires to having a 'Sticky Campus' where students remain on campus before and after course work formalities | <p>There is frustration with the lack of supporting transport systems facilitating student mobility between the campus, the CBD and the waterfront, including:</p> <ul style="list-style-type: none"> Accessibility to and from campus, especially for students residing in JCU on-campus accommodation and outer suburbs, and working in other urban centres, the waterfront or the CBD Intermittent bus services that also do not operate after 6pm (JCU business courses run 6-9pm) A low perceived sense of personal safety (Students and Staff) <p>This sentiment is evident in a third-party survey of student satisfaction, where JCU ranked last in Australia for public transport satisfaction.</p> <p>There was also commentary about a lack of sense of 'arrival' at JCU, with supporting on-campus mobility services (e.g. on-campus bus, e-bikes, segways, scooters etc).</p> | <ul style="list-style-type: none"> A Trackless Tram System initiative could promote educational and research opportunities within related disciplines such as engineering and business, in collaboration with others There could be an opportunity to develop an edu-tourism strategy for Townsville that identifies and develops edu-tourism activities and facilities for recreational travellers, school and study groups and research community Ongoing development of key international student markets through Study Queensland and Study Townsville This initiative could leverage the existing attractive cycleways and help to encourage active transport Catalyst for developing shade (n/b location in the Dry Tropics with sporadic, intense rainfall), community gardens, vistas etc to improve the amenity value of on-site and surrounding infrastructure - potential uplift in property value |
| QLD Department of Housing and Public works | <ul style="list-style-type: none"> The Department aspires to help enable urban renewal and revitalisation in Townsville The Department seeks to offer affordable and diverse housing solutions to the community that meet the current needs of the population. This includes a focus on high-rise apartment style living close to amenities and public transport. | <ul style="list-style-type: none"> Current lack of community support to deliver multi-level apartment style accommodation within Townsville suburbs, in spite of existing planning provision for such development Lack of evidence regarding the benefits of a different transport nodal scenario along this corridor (more studies needed) | <ul style="list-style-type: none"> This initiative addresses the Department's internal aspirations with regard to City Deal, to urban renewal and revitalisation This initiative provides an opportunity to undertake local land use transport modelling It helps to address the untapped demand for different types of housing (i.e.: two-bedroom apartments) |
| QLD Department of Transport and Main Roads | <ul style="list-style-type: none"> Vision of mobility as a service for Queenslanders, with a long-term perspective on creating conditions conducive to transit oriented | <ul style="list-style-type: none"> Could undermine (pre-empt) modernisation efforts currently underway (2019-2021) to firstly address low public patronage of the current public transport (PT) | <ul style="list-style-type: none"> Opportunity to investigate data analytics initiatives to better understand travel patterns to major nodes as well as experiences, expectations and aspirations of key places within the city (e.g. CBD, Douglas Health and Knowledge |

| Stakeholder | Key priorities | Key perceived barriers to corridor urban revitalisation | Key perceived opportunities with corridor improvements |
|-------------------------|---|---|---|
| | <p>development and associated transport technologies</p> <ul style="list-style-type: none"> • Focus on ensuring reliability of trunk road connector services and improving patronage of existing routes • Operating within the context of an existing state-wide prioritisation of public transport investment, noting the relatively good performance of the proposed transport route and modernisation efforts underway including ticketing, real time data access, bus stop improvements (i.e. low priority for further investment) • Five-yearly contract with Sun-bus (renewed in 2019), with exclusive road access arrangements for public transport | <p>system – behaviour change important in advance of novel technology solution</p> <ul style="list-style-type: none"> • Lack of supporting context to justify the capital cost of shifting to alternative vehicles (e.g. trackless tram), given priorities elsewhere • Unknown technical and planning complexities that would arise for a trackless tram system related to bus stop rationalisation, design standard compliance, better shelters, side frictions and ability of batteries to perform in tropical climates (speed and inclines) • Future challenge in meeting the demands of future disconnected residential development in different areas of the city that are already approved | <p>Precinct) – including updating key surveys to be consistent and meaningful</p> <ul style="list-style-type: none"> • Opportunity to investigate smart transport solutions for Townsville, considering climate, geography, socio-economic, disaster-tolerant, weather responsive • Potential opportunity for City Deal participants interested in this initiative, to engage with local transport provider (Sun-bus) to consider future trials and partnership opportunities • Improving perceptions and visibility of the network in providing mobility as a service for Queenslanders |
| Stockland | <ul style="list-style-type: none"> • Current 50-50 partnership with AMP capital • Extensive offerings to the direct population and services the high end and speciality needs of broader regional centres • Need to stack up the business case for future developments • Future development of a community infrastructure with green open spaces, pop-ups stores and cinema facilities to develop the financial business case for future developments | <ul style="list-style-type: none"> • Current obstructions and safety threats posed by squatters • Poor choice of employees as a workplace • Lack of flood immunity in current retail property • Lack of connectivity and frequent public transport to and from Stockland | <ul style="list-style-type: none"> • Significant potential exists to establish new specialist retail outlets and national and international franchises. • Ongoing commercial and residential development, combined with significant natural amenity will support • Retail growth in Townsville’s CBD. Townsville City Council is actively involved in major initiatives including a new 97 ha waterfront development within the CBD. • Invest Townsville aims to secure investment that will play a strategic role in the economic growth of the city. • Thuringowa Central has the potential to develop as a major retail and lifestyle hub, servicing rapid population growth in Townsville’s north-western suburbs. |
| Townsville City Council | <ul style="list-style-type: none"> • This initiative must address the revitalisation of the CBD as a priority • This corridor must be part of City-wide efforts (e.g. as a leading initiative that can be augmented and replicated), to improve public transport options for Townsville residents and visitors • Townsville City Council advocates for ‘Cool and comfortable’ design solutions for the built environment and associated infrastructure | <ul style="list-style-type: none"> • Council has limited funds but an engaged community that is committed to a thriving city • There is a lack of readily available, frequent, reliable transport systems for the Townsville community to use • Challenges of corridor improvements to deal with design constraints (e.g. clearance to structures with Energy Queensland) | <ul style="list-style-type: none"> • Opportunity to facilitate a technology trial in Townville enabling normalising and socialising people to the technology • Opportunity to promote Townsville communities to shift to active transport with shared pathways, part of reshaping the city to make it more pedestrian-oriented • Potential to align with developing a greening strategy with design guideline and informed by the CRC for water sensitive cities and complete Streets approach |

| Stakeholder | Key priorities | Key perceived barriers to corridor urban revitalisation | Key perceived opportunities with corridor improvements |
|---|--|---|--|
| Townsville Hospital and Health Services | <ul style="list-style-type: none"> • The Townsville Hospital is a public tertiary care hospital in Douglas, Townsville, Queensland, Australia, and the largest facility within the Townsville Hospital and Health Service geographic area • Has the vision to provide timely and high-quality healthcare services • Has developed co-ordinated communications and branding strategy for Townsville that articulates its competitive strengths and its place-based opportunities • Has developed an over-arching structure or master plan for the Tropical Intelligence & Health Precinct (TropiQ) to establish it as an integrated precinct, rather than a collection of precincts | <ul style="list-style-type: none"> • Lack of a well-integrated, frequent and reliable transport system accessible for the university, the hospital, the army barracks • Lack of attention to inclusive public transport options that enable people needing health care to easily get to and from appointments and treatment (i.e. stable, comfortable, affordable ride options) | <ul style="list-style-type: none"> • Opportunity to undertake SASR of providing a high quality, high frequency shuttle service between the CBD and Health and Knowledge Precinct. • Conduct ongoing development of research and clinical delivery of tropical health to continue to build on existing competitive advantage. • Formulation of place strategies for Townsville CBD and Health and Knowledge Precinct • Consider the emerging technology elements such as mobility user service, electric rideable, how do these things fit together |

* Interviews were not able to be conducted, so notes are based on commentary received during previous meetings and documents available with regard to City Deal aspirations and TKHP discussion