Route Strategy: Tugun to Coolangatta

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Tugun to Coolangatta Multi Modal Corridor Study
29 June 2022

Route Strategy: Tugun to Coolangatta

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Document history and status

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0	14/4/22	Draft final for review				
1.1	29/6/22	Final issue				

Any content relating to the Gold Coast Airport, Gold Coast Heavy Rail Extension and personal information (for example names) have been removed from this report.

Gold Coast Airport will confirm the light rail route and station location serving the airport precinct as part of their master planning development.

Possible future heavy rail extension and station is subject to a separate planning project by TMR and further information can be found at: https://www.tmr.qld.gov.au/projects/gold-coast-heavy-rail-extension-varsity-lakes-to-gold-coast-airport

The Appendices have been removed due to the technical nature of these documents.

Jacobs Group (Australia) Pty Limited

32 Cordelia Street
PO Box 3848
South Brisbane, QLD 4101
Australia

T +61 7 3026 7100
F +61 7 3026 7300
www.jacobs.com

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Executive summary

Overview

This report is the final deliverable for the Tugun to Coolangatta Multi Modal Corridor Study. The principal purpose of the study was to consider the strategy, needs and functions of all modes of transport, including integration and interfacing requirements over the planning horizon to 2041, within the study corridor. The study's ultimate purpose was to identify the land requirements to enable implementation of a preferred range of transport infrastructure solutions including for Light Rail, buses, pedestrians, bike riders, private transport (including freight) and prevent encroachment by development.

The extent for this Route Strategy is from Boyd Street, Tugun to the QLD/ NSW border at Coolangatta. The corridor is approximately 5km in length and includes the Gold Coast Highway plus its service roads (Coolangatta Road and Golden Four Drive) as well as land within the airport terminal precinct, between Tugun and Kirra. Between Kirra and the NSW border the study corridor encompasses both Musgrave Street/ Marine Parade to the north and Coolangatta Road/ Tweed Street to the south. For the purpose of this study, the corridor has been split into four sections as follows Bilinga, Airport, Kirra and Coolangatta

This report provides detailed background information on existing conditions, discusses future issues (including opportunities and constraints) and outlines the strategic drivers for investigating changes to transport infrastructure and services within the corridor. This document then sets the 'vision' for the corridor and describes the option development and option assessment in later stages of the project. Finally, this document describes the preferred option in terms of new and augmented transport infrastructure within the study area.

Planning context

After reviewing relevant policy and strategy documents, the following specific directions and desired changes were identified to help guide this study:

- Light Rail between Broadbeach South and Coolangatta is a key assumption of higher order plans such as the South East Queensland Regional Plan (*ShapingSEQ*) and Regional Transport Plans for South East Queensland and therefore will need to be accommodated in any corridor planning.
- Upgraded high quality (principal) cycle facilities are expected to be provided as a priority (within the next 10 years) – this includes facilities on the Gold Coast Highway/Coolangatta Road corridor to support the existing Oceanway shared path facility on the coastal corridor
- Transport and land use planning should seek to complement the outcomes of the Burleigh Heads to Tugun Route Strategy whereby through traffic is encouraged to use the M1 to support a more attractive and liveable coastal corridor. Nevertheless, the Gold Coast Highway from Stewart Road (Tugun-Currumbin Road) to the airport will need to remain an efficient movement corridor to cater for oversized and hazardous goods vehicle as well as support Tugun Bypass tunnel closures.
- The Gold Coast Airport is a key destination within the 'Southern Gateway' Regional Economic Cluster. Improving access to this node (which will increasingly accommodate more than just airport passengers and workers) from the wider region, through a wider range of mode options is a major opportunity.
- There is need to accommodate population growth and additional housing within the corridor which is within the existing urban footprint, in order to protect green spaces. However, development and density should provide variety and should enhance the character of the southern Gold Coast villages and centres.

Current situation

The Tugun to Coolangatta study area is physically constrained by the Pacific Ocean to the east and the Cobaki Broadwater to the west. Within this part of the City of Gold Coast, the Gold Coast Highway and the M1 (Pacific Motorway) are the primary transport links. The Gold Coast Highway between Tugun and Kirra performs a key north-south arterial road function carrying an average annual daily traffic (AADT) of 39,000 in 2019 (2019 AADT Report) and 38,000 AADT in 2020 (2020 AADT Report), while the M1 to the west provides a regional and national north-south motorway function, carrying almost 64,000 vehicles per day in 2019 south of Stewart Road (2019 AADT Report). The AADT on the M1 was significantly affected by COVID-19 in 2020 and 2021 due to the QLD/NSW border closure, reducing to 38,000 in 2020.

The Gold Coast Highway (and its parallel service roads) are a dominant feature within the Bilinga, Airport and Kirra sections of the study area. East of the airport, the nature of the road network is much less strategic with Coolangatta Road/ Tweed Street and Musgrave Street/ Marine Parade forming 'distributor' type roads links between the Gold Coast Highway and the twin towns of Coolangatta/ Tweed Heads.

Along the coastal corridor, a strategic off-road shared path called the Oceanway, provides an attractive and uninterrupted facility for pedestrians and bike riders.

Within the study area are two high frequency bus routes, the 700 operating from Tweed Heads to Broadbeach South and the 777 operating from Gold Coast Airport to Broadbeach South (limited stops). These are supported by a range of connector, local and school bus routes.

Overall, the Tugun to Coolangatta study area is a multi-modal corridor in nature carrying general traffic, high frequency bus services as well as pedestrians and bike riders.

Route planning pressures

Population projections for Queensland are developed by the Queensland Government Statisticians Office (QGSO) for forecast years including 2041 where TMR allocates these forecasts to specific "zones" to be used for transport model forecasting purposes based on their future planning. For this project, the TMR (QGSO2018) was adopted to forecast population and employment growth which was done by analysing the zones within the study area (between Boyd Street, Warner Street and Airport). Based on this analysis, over a 22-year period between 2019 and 2041 the residential population of the study area is projected to rise from 7,200 to 11,800 (a 64% increase) and employment to rise from 5,700 to 7,700 (a 35% increase). Most of the population growth is along the coastal strip straddling the Gold Coast Highway.

Analysis of future traffic volumes and passenger movements using the Gold Coast Strategic Transport Model (GCSTM) was undertaken to inform the scale of change and growth in transport demands between:

- Base 2019 GCSTM scenario and
- Future2041 GCSTM scenarios
  - No road network changes in QLD compared to 2019
  - Light Rail extended to Burleigh Heads

The analysis found that between 2019 and 2041:

- North of Stewart Road, trips on the Gold Coast Highway are estimated to increase by 10% (increase of 2,800 vehicles per day) however Pacific Motorway (M1) volumes increase by 76% from 95,700 to 168,100 vehicles per day between 2019 and 2041. Public transport accounted for 18% of total trips on the Gold Coast Highway in 2019 but reduce to 14% of total trips in 2041 (as vehicle trips increase while public transport trips remain similar).
- All trips on the Gold Coast Highway south of Stewart Road are estimated to increase substantially:
  - North of Boyd Street traffic volumes are estimated to increase by 85%, carrying up to 74,900 vehicles per day.

  - South of Boyd Street: traffic volumes are estimated to increase by 62% (from 40,400 vehicles per day in 2019 to 65,600 vehicles per day in 2041) and by 156% south of the Gold Coast Airport (to 37,900 vehicles per day in 2041)
- Coolangatta Road and Musgrave Street in Kirra each increase by around 50% with volumes approximately 17,900 vehicles per day on each corridor.

These transport analyses illustrate that there will be substantial traffic growth in the network, without enhanced public transport especially on the Gold Coast Highway south of Stewart Road (85% - 156% growth within Bilinga) and on the M1 Pacific Motorway north of Stewart Road (59%-76% growth and approx. 168,100 vehicles per day). This reinforces the opportunity that enhanced public transport could play in managing the growth in transport demand on the southern Gold Coast and reduce pressure on the road network by 2041. A key conclusion is the need to protect the corridor to allow for Light Rail to be implemented, in some form, at some point in the future.

Route vision

Using the findings from the analysis of existing conditions and future challenges, combined with stakeholder inputs and feedback, an overarching vision statement for this project's study area was developed as follows:

"The Tugun to Coolangatta corridor will connect the southern Gold Coast and its collection of distinct and unique places, with their varied character, density and scale. The corridor and communities along it will connect seamlessly through cross-corridor connections and to the wider city and region with enhanced public and active transport facilities as alternatives to private vehicle travel. Light Rail stations served by frequent, reliable G: link services, will integrate with and further activate key precincts, villages and centres (including the airport precinct). Appropriate and diverse land uses will establish within a comfortable walking distance of the stations, contributing to more vibrant and affordable communities. High quality active transport infrastructure will complement major public transport investment to help in sustainably accommodating more people as the corridor becomes a more desirable place in which to live, work, learn and play."

This vision was supported by service requirements for the four distinct sections of the study area: namely Bilinga, Airport, Kirra and Coolangatta, which were used to guide the option development process.

Longlist options

Option development involved first developing a longlist of LRT alignment options, followed by further design development and assessment of a shortlist of more detailed layout options.

Longlist option development and assessment was, in itself, a multi stage process that involved:

- Step 1: Identifying the most feasible corridor(s) within each section of the study area. For Bilinga, only one broad corridor (Gold Coast Highway) was identified, with two corridors for the Airport and Kirra precincts and three corridors in Coolangatta.
- Step 2: Identifying the station location investigation areas through a review of current and future resident and employment locations within a five to 10 minute walk of Light Rail. As a result, five broad station location areas were recommended, namely Bilinga, Airport, North Kirra, Kirra and Coolangatta with an overall average station spacing of between 900-950m.
- Step 3: Taking the agreed corridor and station locations above, basic option concepts were developed. Key alignment features and cross section arrangements were identified, with consideration for the issues and opportunities for each option that may require further investigation.
- Step 4: The basic concepts and supporting information was presented to key stakeholders from TMR and the City of Gold Coast in May 2021. Feedback on each option was recorded and used to finalise the long list prior to evaluation.
- Step 5: A high level assessment framework was then developed and applied to help 'filter' the longlist corridor options down to a shortlist. This qualitative multi criteria analysis (MCA) was developed to be consistent with TMR Smarter Solutions MCA tool.

This process resulted in two shortlist options in each of the four sections of the study area, with the ability for any option in one section to be combined with any option in the adjacent section.

Shortlist options

For the shortlist options (two per study area section) that passed through the longlist filter, each was subject to further testing and refinement including:

- Different traffic access/ intersection configuration options
- Different Light Rail alignment options (within the selected corridor)
- Different station location sub-options (within the recommended investigation areas)

Through this refinement stage, the project team were able to identify the issues and opportunities with each option. The final refined short-listed options were:

- B1-3: Between Gold Coast Highway and Golden Four Drive through Bilinga
- B2-3: Centre of Gold Coast Highway through Bilinga
- A1-3: Closer to airport terminal through Airport precinct
- A2-3: Closer to Gold Coast Highway through Airport precinct
- K2-2: Musgrave Road, Miles Street and old railway cutting through Kirra
- K3-2: Coolangatta Road and old railway cutting through Kirra
- C2-2: Griffith Street through Coolangatta
- C3-1: Chalk Street through Coolangatta

These eight shortlist options were then assessed using a new MCA specific to the shortlist. The MCA framework was developed in conjunction with TMR and City of Gold Coast and included consideration of the TMR smarter solutions MCA guide, the Infrastructure Australia (IA) MCA guide and the Project corridor vision.

A Technical Working Group (TWG) workshop was held in September 2021 with relevant stakeholders including City of Gold Coast, various TMR divisions and Transport for NSW (TfNSW). Participants reviewed the draft MCA findings and scores for each option and feedback was used to draw the following conclusions:

- In Bilinga, the preferred alignment was between the Gold Coast Highway and Golden Four Drive (known as B1-3). Currently there is significant vegetation in this zone and as such additional investigation was recommended to seek greater visual separation, retain mature trees wherever possible and to deliver a road corridor that creates an entry/gateway statement to the Gold Coast from the Airport;
- In the Airport, the preferred alignment (known as A1-3) resulted in a consolidated multi-modal (Light Rail, heavy rail and bus) public transport facility located between the airport terminal and the proposed new internal Airport distributor road (approx. 150-180m from the airport terminal building). However, it was noted that heavy rail alignment constraints needed to be investigated further to confirm viability of this location;
- In Kirra, Option K3-2 was the recommended preferred concept to take forward, with LRT located within the Coolangatta Road corridor.
- In Coolangatta, the option C3-1 was the recommended preferred concept to be taken forward, with Light Rail located immediately south of Chalk Street;
- The emerging preferred corridor option was therefore identified as B1-3 + A1-3 + K3-2 + C3-1

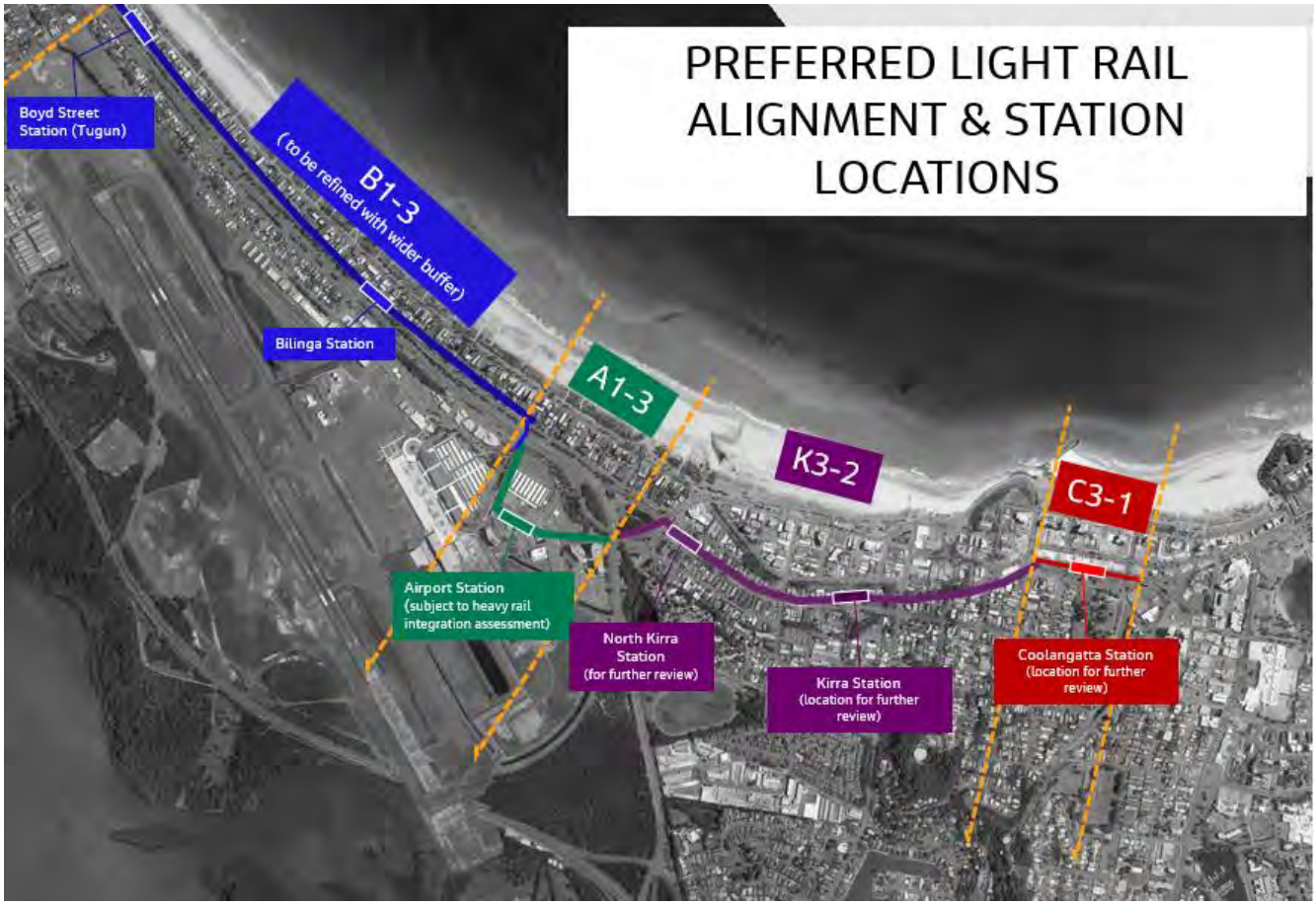


Figure A: Emerging preferred Light Rail alignment and station locations post MCA

Preferred option

The refinement of the emerging preferred corridor option from the MCA included the following steps:

- Review stakeholder feedback and confirm the key design philosophy and design parameters guiding the option refinement
- Undertake additional investigations as required including traffic, land use, geometric design
- Update horizontal design including station location/ configuration and intersection layouts and complete conceptual three-dimensional (3D) design to confirm interfaces with existing features.

The refined preferred option as illustrated in Appendix J of this report included key refinements and changes as described on the following pages.

In **Bilinga**, the horizontal alignment was revised to retain a wider buffer between Golden Four Drive and the LRT corridor allowing some of the existing mature vegetation including Norfolk Island pines, to be retained. Further refinement was also undertaken with regard to local road access and connectivity between the Gold Coast Highway and the two service roads, Coolangatta Road and Golden Four Drive. Light Rail requires a rationalisation of the existing unsignalised accesses to improve safety and efficiency for all road users. The final design includes a new signalised all movement signalised T-intersection near the Airport and signalised access to/ from Gold Coast Highway north at Desalination Plant Road.

Figure B: Light Rail through Bilinga (looking south)

In the **Airport** section, extensive additional investigations were undertaken to inform feasible heavy rail alignments. A reassessment of the shortlisted public transport interchange location options reconfirmed that a station adjacent to the Rydges Hotel, around 150m from the southern end of the terminal building, provided the best outcome overall. Furthermore, the preferred option for the airport created a large area of unused TMR road corridor land between the Gold Coast Highway and the airport. This land was identified as being the optimal location for a new satellite depot and stabling facility for new Light Rail vehicles.

Figure C: Light Rail through Gold Coast Airport precinct (looking towards terminal building)

In the **Kirra** section, further analysis was undertaken of one station versus two with the agreed recommendation to progress with two stations, one at each end of Coolangatta Road to best serve existing and future land uses and the wider catchment. The location and orientation of the Kirra station was refined to reduce land impacts and improve traffic efficiency in the vicinity of Coolangatta Road and Miles Street. Following feedback from City of Gold Coast and further traffic and active transport analysis, changes were made to the cross section of Coolangatta Road to reduce this to one through lane each way, retain on street parking and provide on road cycle lanes.

Figure C: Light Rail through Kirra (looking east along Coolangatta Rd)

In the **Coolangatta** section, investigations were undertaken around specific station location options and following consultation with City of Gold Coast the terminus station was moved to Warner Street. This places the station more centrally to the precinct and provides good connectivity to Griffith Street and Marine Parade. The station location and configuration also considered a potential future extension into Tweed Shire, which is currently to subject of a Transport for New South Wales funded study. Further design development was also undertaken around the station, to include reconfigured at grade car parking, a station plaza area and bus stops/ kiss n ride facilities on Lanham Street. Lastly, options were investigated for the intersection of McLean Street/ Lanham Street/ Chalk Street with a revised arrangement allowing for all movements to/ from Lanham Street west to be retained.

Figure D: Light Rail terminus at Chalk Street/ Warner Street, Coolangatta

Contents

Appendices

The Appendices have been removed due to the technical nature of these documents.

1. Introduction

1.1 Purpose of this report

This report is the final deliverable for the Tugun to Coolangatta Multi Modal Corridor Study. It provides detailed background information on existing conditions, discusses future issues (including opportunities and constraints) and outlines the strategic drivers for investigating changes to transport infrastructure and services within the corridor. This document then sets the 'vision' for the corridor and describes the option development and option assessment in later stages of the project. Finally, this document describes the preferred option in terms of new and augmented transport infrastructure within the study area.

1.2 Project purpose and description

The principal purpose of the Tugun to Coolangatta Multi Modal Corridor Study was to consider the strategy, needs and functions of all modes of transport, including integration and interfacing requirements over the planning horizon to 2041, within the study corridor. The study's ultimate purpose was to identify the land requirements to enable implementation of a preferred range of transport infrastructure solutions including for Light Rail, buses, pedestrians, bike riders, private transport (including freight) and prevent encroachment by development.

The extent for this Route Strategy is from Boyd Street, Tugun to the QLD/ NSW border at Coolangatta. The corridor is approximate 5km in length and includes the Gold Coast Highway plus its services roads (Coolangatta Road and Golden Four Drive) as well as land within the Airport terminal precinct, between Tugun and Kirra. Between Kirra and the NSW border the study corridor encompasses both Musgrave Street/ Marine Parade to the north and Coolangatta Road/ Tweed Street to the south. A map of the study area is provided in Figure 1.1.

This project forms part of the wider suite of investigations being undertaken as part of Gold Coast Light Rail Stage 4.

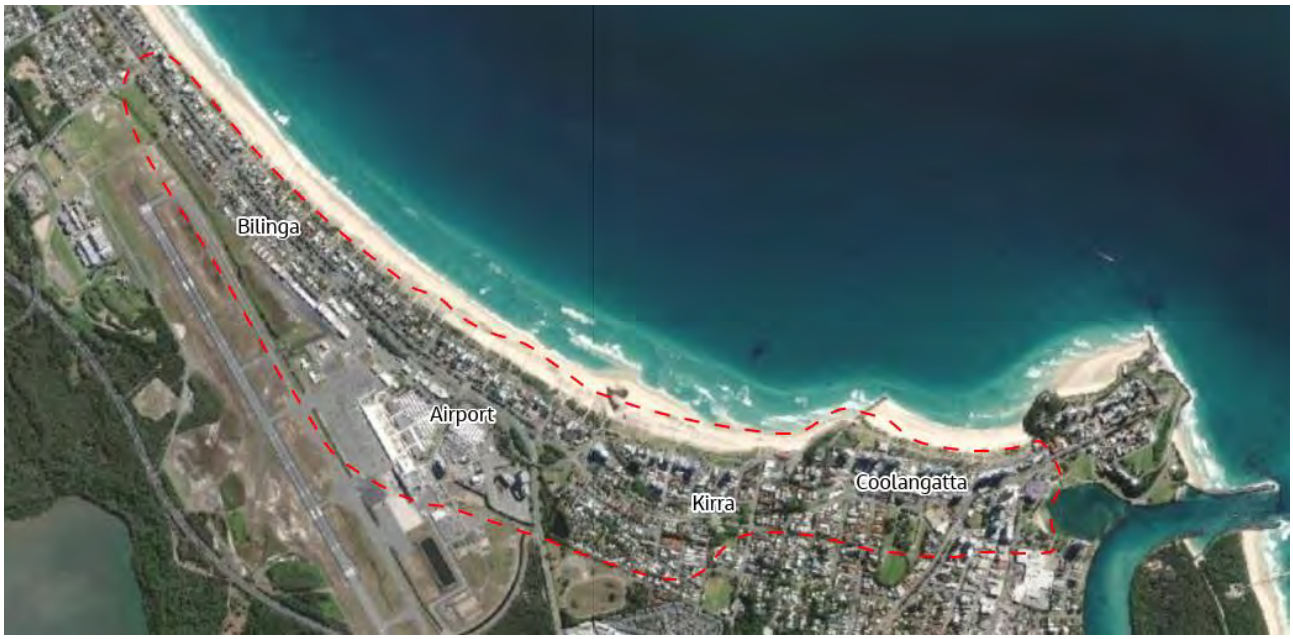


Figure 1.1: Study Area (source: Jacobs, 2022)

1.3 Document structure

Section 1 (this section): Introduction

Section 2: Planning Context

Section 3: Current Situation

Section 4: Route Planning Pressures

Section 5: Route objectives (Vision)

Section 6: Longlist option development and shortlisting

Section 7: Shortlist option development and assessment

Section 8: Preferred option refinement

2. Planning context

This chapter provides an analysis of the policies and strategies relevant to the Tugun to Coolangatta transport corridor as well as relevant projects and studies.

2.1 Strategic plans and policies

A range of strategic plans and policies exist at the Federal, State, Regional and Local levels which provide relevant guidance to the development of a future vision for the study area. These key plans and strategies are identified in Figure 2-1 and are summarised in Table 2-1. A more detailed description is provided in Appendix A.

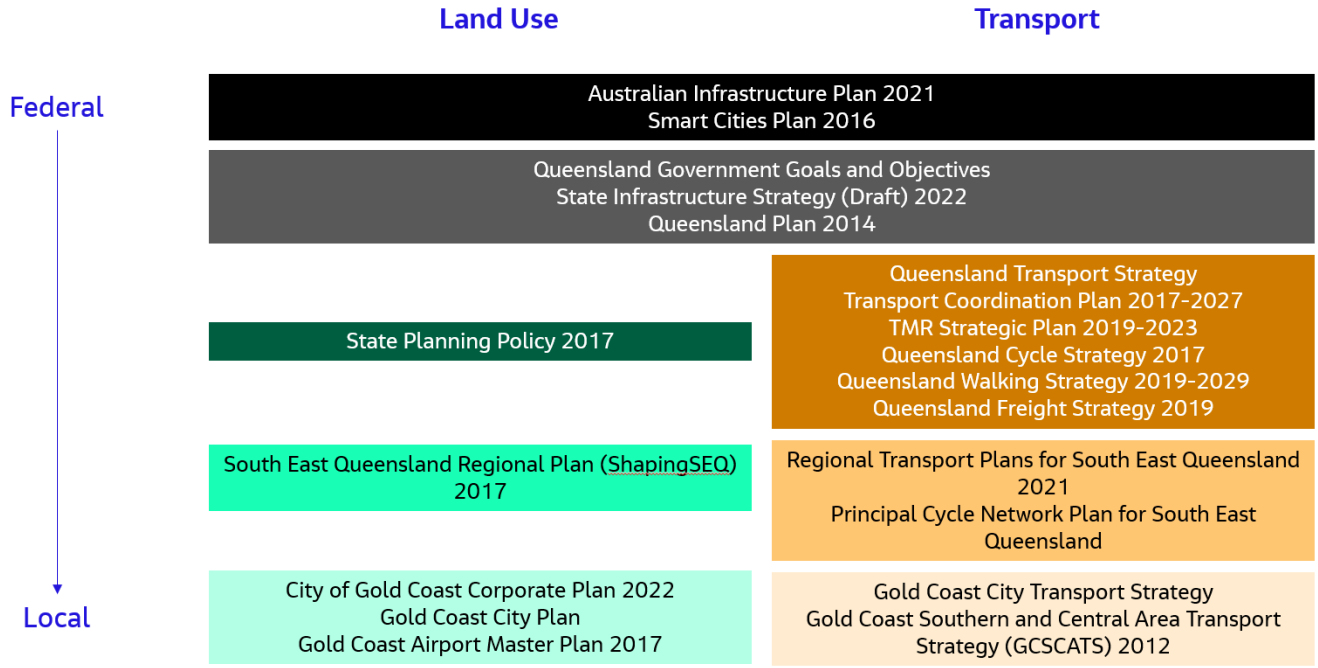


Figure 2-1: Framework of strategic policies and strategies

Table 2-1: Policies, plans and strategies

Document	Description/ relevance
Australian Infrastructure Plan (2021)	The 2021 Australian Infrastructure Plan, released by Infrastructure Australia, provides a reform pathway for responding to the 180 infrastructure challenges and opportunities identified in Infrastructure Australia's 2019 Audit. The plan presents 29 reform recommendations across nine areas of reform, covering three cross sector themes of innovation, resilience and liveability and six infrastructure sectors namely energy, water, telecommunications, social infrastructure, waste and transport Under the Transport reform chapter, the two recommendations of most relevance to this Route Strategy include: ▪ Maximise the overall benefits of transport investments by aligning transport programs with place-based objectives (including specifically linking transport infrastructure funding decisions to published population and land use objectives) ▪ Free people from relying on driving for door-to-door mobility by ensuring urban transport services are managed as an integrated, inclusive, user-responsive and smart transport system
Smart Cities Plan (2016)	The Smart Cities Plan provides a framework to bring together all tiers of government, the private sector, and community to define and achieve shared goals. The intent is for City Deals to position our urban centres, whatever their size, to realise their full potential through coordinated governance, strategic planning, investment and reform. In March 2022, a City Deal was signed between the Commonwealth Government, the Queensland Government and the SEQ Council of Mayors representing 11 local government areas within South East Queensland. However, as City of Gold Coast is not part of the SEQ Council of Mayors, the Gold Coast is not covered by this City Deal. Nevertheless, this Route Strategy should align with the intent of the Smart Cities Plan by aiming to create a more efficient and resilient transport system to improve accessibility and connectivity both within the Gold Coast and across SEQ
Queensland Government Goals and objectives (2021)	Section 10 of the *Financial Accountability Act 2009 (Qld)* requires that the Queensland Government prepares and tables in the Legislative Assembly a statement of the government's broad objectives for the community. The government currently outlines nine objectives centred around the theme of 'unite and recover'. Of these nine, objectives 5 (Building Queensland), 6 (Growing Our Regions) and 9 (Protecting our environment) are particularly relevant to this Route Strategy, as they outline a desire to build infrastructure that will support a growing region (in terms of growing transport demands) but in a way that is more environmentally sustainable.
Draft State Infrastructure Strategy (2022)	The Queensland Government has released a Draft State Infrastructure Strategy (SIS) replacing the former State Infrastructure Plan. The new strategy sets out a framework for building a strong, resilient and sustainable Queensland, providing a direction to guide future infrastructure planning and investment over the next 20 years. The overarching vision of the strategy is as follows: *We will drive collaborative state infrastructure planning to boost productivity, grow our economy and create jobs throughout the state. Infrastructure planning and delivery will leverage opportunities to improve the liveability of our communities and capitalise on innovation to build a strong, sustainable, and resilient Queensland*. Of the five focus areas in the strategy, four are of specific relevance to this Route Strategy, namely Connecting our Regions, Creating Liveable Communities, Building a 2032 Games Legacy and Driving Infrastructure Performance.

Document	Description/ relevance
Queensland Plan (2014)	The Queensland Plan is an aspirational community vision document. The plan includes nine foundations that create the framework for the Plan, each with its own goals. These foundations are Education, Community, Regions, Economy, Health and Wellbeing, Environment, People, Infrastructure and Governance. Each goal is supported by success factors and targets, which are divided into primary measures, lead indicators, and complementary secondary measures. This plan is intended to guide the development of subsequent plans and strategies and is therefore high level in nature.
State Planning Policy (2017)	The State Planning Policy July 2017 (SPP) is the pre-eminent state planning instrument that defines the Queensland Government's interests in planning and development. The SPP identifies policy and planning outcomes for 17 matters of State interest across five overarching themes. Generally, the planning and development policies within the SPP are intended to be operationalised through regional plans and local government planning schemes and support the development of Queensland Government policies and documentation as it relates to planning and development (e.g. Regional Transport Plans). Overall, the SPP recognises that infrastructure delivery is critical to driving economic growth and providing access to services, community infrastructure and employment opportunities but notes that it must be balanced with the protection of environmental, community and cultural heritage values.
QLD Transport Strategy (2020)	The Queensland Transport Strategy provides a 30-year vision for the transformation of the state's transport system that will have flexibility in responding to customer preferences, global trends and emerging technologies. It aligns to the SIS and the Queensland Plan (above) and will inform future versions of the Transport Coordination Plan (10-year plan) and TMR Strategic Plan (4-year departmental plan) below. The Strategy details five strategic outcomes to support a future-focused transport system over the next 30 years: 1. Accessible, convenient transport 2. Safe journeys for all 3. Seamless, personalised journeys 4. Efficient, reliable and productive transport for people and goods and 5. Sustainable, resilient and liveable communities
Transport Coordination Plan (2017)	The development of a Transport Coordination Plan is a requirement of the *Transport Planning and Coordination Act 1994*. The intent of the Act is to achieve overall transport effectiveness and efficiency through strategic planning and management of transport resources. The Transport Coordination Plan is intended to contribute to the Act's objectives and provides the overarching framework for strategic planning and management of transport in Queensland. The Transport Coordination Plan 2017-2027 identifies a vision for transport in Queensland, as well as three goals and five objectives to help achieve the vision. The objectives articulate the government's expectations of what the transport system will provide for Queenslanders over the next 10 years. The plan includes key indicators and criteria to guide the successful delivery of these objectives. Of particular relevance to this Route Strategy are the aspirations for a transport system that safely meets the needs of everybody (irrespective of age or ability) and to do so in a way which contributes to a cleaner, healthier more liveable environment.
TMR Strategic Plan 2019, revised 2021)	The TMR Strategic Plan is intended to guide the department's investment and planning decisions in a way that meets government objectives and supports the Transport Coordination Plan. TMR's vision for the transport network is to *create a single integrated transport network accessible to everyone*. Of the five supporting department objectives, the ones of most relevance to this Route Strategy are the objectives around

Document	Description/ relevance
	Safety, Sustainability and Accessibility, ensuring that the transport network evolves including through the greater promotion of active and shared (including public) transport modes.
Queensland Cycle Strategy (2017, re-released 2020)	The Queensland Cycle Strategy (QCS) sets the direction for cycling in Queensland over the next decade in order to make cycling enjoyable, comfortable, healthy and safe. To grow cycling participation rates, the QCS notes that cycling infrastructure should help new riders feel safe and confident about using a bike for transport and support all riders to feel comfortable on their journey. People who want to start cycling, rate physically separated cycleways as their #1 priority to encourage cycling. QCS also aims to improve links between cycling and public transport infrastructure to support people to ride a bike as part of their journey. This includes making sure bike facilities are available on key public transport routes and that people have access to secure bicycle parking at public transport links. The QCS is supported by the Queensland Cycle Action Plan (QCAP), which is a 2-year program of short-term actions to help implement the 10-year vision of the QCS.
Queensland Walking Strategy (2019)	The Queensland Walking Strategy 2019-2029, outlines a vision for walking in Queensland along with priorities over the next 10 years with an overarching vision for walking: *an easy choice for everyone, every day* The document highlights the need to develop healthy walkable neighbourhoods with quality open space from the outset that include a mix of commercial, education and entertainment areas with a variety of housing types and densities. For existing communities, the strategy suggests that providing more connected, smooth and even paths, shade and street trees along routes, greater separation from traffic, and lower traffic speeds in the right places will encourage people to walk more.
Queensland Freight Strategy (2019)	The Queensland Freight Strategy sets a ten-year shared vision for the state's freight system: an integrated, resilient and safe freight system that supports the economy and community. It outlines a series of shared commitments (by industry, customers and governments) to achieve this vision. The plan's vision and commitments are supported by nine "delivery statements' which includes encouraging rail freight on strategic corridors, and maximising productivity through non infrastructure solutions, among others.
ShapingSEQ: South East Queensland Regional Plan (2017)	The South East Queensland Regional Plan 2017 (*ShapingSEQ*) is the relevant statutory regional plan for the project area and provides a framework to manage growth, land use and development across the SEQ region. It sets a 50-year vision for the region, as well as setting out goals, elements, and directions which facilitate the delivery of this vision. A key outcome sought by *ShapingSEQ* is the integration of land use and infrastructure planning to ensure that infrastructure constraints and capacity guides land use planning, and desired land use outcomes are supported by infrastructure. Coolangatta is identified within *ShapingSEQ* as a major regional activity centre within SEQ's southern sub-region that is intended to accommodate a significant proportion of the southern Gold Coast's population growth through urban consolidation. Further, Coolangatta forms a key population and employment node in the Southern Gateway Regional Economic Cluster (REC) that is identified within the southern sub-region, an emerging REC that supports priority sectors of health and tertiary education, manufacturing (focused on aviation industries) and tourism clusters.

Document	Description/ relevance
	The Tugun to Coolangatta section of the Gold Coast Light Rail is identified as a key element of the broader SEQ region's strategic road and freight system at 2041. An extension of the Gold Coast Light Rail is identified as priority region-shaping infrastructure within the southern sub-region that will form a key transport link and support future growth within the southern Gold Coast.
Regional Transport Plans for South East Queensland (2021)	The Regional Transport Plan for South East Queensland has four outcomes areas, linked to the Regional Plan outcomes areas, namely Grow, Prosper, Sustain and Live. Under each of these four outcome areas are a series of transport objectives and specific directions. The plan details an anticipated frequent public transport network for the Gold Coast in 2041 which includes Light Rail between Burleigh Heads and Gold Coast Airport. Other actions relevant to this Route Strategy include prioritising active transport to create walkable and well-connected communities as well as encouraging transit-oriented development along public transport corridors.
Principal Cycle Network Plan for South East Queensland (2016)	The SEQ Principal Cycle Network Plan (PCNP) identifies two parallel routes within the study corridor as principal cycle routes. That is, both the Gold Coast Highway/ Coolangatta Road/ Tweed Street and the Oceanway/ Pacific Parade/ Musgrave Street/ Marine Parade corridors are shown as Principal Routes. The identified Principal routes are indicative and intended to guide further planning and design to determine the precise route and design of cycle facilities. Nevertheless, the PCNP sets an expectation for the inclusion of high-quality cycle infrastructure in or near the Gold Coast Highway corridor as well as parallel to it, to cater for the widest range of potential users
City of Gold Coast Corporate Plan (2022)	The City of Gold Coast (CoGC) Corporate Plan 2022 sets the vision "Inspired by Lifestyle. Driven By Opportunity" for the city. The vision is underpinned by 3 themes, being Place, Prosperity and People. The Corporate Plan is intended to drive the activities of the council, including land use and transport planning and investment decisions. The plan includes clear aspirations around liveability and sustainability, as well as a diverse and productive economy.
Gold Coast City Plan (2016)	The Gold Coast City Plan 2016 plus amendments (v8) is the key instrument used by City of Gold Coast to regulate and manage future growth, land use and development in a way that advances planning and development policies identified within the SPP and relevant regional plan at the local level. The City Plan strategic framework identifies a strategic intent of establishing the Gold Coast as a world class city and identifies six broad themes that collectively seek to deliver on this intent. Generally, strategic outcomes within the planning scheme seek the integration of land use with transport infrastructure as a means of increasing accessibility and connectivity across the Gold Coast, providing choice and connecting people with places of economic, social and environmental value. The planning scheme identifies Coolangatta as a major centre that is the Gold Coast's pre-eminent southern beachside destination, which is expected to provide for higher density residential development, services and employment over the life of the planning scheme. Further, the Gold Coast Airport/Southern Cross University is identified as a key specialist centre that is a major economic generator for the communities in SEQ and northern New South Wales. The planning scheme's focus on a more consolidated, compact urban form represents a significant shift in land use policy, which seeks to focus development away from the city's fringe and towards high amenity, well-serviced activity centres within the city's existing urban footprint. A key element of this policy is the identification of Light Rail

Document	Description/ relevance
	urban renewal areas within the city which are intended to be targeted for urban consolidation and renewal. The planning scheme identifies Light Rail urban renewal investigation areas, including land within the project area, where more detailed planning is required to identify a preferred future growth scenario.
Gold Coast Airport Master Plan (2017)	This Master Plan provides a strategic vision for Gold Coast Airport. The Master Plan includes plans for a new access road from the Gold Coast Highway to the south of the Airport, on or near the QLD/ NSW border as well as a range of future transport linkages including the Gold Coast Light Rail extension and Gold Coast heavy rail extension. While the plan acknowledges that timing of these potential projects is subject to further detailed investigation and funding commitments, it states that protecting these transport corridors is critical to preserve the future economic growth advantages of enhanced connectivity. The plans also note that these significant passenger transit opportunities will continue to be considered during future master planning cycles with appropriate responses incorporated, based on further project feasibility assessments and funding commitments. The outcomes of this Route Strategy will inform these future updates.
Gold Coast City Transport Strategy (2013)	The Gold Coast City Transport Strategy guides transport policy and investment decisions. Its vision is for smart growth, a connected city and sustainable travel choices. The strategy is underpinned by six objectives with supporting actions to expand and deliver on the vision, grouped around five outcome areas as follows. ▪ Integrated transport and land use: prioritise future urban developed as transit-oriented development in centres and along key public transport corridors including the Broadbeach to Coolangatta corridor ▪ Public transport network: progressively deliver city wide integrated high frequency public transport network consisting of Light Rail, heavy rail and rapid bus ▪ Active transport network: develop a connected and accessible active transport network with improved safety and security (including implementing community boulevards and pedestrian priority zones along the coastal strip) ▪ Road and freight network: make the most of existing infrastructure and promote greater use of public and active transport as well as improve the legibility of the road network to encourage motorist to avoid unnecessary trips through activity centres and beachside areas. ▪ Changing travel behaviours: expand council's active travel initiatives targeting schools, workplaces and communities
Gold Coast Southern and Central Area Transport Strategy (2012)	TMR initiated the Gold Coast Southern and Central Area Transport Study (GCSCATS) in recognition of the need to provide a more sustainable and integrated transport system for the Gold Coast. GCSCATS is of direct relevance to this Route Strategy as it defined the preferred transport elements for a 2031 network which included Light Rail to Gold Coast Airport and Coolangatta CBD supported by comprehensive pedestrian and cycle networks (especially along the coastal spine). It also included passenger rail extended to Elanora, 6 laning of the M1 Pacific Motorway to Tugun and land use planning overlays to influence parking supply and pricing in areas supported by Light Rail.

2.2 Relevant projects and related studies

2.2.1 TMR projects/ studies

Table 2-2: Transport and Main Roads (QLD) projects and studies

Project	Description/ relevance
Gold Coast Light Rail Stage 4	The Tugun to Coolangatta Multi Modal Corridor Study forms part of the wider suite of investigations being undertaken as part of Gold Coast Light Rail Stage 4. In its entirety, the current planning for Stage 4 is intended to deliver a Preliminary Evaluation and Business Case to support future investment in the proposed 13km southern extension of Light Rail from the southern extent of Stage 3 (now under construction) at Burleigh Heads to Coolangatta via the Gold Coast Airport.
Heavy Rail Extension to Gold Coast Airport planning study	In 2005, TMR identified a possible corridor to extend heavy rail south of Robina to Tugun. Following community consultation, a preferred rail corridor between Robina and Tugun (QLD/NSW border) was identified and preserved in 2008. The first stage between Robina and Varsity Lakes was then constructed in 2009. Further investigations were also conducted in 2009 as part of a wider Robina to Tugun Rail Impact Assessment Study that considered technical, environmental, social and economic impacts of a preferred rail alignment. Following completion of the detailed design for the M1 Varsity Lakes to Tugun project (now under construction), which shares the same corridor for much of its length, TMR commenced further investigations to revisit and refine the planning for this future rail link. This will include updating a concept design and reconfirming or refining the property requirements to enable this rail extension to be implemented in the future. This planning interfaces directly with the Tugun to Coolangatta MMCS at Gold Coast Airport where both Light Rail and heavy rail stations are planned and a preferred multi-modal interchange arrangement will need to be identified.
M1 Varsity Lakes to Tugun upgrade	The $1 billion Pacific Motorway Varsity Lakes to Tugun (VL2T) project is being delivered to upgrade 10km of the M1 and is being constructed in packages. All three packages are now under construction. Key features of the upgrade include: ▪ Widening 10km of the M1 from 2 to a minimum of 3 lanes in both directions between Varsity Lakes (Exit 85) and Tugun (Exit 95), including improvements to the road alignment, upgrading three motorway interchanges and extending all entry and exit ramps. ▪ Constructing a new 2-way western service road between Tallebudgera (Exit 89) and Palm Beach (Exit 92) and a new bridge over Tallebudgera Creek connecting the new western service road. ▪ Installing smart motorway technologies to improve travel time between Nerang and Tugun. ▪ Installing bicycle and pedestrian paths to improve active transport connections

2.2.2 Gold Coast Airport access changes (QAL)

The Queensland and New South Wales Governments, as well as the Gold Coast Airport, have entered into an agreement to fund and construct a new southern vehicular access at the Airport as identified in the 2017 Master Plan (refer Figure 2-2).

Figure 2-2: Gold Coast Airport Southern Entrance concept design (Source: https://www.archipelago.com.au/gca-southern-entry)

The Queensland Government has committed $6.2 million to the project, which will create a new entrance to the airport precinct on the Queensland/New South Wales border, reducing traffic at the current access at the intersection of the Gold Coast Highway and Terminal Drive (south).

The plan also includes a range of upgrades to internal airport access roads and intersections including Queensland Airport Road and Southern Cross Drive, as well as improved access to the new Ground Transport and Car Hire Access areas.

2.2.3 New South Wales projects/ studies

Table 2-3: NSW projects and studies

Project	Description/ relevance
Pacific Highway Tweed Heads Microsimulation (TfNSW)	Transport for NSW (TfNSW) is undertaking a planning investigation for 20km of the Pacific Highway (Motorway) between Stewart Road (Tugun) and Tweed Valley Highway. This investigation has been prompted by the current upgrades to the M1 currently under construction between Varsity Lakes and Tugun and the sustained population growth in Tweed, which will continue with further planned land releases (greenfield expansion) within the Tweed Shire. The purpose of the study is to identify upgrades required to cater for this population growth while maintaining the national function of the Pacific Highway – the primary north south road link between Sydney and Brisbane and a vital piece of the nation's

Project	Description/ relevance
	land transport infrastructure. Upgrades are also required to improve safety, reducing the number of fatalities.
Tweed Multi Modal Corridor Study (TfNSW)	TfNSW has identified an extension of Gold Coast Light Rail into Tweed Shire as an initiative for investigation under the Regional NSW Services and Infrastructure Plan, a Future Transport 2056 supporting plan. The Tweed Multi-Modal Corridor Study was undertaken partly in parallel with this Tugun to Coolangatta Multi Modal Corridor Study to take a wholistic view of route options and future transport requirements to allow for a potential future southern extension of Light Rail into Tweed Shire
Tweed Regional City Action Plan (NSW DPIE)	Regional City Action Plans identify a vision, city drivers, objectives, actions and a delivery framework to promote employment growth, greater housing diversity and plan for infrastructure delivery. The NSW Department of Planning, Industry and Environment (DPIE) commissioned Deicke Richards to undertake an Enquiry by Design (EbD) process to inform the development of the Tweed Regional City Action Plan. The project sought to engage with a broad range of stakeholders to identify and explore a shared vision for the future planning of the city, as well as develop innovative urban design and land use opportunities to enable growth, support high liveability and attract investment.

2.2.4 Urban design, placemaking and place analysis studies (CoGC)

The City of Gold Coast has undertaken various place-based studies within the corridor with the overall aim of protecting and enhancing areas on the Gold Coast with a particular local identity, natural resource base or development character. The primary intent of these place analysis studies is to provide a resource to ensure character elements are appropriately considered in future development decisions along the southern Gold Coast strip. Key findings and recommendations for the Bilinga, Kirra and Coolangatta areas (noting that Tugun town centre is north of our study area) are outlined below.

Table 2-4: City of Gold Coast place-based studies

Study name/ area	COGC study findings
Kirra Place Analysis (CoGC 2019)	The Kirra neighbourhood centre located along the ocean front is the central focus of a small residential suburb, which has an intimate character and is characterised by large expanses of parkland along the oceanfront with distinctive mature vegetation. Other features include: ▪ One sided commercial/retail strip with activity nodes with interspersed residential ▪ Street grid and associated road widths inform proportion of building height. ▪ High quality public realm with northern aspect and outlook ▪ Legible gridded streetscape that is flat and accessible and diversity of open space with varying forms. ▪ Framed to the east by Kirra Hill and Mount Murraba ridgeline forming elevated outlooks with iconic views. ▪ Existing sense of Gateway created by open space and existing views.
Coolangatta and Kirra Business Centre Place Based Master Plan (CoGC, 2020)	The Coolangatta and Kirra Business Centre Place Based Master Plan aimed to unlock the precinct's potential and guide its transformation into one of the city's most vibrant and diverse beachside neighbourhoods and business centres. Through well engaged place making, thorough site analysis and urban design, opportunities aim to improve the street environment. Many of the challenges in strengthening and enhancing the area's pedestrian environment and public space revolve around achieving solutions

Study name/ area	COGC study findings
	with existing traffic issues. Key strategies included reducing traffic speed and shifting parking away from high pedestrian areas to improve walkability and cycling
Coolangatta Streetscape Design Guidelines (CoGC, 2019)	The aim of the Streetscape Design Guidelines is to provide direction about the spatial organisation and materiality of the public realm within the Major Centre and adjoining areas. The Guidelines are intended to support the City Plan and the Coolangatta and Kirra Business Centre Placed Master Plan with public realm outcomes expected of Coolangatta, by improving the pedestrian experience.
Gold Coast Light Rail Stage 3 (and 4) – Urban Design Framework (CoGC, 2017)	This document provided an urban design framework to respond to the emerging challenges of growth on the coastal corridor between Broadbeach and Coolangatta to capitalise on future Light Rail and to accommodate population growth while preserving the natural setting and amenity that defines the Gold Coast. The urban design framework provides a "road map" describing the future shape of the Broadbeach to Coolangatta study corridor and how growth could be guided to maximise community benefit and liveability. Key moves and recommendations for each section of the study corridor were identified and should be taken into consideration: Key moves for Bilinga and Airport are as follows: ▪ Strengthen the Terminal Drive to Johnson Street connection as a key east west green link ▪ Reinforce Lang Street as a minor green link ▪ Improve public realm and planting on George Street ▪ Improve public realm and planting treatments along the Gold Coast Highway creating an attractive and safe pedestrian environment ▪ Improve public realm treatments and intensify development entitlements on nominated east-west streets ▪ Reinforce active edges in existing activity nodes and introduce new active uses where increased density entitlements and Light Rail nodes are proposed ▪ Investigate future renewal opportunities with the Airport car park, Tourist Park and Racecourse Key moves for Kirra and Coolangatta are as follows: ▪ Strengthen Miles Street (Kirra) and Dutton Street (Coolangatta) as precinct focussed green street connections ▪ Focus renewal improvements and public realm in close proximity to Light Rail stations ▪ Reconfigure the Chalk Street carpark to better integrate with new Light Rail ▪ Introduce high quality cycle infrastructure along Coolangatta Road and the Gold Coast Highway ▪ Consolidate and reinforce active edges along the foreshore ▪ Improve the foreshore parks includes spaces adjoining Surf Life Saving Clubs ▪ Strengthen pedestrian and cycle permeability across the Gold Coast Highway and Coolangatta Road ▪ Reinforce Miles St role as a local bus connection to the wider movement network and integrate the Coolangatta bus interchange with the Light Rail terminus

2.3 Strategic directions for the Tugun to Coolangatta corridor

Specific directions and changes that emerge from the review of the above documents include:

- Light Rail between Broadbeach South and Coolangatta is a key assumption of higher order plans such as the South East Queensland Regional Plan (*ShapingSEQ*) and Regional Transport Plans for South East Queensland and therefore will need to be accommodated in any corridor planning.
- Upgraded high quality (principal) cycle facilities are expected to be provided as a priority (within the next 10 years) – this includes facilities on the Gold Coast Highway/Coolangatta Road corridor to support the existing Oceanway shared path facility on the coastal corridor
- Transport and land use planning should seek to complement the outcomes of the Burleigh Heads to Tugun Route Strategy whereby through traffic is encouraged to use the M1 to support a more attractive and liveable coastal corridor. Nevertheless, the Gold Coast Highway from Stewart Road (Tugun-Currumbin Road) to the airport will need to remain an efficient movement corridor to cater for oversized and hazardous goods vehicle as well as support Tugun Bypass tunnel closures.
- The Gold Coast Airport is a key destination within the 'Southern Gateway' Regional Economic Cluster. Improving access to this node (which will increasingly accommodate more than just airport passengers and workers) from the wider region, through a wider range of mode options is a major opportunity.
- There is need to accommodate population growth and additional housing within the corridor which is within the existing urban footprint, in order to protect green spaces. However, development and density should provide variety and should enhance the character of the southern Gold Coast villages and centres.

3. Current situation

3.1 Existing route function

The Tugun to Coolangatta study corridor is physically constrained by the Pacific Ocean to the east and the Cobaki Broadwater to the west. Within this part of the City of Gold Coast, the Gold Coast Highway and the M1 (Pacific Motorway) are the primary transport links. The Gold Coast Highway between Tugun and Kirra performs a key north-south arterial road function while the M1 to the west provides a regional and national north-south motorway function.

Within the vicinity of the study corridor, the Gold Coast Highway is only connected to the M1 at one location in the south where the Gold Coast Highway veers away from the coast along what was previously known as the Tweed Heads Bypass, to join the M1. The Gold Coast Highway (and its parallel service roads) are a dominant feature within the Bilinga, Airport and Kirra sections of the study area. East of the airport, the nature of the road network is much less strategic with Coolangatta Road/ Tweed Street and Musgrave Street/ Marine Parade forming 'distributor' type roads links between the Gold Coast Highway and the twin towns of Coolangatta/ Tweed Heads.

Overall, the Tugun to Coolangatta is a multi-modal corridor in nature carrying general traffic, high frequency bus services as well as pedestrians and bike riders. The map in Figure 3-1 illustrates the functional road hierarchy as defined by City of Gold Coast. More detail on the utilisation of the corridor by different transport modes is provided in Section 3.3.

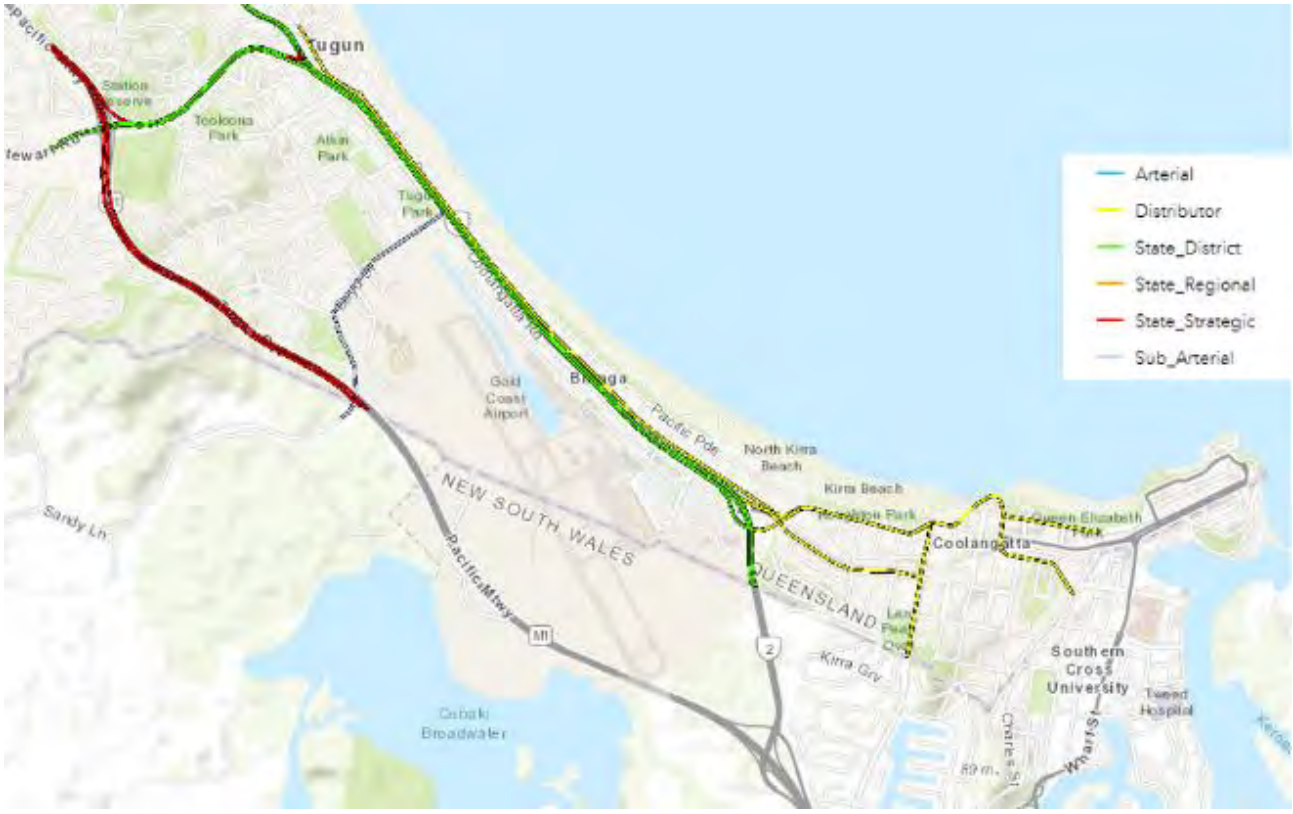


Figure 3-1 Functional road hierarchy (Source City of Gold Coast, 2022)

3.2 Existing route features and risks

3.2.1 Road corridor features

Eight key road environments have been identified within the extents of the study area as follows:

- Bilinga and Gold Coast Highway (GCH)
- Airport Interchange
- Kirra Gold Coast Highway
- Kirra Musgrave Street
- Kirra Marine Parade
- Kirra Coolangatta Road
- Coolangatta Tweed Street
- Coolangatta Griffith Street

Key details on these current road environments are summarised in Figure 3-2. General road details are defined in Table 3-1 to Table 3-7 with corresponding images providing context of the typical carriageways within each area as seen in Figure 3-3 to Figure 3-9. The airport interchange has been excluded from the general road details assessment as it is formed from a number of road environments and cannot easily be generalised. Figure 3-2 summarises these different road environments highlighting the carriageway widths, speeds, number of lanes and directions of travel. Bus stop locations within the corridor are described in Section 3.3.3 while active transport facilities are summarised in Section 3.3.4.

Figure 3-2 Road corridor features

Table 3-1: Gold Coast Highway (Bilinga and Airport) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, 4 through lanes (2 northbound and 2 southbound) plus turning lanes
Lane widths	Variable between 3.3m and 3.5m
Speed environment	80 km/h
Shoulder width	Generally, between 2m and 2.5m
Median width and type	1.5m to 7.0m dependent on turn lanes – grassed median
Auxiliary lane details	All auxiliary right and left turn lanes from GCH are single lanes Two unsignalised intersections (give way) and two signalised intersections along route Unsignalised intersections (Coolangatta Road/Desalination Plant Road & Golden Four Drive, Coolangatta Road/Loongana Avenue & Golden Four Drive/Surf Street) Signalised intersections (Kirribin Street & Golden Four Drive, Eastern Avenue & Golden Four Drive). Auxiliary left turn lane from Gold Coast Highway to Kirribin Street.
Floodway details	Coastal erosion effects on Golden Four Drive see Section 3.2.6 for extents
Terrain type	Flat
Bus facilities	In-line bus stops along Golden Four Drive and Coolangatta Road (spacing between 300m to 400m).
Active transport	Shoulder includes bike lane on both northbound and southbound shoulders along Gold Coast Highway and on-road cycle lanes on Coolangatta Road.
Pedestrian infrastructure	No pedestrian facilities along Gold Coast Highway but pathways provided along Golden Four Drive and Coolangatta Road. Signalised east-west pedestrian crossings located at intersections with Kirribin Street and Terminal Drive.

Figure 3-3 Gold Coast Highway (Bilinga and Airport) typical carriageway (Image source: Metromap 2020)

Table 3-2: Gold Coast Highway (Kirra) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, 4 through lanes (2 northbound and 2 southbound)
Lane widths	3.5m
Speed environment	80 km/h
Shoulder width	Approximately 1.5m
Median width and type	8.2m
Auxiliary lane details	No auxiliary lanes within study area
Floodway details	CoGC identifies area as requiring flood assessment and potential for Coastal Erosion see Section 3.2.6 for extents
Terrain type	Flat
Bus facilities	In-line bus stops along Golden Four Drive (spacing between 200m to 400m).
Active transport	Shoulder includes bike lane on both northbound and southbound shoulders along Gold Coast Highway and on-road cycle lanes on Coolangatta Road.
Pedestrian infrastructure	No pedestrian facilities

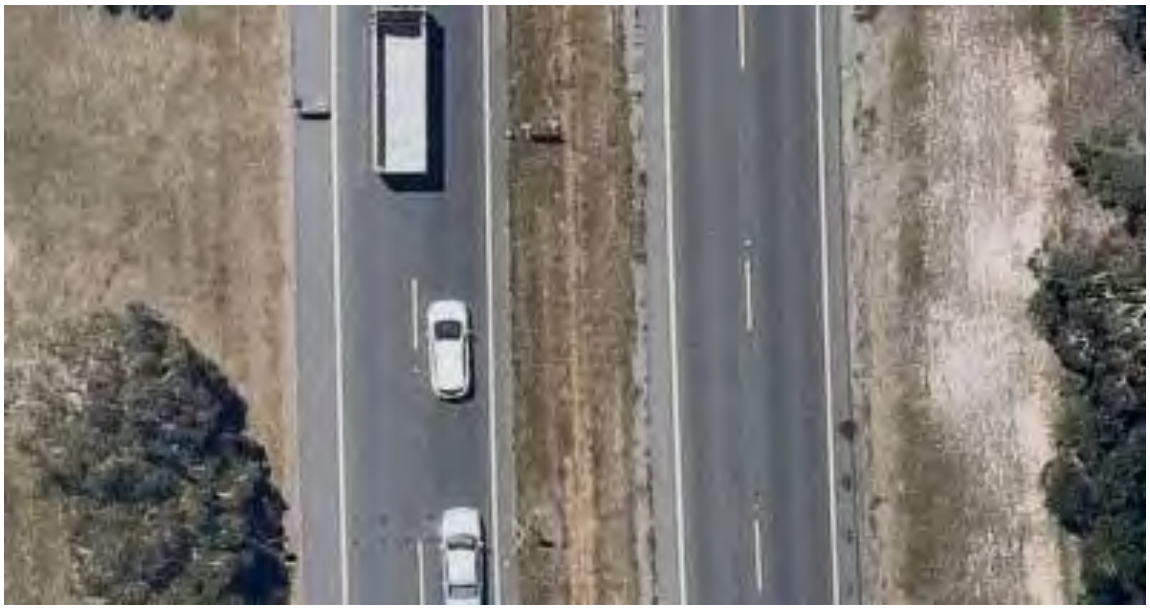


Figure 3-4 Gold Coast Highway (Kirra) typical carriageway (Image source: Metromap 2020)

Table 3-3: Musgrave Street (Kirra) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, two through lanes (one westbound and one eastbound) plus turning lanes
Lane widths	Variable between 3.0m and 3.2m
Speed environment	50km/h
Shoulder width	Westbound 3.5m to 4.0m and shoulder parking Eastbound 1.5m to 2.0m
Median width and type	Generally, between 0m to 3.0m dependent on turning lanes
Auxiliary lane details	Most auxiliary right turn lanes from Musgrave Street are single lanes and unsignalised (giveway) and provide access to Winston Street, Coyne Street, Haig Street, Douglas Street, Lord Street. One signalised intersection with auxiliary left and right turn lanes on Musgrave Street and Douglas Street.
Floodway details	Coastal erosion effects see Section 3.2.6 for extents
Terrain type	Flat
Bus facilities	Indented bus stops located in shoulder parking (spacing between 240m to 350m)
Active transport	Shoulder includes bike lane on both westbound and eastbound. Oceanway located to the north of Musgrave Street.
Pedestrian infrastructure	Pedestrian pathway located south of the carriageway. The Oceanway is located north of the carriageway that is shared by both pedestrians and bicycle riders. Signalised pedestrian crossings located at intersection with Douglas Street

Figure 3-5 Musgrave Street (Kirra) typical carriageway (Image source: Metromap 2020)

Table 3-4: Marine Parade (Kirra) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, two through lanes (one northbound and one southbound)
Lane widths	Variable between 3.0m and 3.2m
Speed environment	50km/h
Shoulder width	1.5m to 2.0m includes bike lane
Median width and type	0m
Auxiliary lane details	Two signalised intersections with single right turn lanes connecting Marine Pde, Miles St and a local business & Marine Parade with Marine Parade. Two roundabouts no dedicated lanes
Floodway details	Coastal erosion effects see Section 3.2.6 for extents
Terrain type	Flat
Bus facilities	In-line bus stops located in shoulder parking (spacing between 90m to 250m)
Active transport	Shoulder includes bike lane on both westbound and eastbound.
Pedestrian infrastructure	Pedestrian pathway located south of the carriageway. The Oceanway is located north of the carriageway that is shared by both pedestrians and bicycle riders. Signalised pedestrian crossings located at intersection with Miles Street. Along the Kirra Headland, pedestrian pathway of approximately 4.0m runs along the beachside of the carriageway.

Figure 3-6 Marine Parade (Kirra) typical carriageway (Image source: Metromap 2020)

Table 3-5: Coolangatta Road (Kirra) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, four through lanes (two eastbound and two westbound) plus turning lanes. At intersection with Haig St transitions to 2 through lanes (1 eastbound and 1 westbound)
Lane widths	3.1m to 3.4m
Speed environment	Variable – between 50km/h and 60 km/h with the majority of the corridor 50km/h
Shoulder width	Generally, between 2.0m and 2.5m includes shoulder parking
Median width and type	Generally, 4.0m to 11.0m dependent on turning lanes. Maximum median is 18.5m
Auxiliary lane details	All auxiliary right turn lanes from Coolangatta Road are single lanes One signalised intersection connecting Miles Street, Coolangatta Road & Tweed Street with auxiliary right turn lanes.
Floodway details	CoGC identifies area as requiring flood assessment, see Section 3.2.6 for extents
Terrain type	Flat
Bus facilities	No bus stops located along road within this corridor
Active transport	No active transport facility
Pedestrian infrastructure	Pedestrian pathways located north and south of the carriageway with varying widths. Signalised pedestrian crossings located at intersections with Musgrave Street, Appel Street and Miles Street.

Figure 3-7 Coolangatta Road (Kirra) typical carriageway (Image source: Metromap 2020)

Table 3-6: Tweed Street (Coolangatta) general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, two through lanes (one eastbound and one westbound) plus turning lanes
Lane widths	Between 3.1m and 3.3m
Speed environment	50km/h
Shoulder width	Generally, 0m but varies up to 3.8m in areas
Median width and type	0m
Auxiliary lane details	Auxiliary right turn lanes from Tweed Street are single lanes
Floodway details	No floodway evident
Terrain type	Flat
Bus facilities	No bus stops located along road within this corridor
Active transport	No active transport facility
Pedestrian infrastructure	No pedestrian facilities

Figure 3-8 Tweed Street (Coolangatta) typical carriageway (Image source: Metromap 2020)

Table 3-7: Coolangatta Griffith Street general road details

Category	Details
Divided road	Yes
Surface type	Asphalt
Number of lanes	Generally, two through lanes (one eastbound and one westbound)
Lane widths	Variable between 3.2m and 3.7m
Speed environment	50km/h
Shoulder width	Variable between 0m to 7.5m dependent on street parking (diagonal and parallel)
Median width and type	Generally, 2m but up to 4.5m in areas
Auxiliary lane details	Auxiliary right turn lanes from Griffith Street are single lanes connecting to Boundary Street.
Floodway details	No floodway evident
Terrain type	Flat
Bus facilities	Significant public transport corridor with one in line bus stop servicing a number of services.
Active transport	No active transport facility
Pedestrian infrastructure	Pedestrian facilities along north and south of corridor. Corridor is pedestrian dominated with twelve zebra crossings located along entire corridor.

Figure 3-9 Coolangatta Griffith Street typical carriageway (Image source: Metromap 2020)

3.2.2 Land use and place

The study area is characterised by a narrow urban corridor bounded by the district centre of Tugun to the north, the Pacific Ocean to the east, and Tweed Heads to the south/east. There are a diversity of land uses within the corridor, ranging from low-medium density residential development within the more suburban areas of Bilinga and Kirra to higher-order commercial and retail activities within the Coolangatta activity centre.

The following section provides a general overview of existing land uses within the study area as well as the future planning intent for the corridor as expressed by relevant planning instruments, principally the Gold Coast City Plan (also known as the Planning Scheme) which is informed by and responds to the South East Queensland Regional Plan (*ShapingSEQ*).

Submissions received during the fourth round of public consultation carried out by City of Gold Coast for the Our City Our Plan amendment package are currently being reviewed. Following the completion of the submissions review, and if there are no further significant changes proposed, the amendment package will progress to the Department of State Development, Infrastructure, Local Government and Planning requesting Ministerial approval to adopt. The amendment package could result in changes to the following section of this report.

3.2.2.1 Bilinga

The Bilinga section of the study area is presently characterised by predominantly low-density residential development to the south of the Gold Coast Highway, with some airport-related activities located at the south eastern extent along Adina Avenue and Eastern Avenue. Land to the north of the Gold Coast Highway is generally characterised by low to medium density residential development, with a number of short-term accommodation activities scattered along Pacific Parade and Golden Four Drive.

Other prominent land uses within the vicinity of the Bilinga section of the study area (Figure 3-10) include:

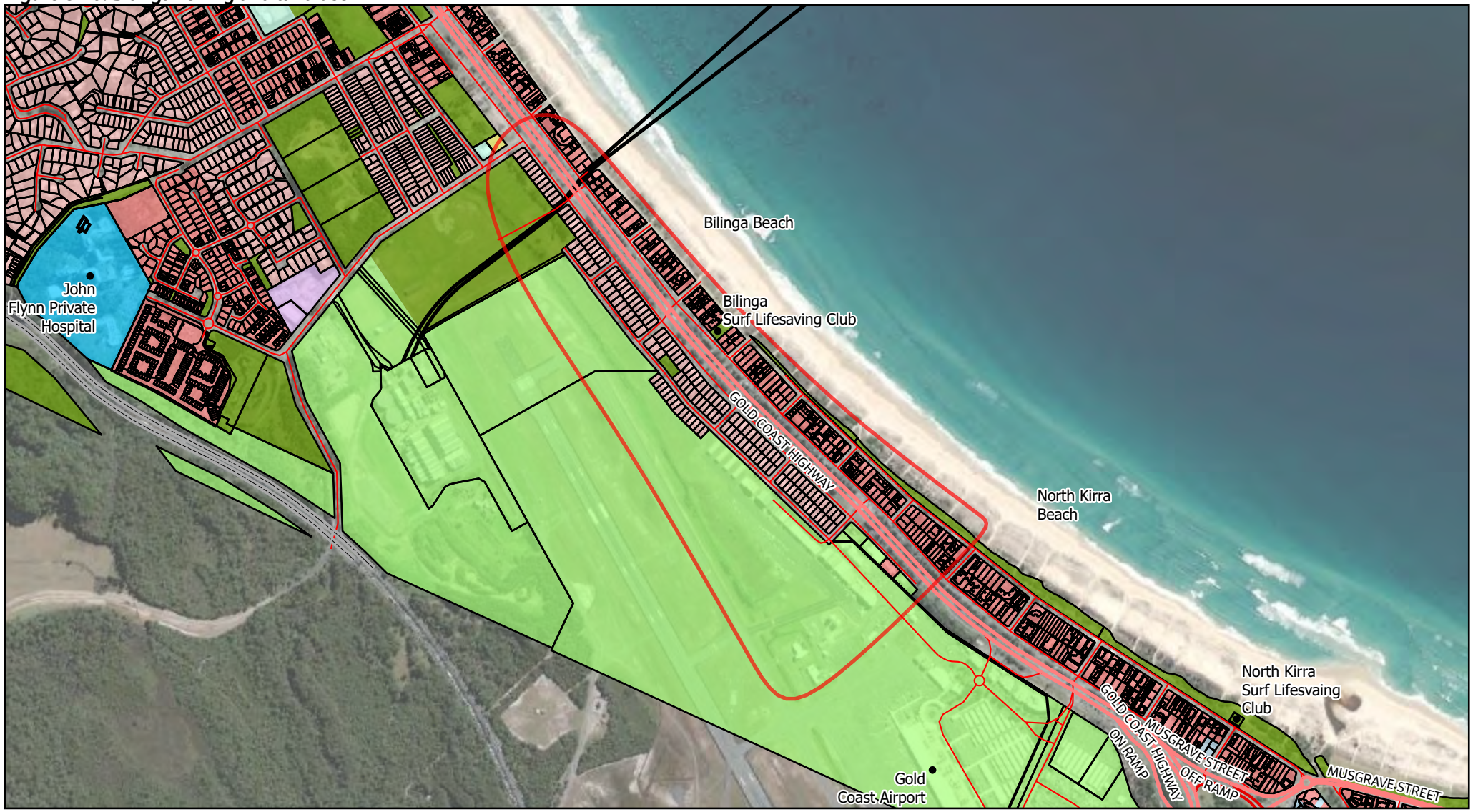
- the Gold Coast Airport
- Bilinga Beach
- the Bilinga Surf Lifesaving Club
- John Flynn Private Hospital.

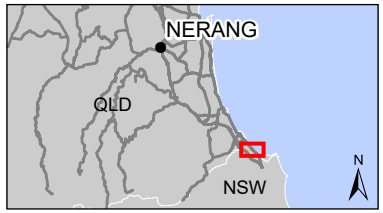
Planning Scheme zoning for the Bilinga section of the study area is identified in Figure 3-10, and generally provides for low density residential and special industry land uses to the south of the Gold Coast Highway and medium density residential land uses to the north of the highway. The Planning Scheme envisages building heights to the north of the highway ranging from 15 m – 23 m (approximately 4 – 6 storeys), whereas heights up to 9 m are generally envisioned in residential areas to the south of the highway. Building height for land within the Gold Coast Airport is not identified within the planning scheme, and accordingly is understood to be generally limited by the Airport's Obstacle Limitation Surfaces (OLS).

A desktop analysis of the study area has identified that the intended pattern of land use within the Bilinga section of the study area, as expressed through the planning scheme zoning, is currently largely unrealised to the north of the Gold Coast Highway. While a number of sites in this area have been developed for medium density land uses, there are a number of lots which are either presently vacant or underutilised (e.g. developed for low density residential land uses) given the permissible building height within this area. Conversely, land to the south of the highway is generally in alignment with the Planning Scheme intent for the area.

Bilinga is bisected by the Gold Coast Highway and acts as the entry to Kirra and Coolangatta business centres. Due to the location of the Gold Coast Highway, the local network between the residences to the east and west of the highway are significantly separated. The area is characterised by the beach on the east with a number of surf clubs that are accessible via Pacific Parade or the Oceanway and the airport land uses to the west.

Figure 3.10: Bilinga zoning and land use





LEGEND

- Bilinga Project Area
- Freeways/Motorways
- Highways
- Local Connector Roads
- Street/Local
- Cadastre
- Low density residential
- Medium density residential
- Neighbourhood centre
- Sport and recreation
- Open space
- Low impact industry
- Community facilities
- Innovation
- Special purpose

0 95 190 380
Metres

GDA 1994 MGA Zone 56 A4 1:15,000

Jacobs

Source: DNRME: Cadastre, GCCC: Zoning Jacobs: Project Area, Metromap: Imagery

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3.2.2.2 Airport (including North Kirra)

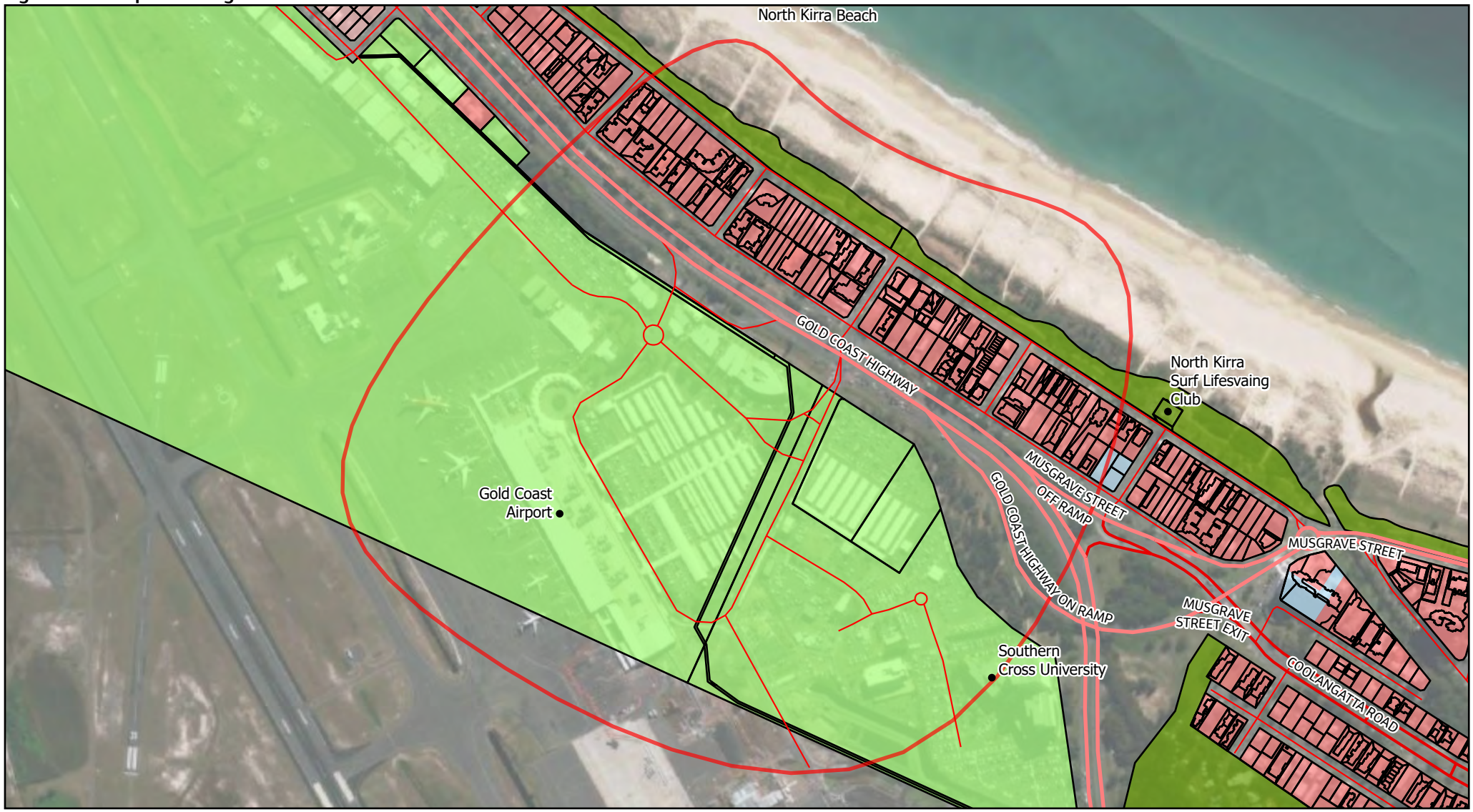
Land use within the Airport section of the study area is currently characterised by a mix of low and medium density residential development to the north of the Gold Coast Highway, with a number of short-term accommodation activities scattered along Pacific Parade and Golden Four Drive. Land uses to the south of the highway includes the Gold Coast Airport, Southern Cross University Gold Coast Campus, and accompanying supporting activities that includes carparking and commercial and retail development. Other prominent land uses within the Airport section of the study area includes North Kirra Beach and the North Kirra Surf Lifesaving Club.

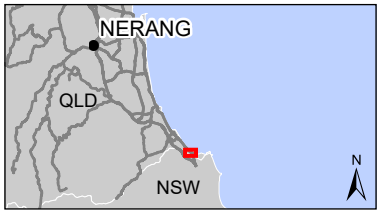
Planning Scheme zoning for the Airport section of the study area is identified in Figure 3-11. The Planning Scheme provides for medium density residential land uses to the north-east of the Gold Coast Highway, with land to the south-west of the highway zoned Special Purpose. The Planning Scheme envisages building heights to the north-east of the highway ranging from 15 m – 23 m (approximately 4 – 6 storeys), whereas building height and specific land uses within the Gold Coast Airport land is governed by the Airport Master Plan but with examples of buildings in the order of 10 storeys such as Southern Cross University (SCU).

Based on a desktop analysis of the Airport section of the study area, the general Planning Scheme intent for land to the north-east of the Gold Coast Highway is considered to be generally unrealised. While some land has been developed for land uses of a scale envisioned by the Planning Scheme, there are a number of underutilised or otherwise vacant lots within this area. Land to the south-west of the highway is generally considered to be underutilised given the existing building height and densities and the dominance of car parking surrounding the airport and university sites.

The area is bisected by the Gold Coast Highway where the south/west is dominated by commercial development and airport car parking creating a car dominated landscape and north/east having a distinct beach character accessible by active transport.

Figure 3.11: Airport zoning and land use





LEGEND

- Airport Project Area
- Highways
- Local Connector Roads
- Street/Local
- Cadastre
- Low density residential
- Medium density residential
- Neighbourhood centre
- Open space
- Special purpose

0 45 90 180
Metres

GDA 1994 MGA Zone 56 A4 1:7,500

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: DNRME: Cadastre, GCCC: Zoning Jacobs: Project Area, Metromap: Imagery

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3.2.2.3 Kirra

The Kirra section of the study area is presently characterised by a low to medium density residential development to the south of Coolangatta Road. Land to the north of Coolangatta Road is generally characterised by a mix of medium density residential and short-term accommodation, with a mix of medium to high density residential and mixed-use development located in the vicinity of Musgrave Street, Marine Parade and McLean Street.

Other prominent land uses within the vicinity of the Kirra section of the study area (Figure 3-12) include:

- Kirra Beach
- Kirra Beach Surf Club
- Coolangatta State School
- Len Peak Oval, Miles Street Reserve and Lanham Street Park
- Kirra Beach Tourist Park.

Planning Scheme zoning for the Kirra section of the study area is identified in Figure 3-12, and generally provides for medium density residential development excepting land along Musgrave Street and Marine Parade, and McLean Street, which are zoned Neighbourhood Centre and Centre respectively. Further, the Planning Scheme envisages the following building heights in the vicinity of Kirra:

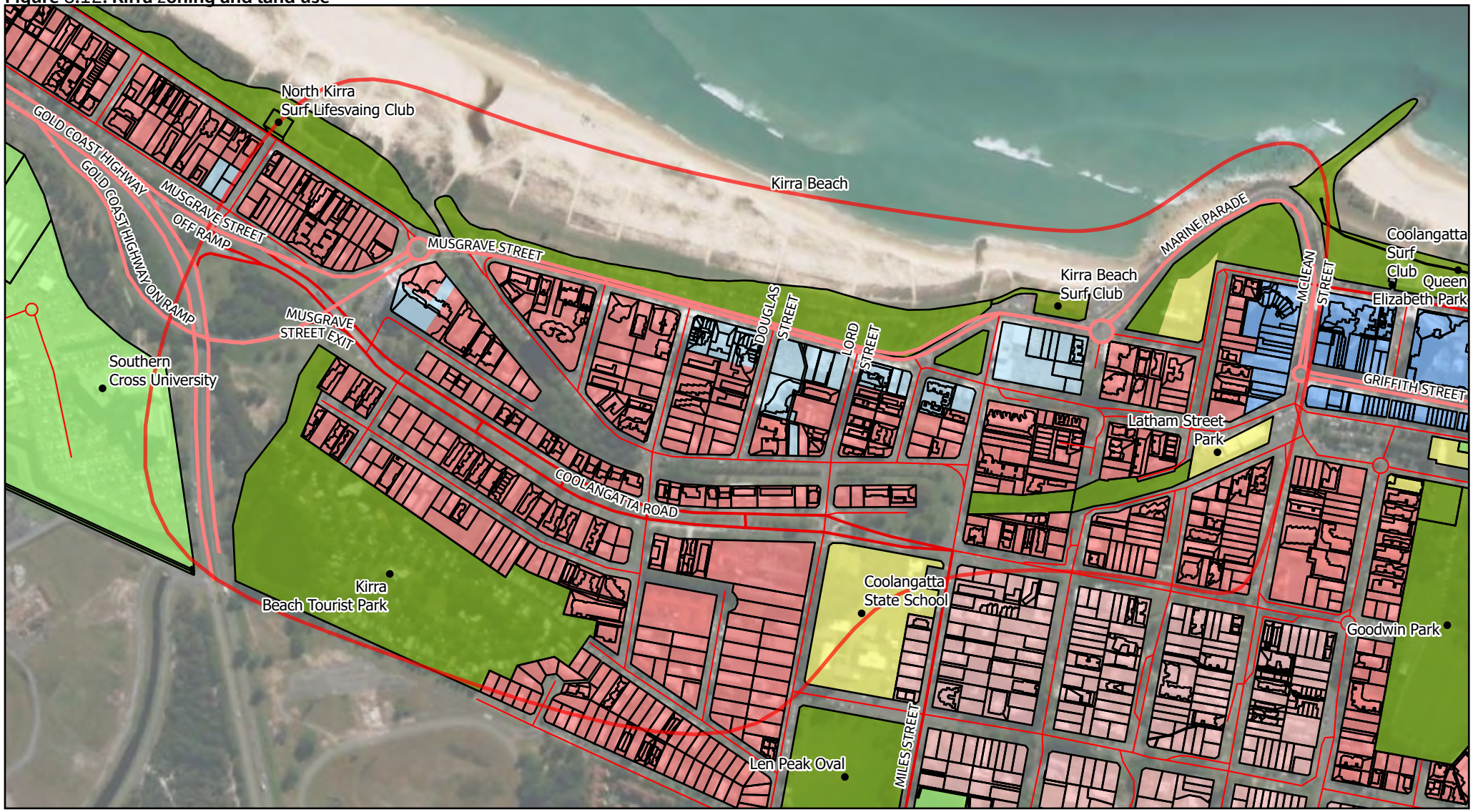
- between 9 m and 15 m (2 – 4 storeys) to the south of Coolangatta Road
- between 15 m and 29 m (4 – 8 storeys) to the north of Coolangatta Road
- 39 m along McLean Street.

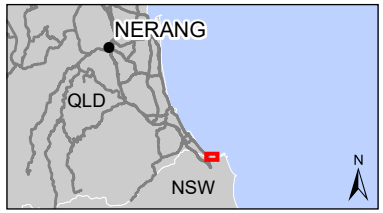
A desktop analysis of the study area has identified that the intended pattern of land use within the Kirra section of the study area, as expressed through the Planning Scheme zoning, is currently largely unrealised. Significant tracts of land within Kirra are either vacant or underutilised, particularly in the vicinity of Coolangatta State School and to the north of Coolangatta Road. Notable under-developed sites in the vicinity of Musgrave Street and Marine Parade that offer significant development potential, including the Kirra Beach Hotel site and the commercial centre on the corner of Musgrave Street and Douglas Street.

Kirra, as detailed in the *Kirra Place Analysis Study* (CoGC, 2019), has a strong relationship with the beach and waterways and creates a strong sense of entry and arrival with the following statement providing a good summary of the significance of 'place':

The Kirra neighbourhood centre is a one-sided commercial strip located along Marine Parade and Musgrave Street on the ocean side of the suburb of Kirra. It is located at the foot of Kirra Hill extending west along the esplanade and looks north through public parkland to the Coral Sea. The existing retail activities have responded to the opportunities of the passing traffic, to attract and service the needs of day trippers, holiday makers and locals. The population is subject to seasonal variation and other local services are provided at the larger shopping areas of Coolangatta and Tweed Heads. The distinctive characteristics of the Kirra neighbourhood centre are the large parkland areas (containing distinctive Norfolk Island Pines, Pandanus, and Casuarina trees) and an esplanade road which runs parallel to the north facing beach and extends around a rocky point to create a publicly accessible beachfront promenade. This extensive piece of accessible public open space wraps around Kirra Hill (containing windswept vegetation, Eucalyptus species and Cotton trees) and forms a gateway to Coolangatta. The proximity to and outlook of the beach and open space from the neighbourhood centre, reinforces the popularity of the retail and restaurants as an active edge looking out over the expansive public realm areas. The beach and public parkland contrasts with the one-sided retail strip opposite and is a public open space asset for the medium density residential development nestled in behind which frames the beachfront.

Figure 3.12: Kirra zoning and land use





LEGEND

- Kirra Project Area
- Highways
- Local Connector Roads
- Street/Local
- Cadastre
- Low density residential
- Medium density residential
- Centre
- Neighbourhood centre
- Open space
- Community facilities
- Special purpose

0 45 90 180
Metres

GDA 1994 MGA Zone 56 A4 1:7,500

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: DNRME: Cadastre, GCCC: Zoning Jacobs: Project Area, Metromap: Imagery

3.2.2.4 Coolangatta

Land use in the vicinity of Griffith Street is generally characterised by a mix of centre activities, including high density mixed-use development and short-term accommodation along Marine Parade and a mix of low to medium density commercial and retail activities centred on Griffith Street, the traditional 'high street' within Coolangatta. Land between Lanham Street and Chalk Street is generally characterised by community, educational and transit-oriented land uses, whereas land at the southern extent of the Coolangatta section generally includes a range of low to medium density residential land uses.

Land at the eastern extent of the Coolangatta portion of the study area is located within the Tweed Heads activity centre in northern New South Wales. Land uses within Tweed Heads includes a range of medium to high density mixed-use development that is centred on Wharf Street, the traditional 'high street' within Tweed Heads.

Other prominent land uses within the vicinity of the Coolangatta section of the study area (Figure 3-14) includes:

- Coolangatta and Greenmount Beaches
- Coolangatta Surf Club, Greenmount Beach Surf Club, Coolangatta Bowls and Recreation Club and Twin Towns Services Club
- Tweed Heads Public School and St Joseph's Primary School
- Jack Evans Boat Harbour
- Coolangatta TAFE
- Coolangatta Transit Centre
- Tweed Public Hospital
- Goodwin Park, Queen Elizabeth Park and Pat Fagan Park.

Planning Scheme zoning within the Coolangatta portion of the study area is identified in Figure 3-14, and generally provides for medium density residential development to the south of Lanham Street, a range of community uses and sport and recreation uses between Chalk Street and Lanham Street, and centre activities to the north of Chalk Street. The Planning Scheme envisages the following building heights for the Coolangatta area:

- 84 m (approximately 24 – 25 storeys) along Marine Parade
- 24 m (approximately 6 storeys) between Griffith Street and Lanham Street
- 15 m – 23 m (approximately 4 – 6 storeys) to the south of Lanham Street.

Based on a desktop analysis of the Coolangatta section of the study area, the general planning intent for this land as expressed by the Planning Scheme is largely unrealised. While some land has been developed for land uses of a scale envisioned by the planning scheme to the south of the Coolangatta area, there are a number of underutilised lots located in the vicinity of Griffith Street and Marine Parade, given the existing building height and densities. Notably, the car parking adjoining the Coolangatta Transit Centre on the fringe of the Coolangatta major activity centre was identified by the desktop analysis as under-developed land with significant development potential.

As detailed in the Coolangatta and Kirra Business Centre Master Plan (City of Gold Coast, 2020), "Coolangatta retains an essence of the unique, beach focussed culture that has defined it throughout its history. Relatively little redevelopment of the iconic shoreline has occurred in comparison to other locations. This laid-back, small-town feel, is a central element of Coolangatta's local character." Based on stakeholder feedback summarised in the *Coolangatta and Kirra Business Centre Master Plan,* Coolangatta is:

- Centred around the beach and surfing including headlands and foreshore
- Family orientated
- Country town feel and a fairly sleepy resort town
- Distinctly different to Broadbeach and Surfers
- Not overrun by high-rise

Analysis highlighted a number of inactive edges and lack of overlapping functions, particularly in Griffith Street during certain times in the day. While Marine Parade has activity both night and day, there is a lack of evening and night-time activity in Griffith Street. Cafes in Griffith Street close at 3pm while most retail outlets, businesses

and offices close between 4-6pm. Figure 3-13 identified current shop fronts and active edges within the Coolangatta town centre.

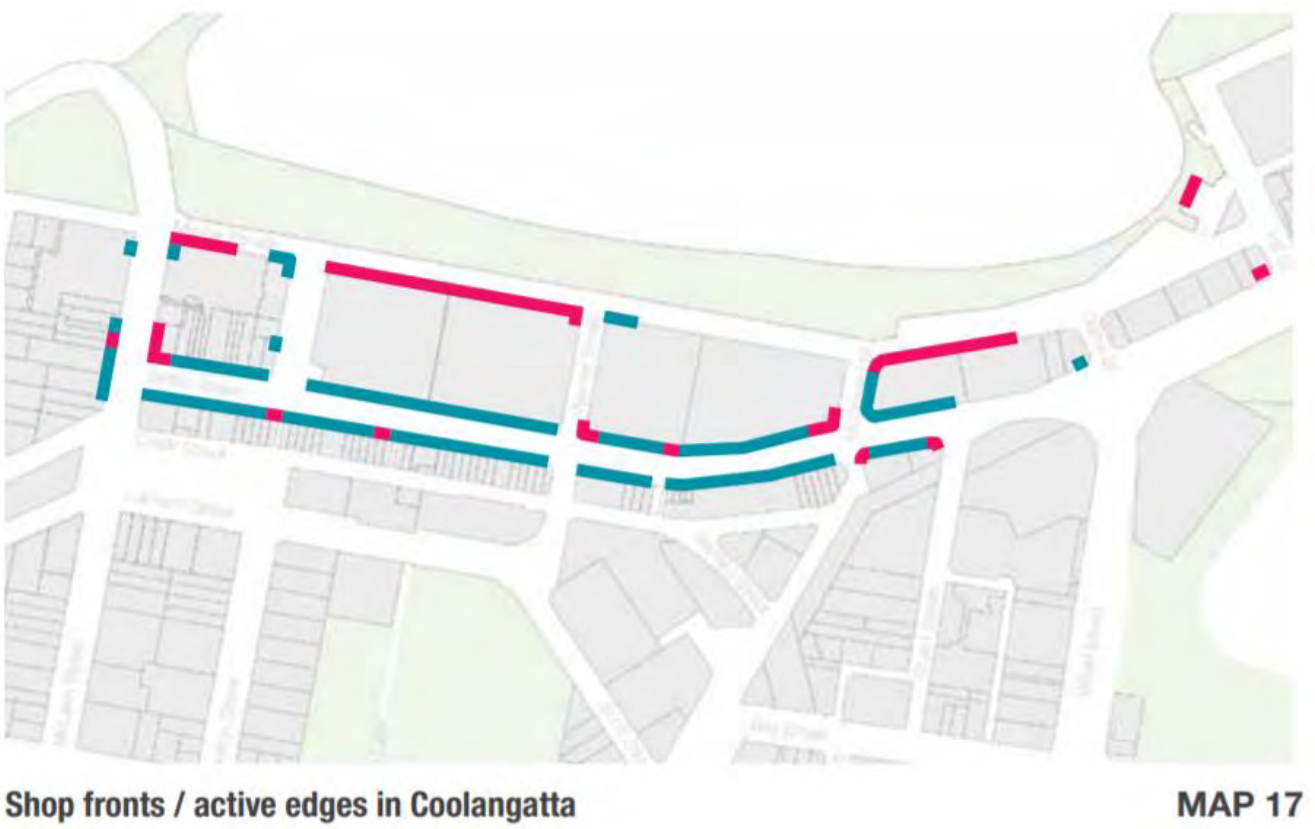
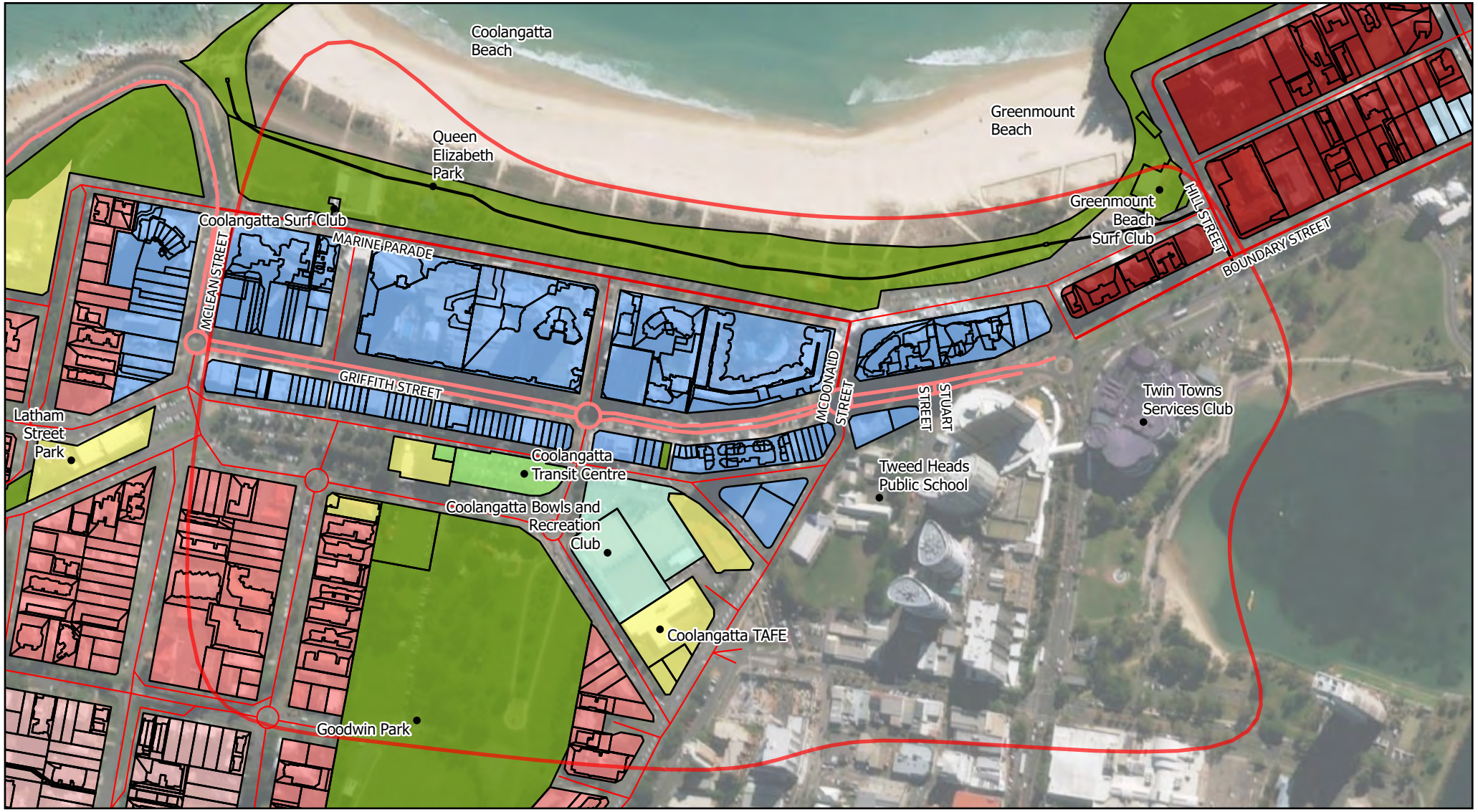


Figure 3-13: Shop fronts / active edges in Coolangatta (Coolangatta and Kirra Business Centre Master Plan CoGC,2020)

Figure 3.14: Coolangatta zoning and land use



Source: DNRME: Cadastre, GCCC: Zoning Jacobs: Project Area, Metromap: Imagery

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3.2.3 Environmental and cultural heritage

The purpose of this section is to identify existing environment and cultural heritage values within the Tugun to Coolangatta study area which have the potential to be impacted by the project. The review of environment and cultural heritage values within the study area was undertaken as a desktop exercise using the following key information sources:

- Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) Development Assessment Mapping System
- DSDILGP State Planning Policy (SPP) Interactive Mapping System (IMS)
- Queensland Government Queensland Globe
- Queensland Government GeoResGlobe
- CSIRO Australian Soil Resource Information System
- a project-specific interactive mapping system prepared with the use of Esri mapping software and incorporating various datasets available on the Queensland Government Open Data Portal
- Bureau of Meteorology Climate Data Online
- Coastal Risk Australia 2100 Mapping
- Gold Coast Planning Scheme
- Gold Coast Airport 2017 Master Plan
- TMR (2018). Cultural Heritage Risk Assessment – Gold Coast Highway (Tugun to Coolangatta) Multi-Modal/Active Transport Planning. South Coast Region, Queensland.
- Gold Coast Heritage Register

3.2.3.1 Climate and natural hazard

Climate data for the study area was sourced from the Bureau of Meteorology (BoM) Coolangatta Station (BoM Station 040717). BoM Station 040717 is located at the Gold Coast Airport and directly adjoins the study area.

The SEQ region, including the study area, is generally characterised by a sub-tropical climate with a distinct summer wet season and winter dry season. Monthly climate statistics between 1982 and 2021, as recorded by BoM station 040717, are presented in Table 3-8.

Table 3-8 : Monthly climate data for the study area (BoM, 2021)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	28.4	28.3	27.4	25.5	23.2	21.1	20.7	21.6	23.4	24.6	26.1	27.4
Mean minimum temperature (°C)	21.0	20.9	19.8	17.0	13.9	11.4	10.2	10.4	13.3	15.9	18.1	19.8
Mean rainfall (mm)	159.0	184.8	196.1	157.6	130.3	137.4	70.5	56.5	39.3	89.1	115.1	155.4
Mean number of days of rain ≥ 1 (mm)	10.4	12.2	13.2	11.3	9.9	8.3	5.7	4.9	4.6	7.3	8.8	10.1
Mean 9am relative humidity (%)	70	72	72	71	70	71	67	61	62	65	68	68
Mean 3pm relative humidity (%)	69	69	67	64	62	60	56	56	61	66	68	68
Mean 9am wind speed (km/h)	18.1	17.1	17.4	16.1	14.9	13.4	13.5	15.2	17.8	19.0	19.4	18.6
Mean 3pm wind speed (km/h)	22.9	21.8	22.3	20.0	18.3	16.8	18.3	20.4	22.2	23.1	22.5	22.7

Mean daily maximum temperatures within the region range between 20.7°C in July and 28.4°C in January, with mean daily minimum temperatures ranging between 10.2°C in July and 21.0°C in January. Annual rainfall is

variable, with the wettest year on record (1999) receiving 2378.2 mm while the driest year on record (1986) received 792.6 mm (BoM, 2021).

Figure 3-15 provides historical climate statistics associated with the wind directions and speed at 09:00 am and 03:00 pm, as collected from BoM Station 040717 between 1987 and 2020. This data suggests that winds in the study area shifting from a prevailing southerly direction at 09:00 am to a relatively variable range of directions at 03:00 pm (BoM, 2021).

Any subsequent climate change projections undertaken for the project may need to source data from a BoM station with a greater reference period than that of BoM Station 040717.

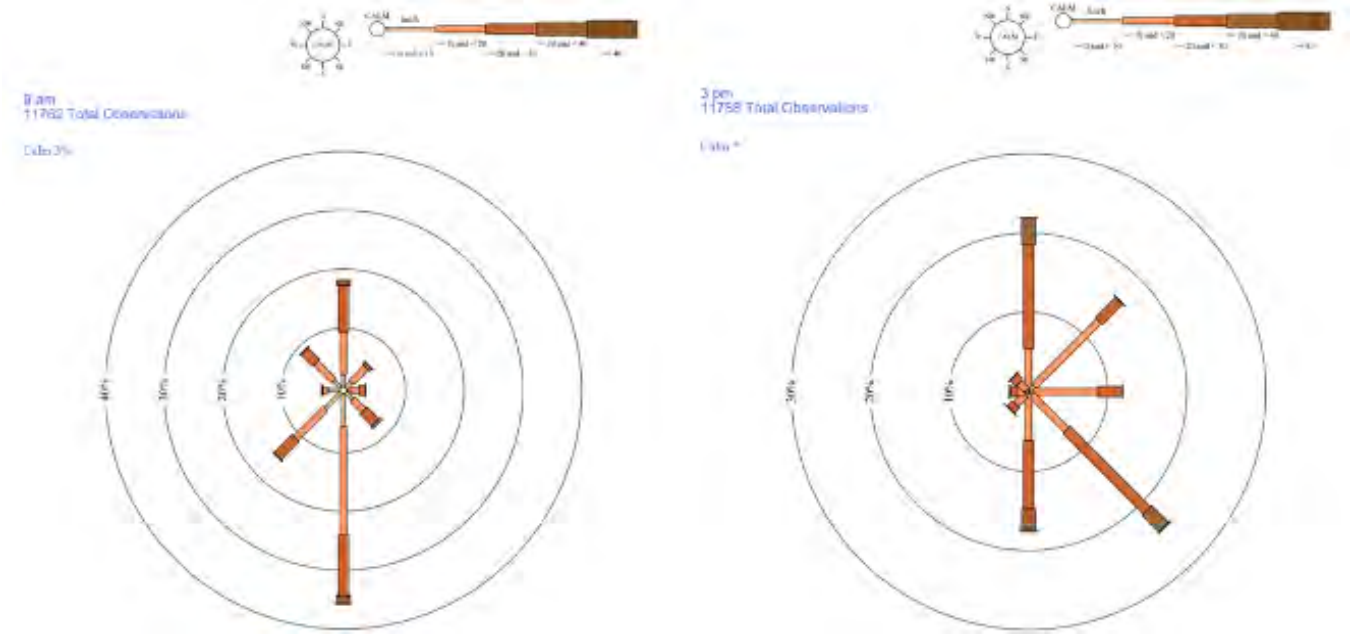


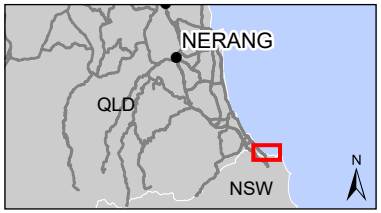
Figure 3-15: Rose of wind direction versus wind speed (km/h) between1982 and 2021 (BoM, 2021).

The project also contains a number of areas that are sensitive to, or at risk of, occurrence of natural hazards, which should be considered when determining an appropriate alignment for the project. Key natural hazard areas are identified on Figure 3-16 and Figure 3-17, and include:

- Land subject to inundation as a result of flooding
- Land prone to storm tide hazard
- Land subject to bushfire risk and areas directly adjoining these areas
- Land subject to erosion as a result of coastal processes.

Further to the above, sea level rise is considered a key natural hazard risk to the project. According to Coastal Risk Australia (2021), the Coolangatta area is projected to see sea level risk of up to 0.74 m by 2100.

Figure 3.16: Natural Hazards - Coastal and Flooding



LEGEND

- Project study area
- Storm tide High Hazard
- Storm tide Medium Hazard
- GCCC Flood Assessment Required
- Coastal Erosion Prone Area

0 125 250 500
Metres

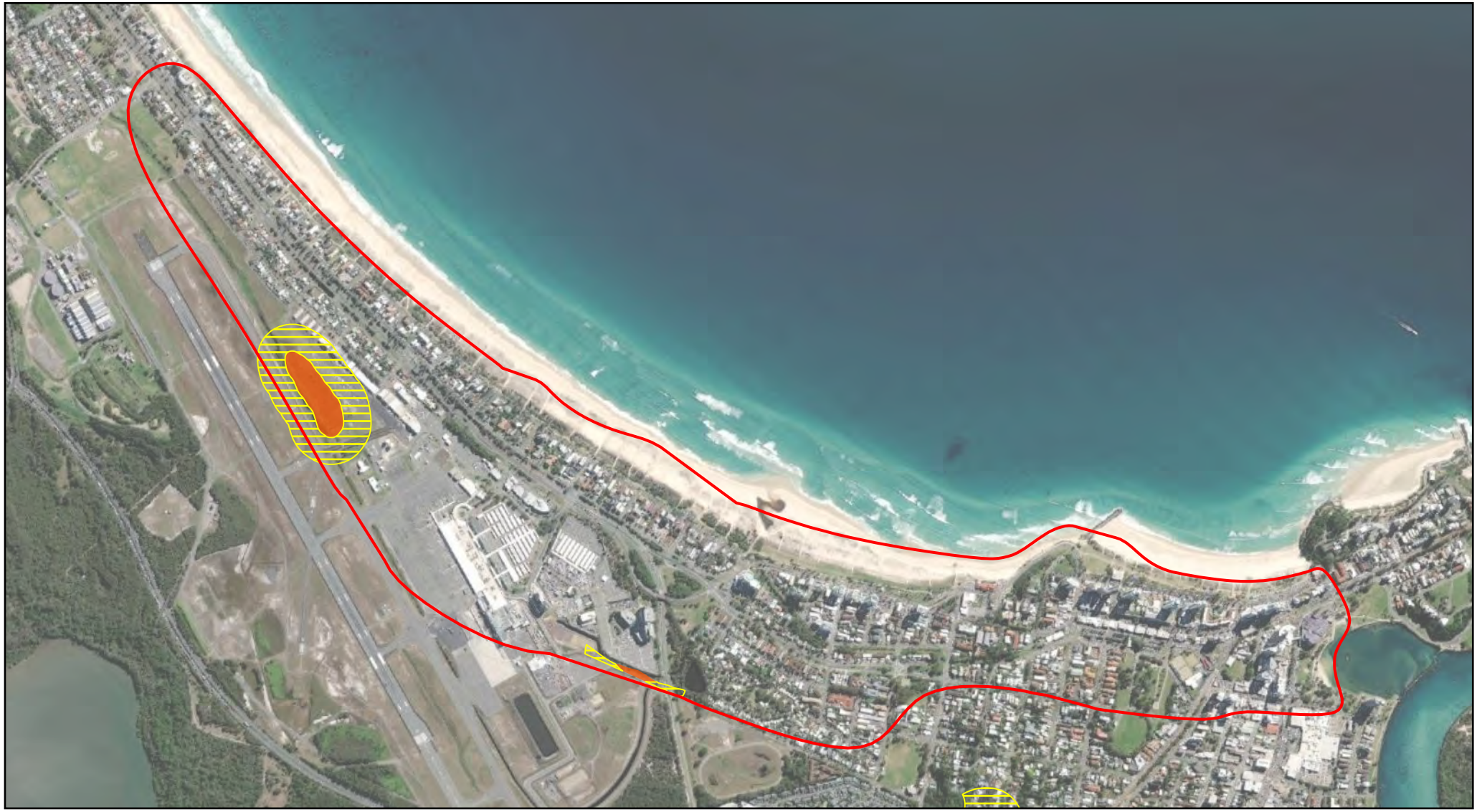
GDA 1994 MGA Zone 56 A4 1:20,000

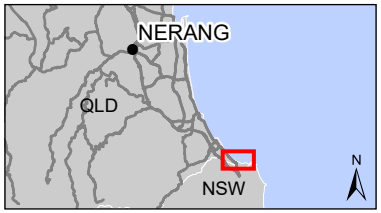
Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: GCCC: Flood Assessment, Bushfire Hazard, DEHP: Erosion, Storm Tide Jacobs: Project Area, ESRI: Imagery

Figure 3.17: Natural hazards – bushfire





LEGEND

- Project study area
- Medium Potential Bushfire Intensity
- Potential Impact Buffer

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: GCCC Bushfire Hazard, Jacobs: Project Area, ESRI: Imagery.

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3.2.3.2 Water

Watercourses

A review of the Watercourse Identification Map has identified that there are no waterways for the purposes of the *Water Act 2000* (Water Act) presently identified within the study area. However, there are a number of 'unmapped' features under the Water Act located within and directly adjoining the study area which are identified on Figure 3-18.

A watercourse determination from the Department of Regional Development, Manufacturing and Water (DRDMW) is required to determine whether the 'unmapped' features in the study area are watercourses or drainage features for the purpose of the Water Act. Should any of the unnamed features be identified as watercourses for the purposes of the Water Act, a Riverine Protection Permit may be required.

Waterways

A review of the Department of Agriculture and Fisheries (DAF) Queensland Waterways for Waterway Barrier Works spatial layer (Figure 3-18) has identified that there are no waterways providing for fish passage within the Queensland portion of the study area. However, there is an unnamed green (low risk of impact) waterway identified approximately 60m to the north of the study area in the vicinity of Tugun Street. Indirect impacts to this waterway should be considered throughout the development of the project.

The easternmost extent of the New South Wales portion of the study area adjoins the Tweed River, a tidal waterway identified as 'Key Fish Habitat' (Figure 3-18). Impacts to the Tweed River should be considered through the development of the project.

Further to the above, the Planning Scheme identifies a local waterway that is a Matter of Local Environmental Significance (MLES) at the southern extent of the Airport and Kirra sections of the study area, adjoining the Queensland and New South Wales Border (Figure 3-19). Indirect impacts to this locally significant waterway should be considered throughout the development of the project.

Wetlands

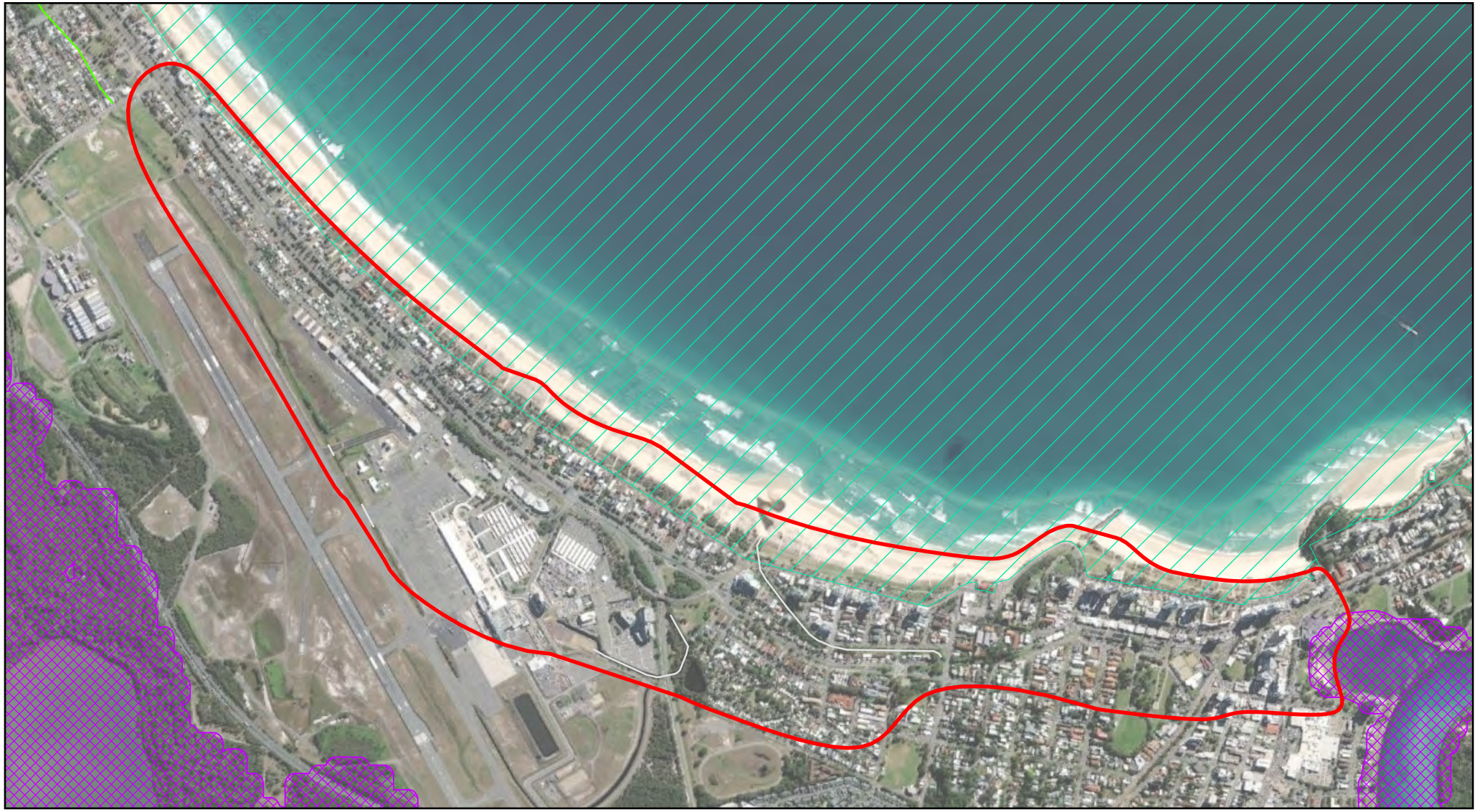
A review of the DSDILGP SPP IMS has identified the presence of several high ecological significant wetlands that are Matters of State Environmental Significance (MSES) within and adjoining the study area. These wetlands are identified on Figure 3-18 and are located within the Gold Coast Airport site and in the coastal areas of Kirra Beach and Snapper Rocks Beach. The Planning Scheme also identifies locally significant wetland features that are MLES within the Gold Coast Airport site (Figure 3-19).

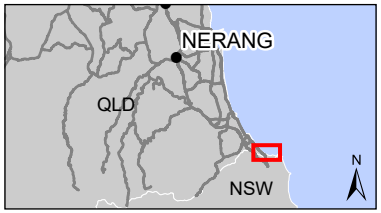
Given the location of these MSES and MLES wetlands it is considered unlikely that the project will result in direct impacts to these features, however indirect impacts to these wetlands should be considered as development of the project progresses.

Coastal management

The study area directly adjoins a significant portion of the coastal environment of the Southern Gold Coast, including Bilinga, North Kirra, Kirra, Coolangatta and Greenmount beaches. The whole extent of the coastal environment adjoining the study area is identified as being within the Coastal Management District (Figure 3-18). Impacts to the coastal environment should be considered as the project progresses.

Figure 3.18: Matters of State Environmental Significance - Water Features





LEGEND

- Project study area
- Unmapped Features
- Coastal Management District
- Key Fish Habitat

Queenslad Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Tugun to Coolangatta Multi Modal Corridor Study

Source: NSWDEH: Key Fish Habitats, DNRME: WWBW, Watercourses DES: Coastal Management District, Jacobs: Project Area, ESRI: Imagery

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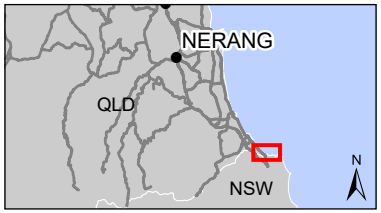
Figure 3.19: Matters of Local Environmental Significance - Water Features



LEGEND

- Project study area
- Waterways
- Canal
- Local Significant Wetlands

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: GCCC: Local Environmental Values, Jacobs: Project Area, ESRI: Imagery.

3.2.3.3 Soils and land management

Topography

The topography of the study area is identified on Figure 3-20 and is characterised by a generally flat environment located below 10 m Australian Height Datum (AHD). There are some undulating areas to the east of Kirra Beach and in the vicinity of Greenmount Beach rising to approximately 20 m AHD.

Soil

The Atlas of Australian Soils Queensland (Queensland Globe, 2021) has identified that soils within the project area are predominantly characterised by dermosols, ferrosols and hydrosols. The general location of these soils are identified in Figure 3-21.

Contaminated land

At this stage of the project, searches of the Environmental Management Register (EMR) and Contaminated Land Register (CLR) have not been undertaken within the study area. While these searches have not been completed, the Gold Coast Airport Master Plan identifies several sites within and adjoining the Gold Coast Airport that are considered to be potentially contaminated sites (Figure 3-22).

Further investigation of contaminated land is expected to be undertaken in subsequent stages of the project.

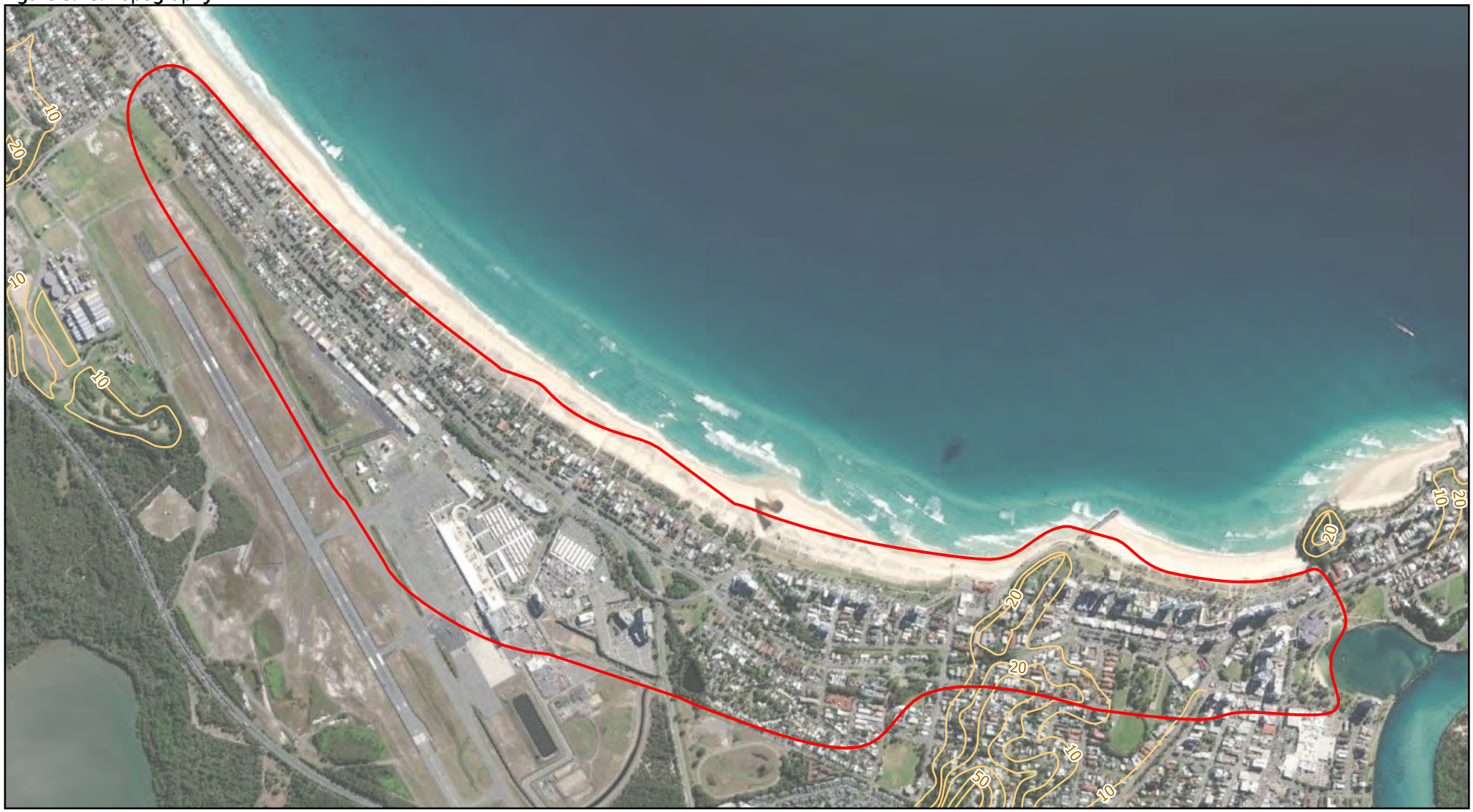
Acid Sulfate Soils

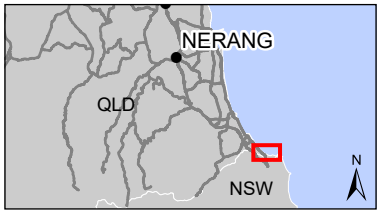
A more detailed discussion on Acid Sulfate Soils can be found in Section 3.2.5

Unexploded ordnance

A search of the DSDILGP Development Assessment Mapping System has identified that the project areas do not contain areas with substantial potential for unexploded ordnance (UXO).

Figure 3.20: Topography





LEGEND

Project study area

Contours (10m)

0 125 250 500

Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Tugun to Coolangatta Multi Modal Corridor Study

Source: DNRM- Contours (1m), Jacobs- Project Area, ESRI, Imagery .

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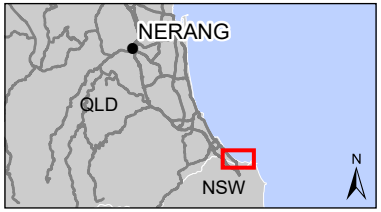
Figure 3.21: Soils



LEGEND

- Project study area
- Dermosol
- Ferrosol
- Hydrosol

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: CSIRO: Soils, Jacobs: Project Area, ESRI: Imagery.

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Figure 3.23: Contaminated Land

LEGEND

- Project study area
- Potentially Contaminated Sites

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: Jacobs: Project Area, Potentially Contaminated Areas ESRI: Imagery.

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3.2.3.4 Biodiversity

Vegetation communities

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) (Appendix B) identified the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland, an endangered threatened ecological community (TEC) as being 'likely to occur' within the study area.

Regional ecosystem (RE) mapping for the study area (Figure 3-23) identifies mapped remnant vegetation occurring within and adjoining the project area in the following locations:

- Category B 'of concern' remnant vegetation in the vicinity of the Gold Coast Airport runway
- Category B 'of concern' remnant vegetation within R.T Peak Memorial Park and at Pat Fagan Park
- Category B 'least concern' remnant vegetation along the foreshore of Bilinga and North Kirra beaches.

The remainder of the study area is located within a Category X area and accordingly does not contain remnant vegetation. Further field assessments may be required to verify the presence of TECs and remnant vegetation within the project area in subsequent project phases.

Further, the planning scheme's biodiversity overlay mapping (Figure 3-24) identifies the following locally protected vegetation within the study area:

- 'High priority vegetation' to the south of Southern Cross University (SCU)
- 'General priority vegetation' along the foreshore of Bilinga, North Kirra, Kirra, Coolangatta and Greenmount
- 'General priority vegetation' between the Gold Coast Highway, the Gold Coast Airport terminal and SCU
- 'General priority vegetation' along the Coolangatta Road corridor.

Protected flora

Searches of the EPBC Act PMST (Appendix B) identified 22 Commonwealth-listed flora species as being potentially present within and adjoining the study area. The Queensland Government's Wildlife Online Database identified 30 State-listed flora species as being recorded within 10 km of the study area.

A review of the Queensland Government Protected Plants Trigger Map identified land in the vicinity of the Gold Coast Airport as potentially containing protected flora species. Should this area be impacted upon by the project, a flora survey will be required.

Further field assessments may be required to determine the presence of habitat for protected flora species within the project area in subsequent project phases.

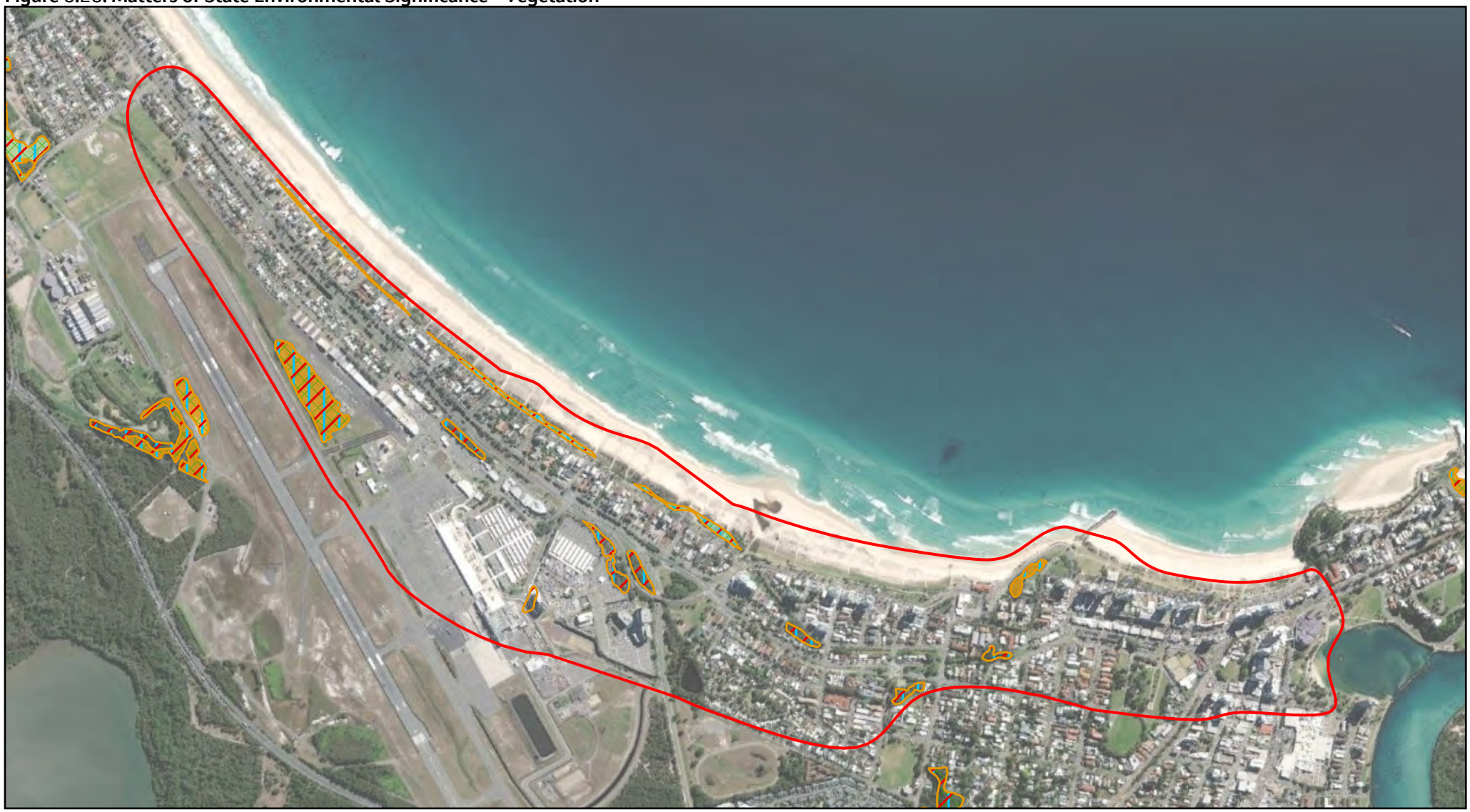
Protected fauna

The EPBC Act PMST has identified a range of Commonwealth-listed fauna species as being potentially present within and adjoining the study area, including:

- 64 terrestrial fauna species
- 76 migratory species
- 103 listed marine species
- 13 whales and other cetaceans.

A search of the Queensland Government's Wildlife Online Database (Appendix B) identified 36 State-listed fauna species as being recorded within 10 km of the study area. In addition, the planning scheme's biodiversity overlay mapping identifies the presence of habitat for locally significant fauna in the vicinity of Greenmount beach and Snapper Rocks (Figure 3-24). Additional field assessments may be required to determine the presence of habitat, foraging or breeding places for protected fauna species within the project area.

Figure 3.23: Matters of State Environmental Significance - Vegetation



Tugun to Coolangatta Multi Modal Corridor Study

Source: DNNME: RE, Essential Habitat, MSES, Jacobs: Project Area, ESRI: Imagery.

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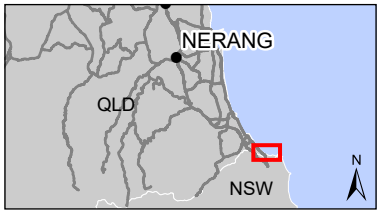
Figure 3.24: Matters of Local Environmental Significance - Vegetation



LEGEND

- Project study area
- Local Significant Species
- General priority vegetation
- High priority vegetation

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Jacobs

Tugun to Coolangatta Multi Modal Corridor Study

Source: GCCC MLES, Jacobs: Project Area, ESRI: Imagery.

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Biosecurity

The EPBC Act PMST (Appendix B) has identified 38 invasive species are likely to occur within and adjacent to the study area, including:

- 17 invasive flora species
- 21 invasive fauna species.

Further field assessments may be required in future project stages to determine the presence of invasive species within the study area.

3.2.3.5 Cultural heritage

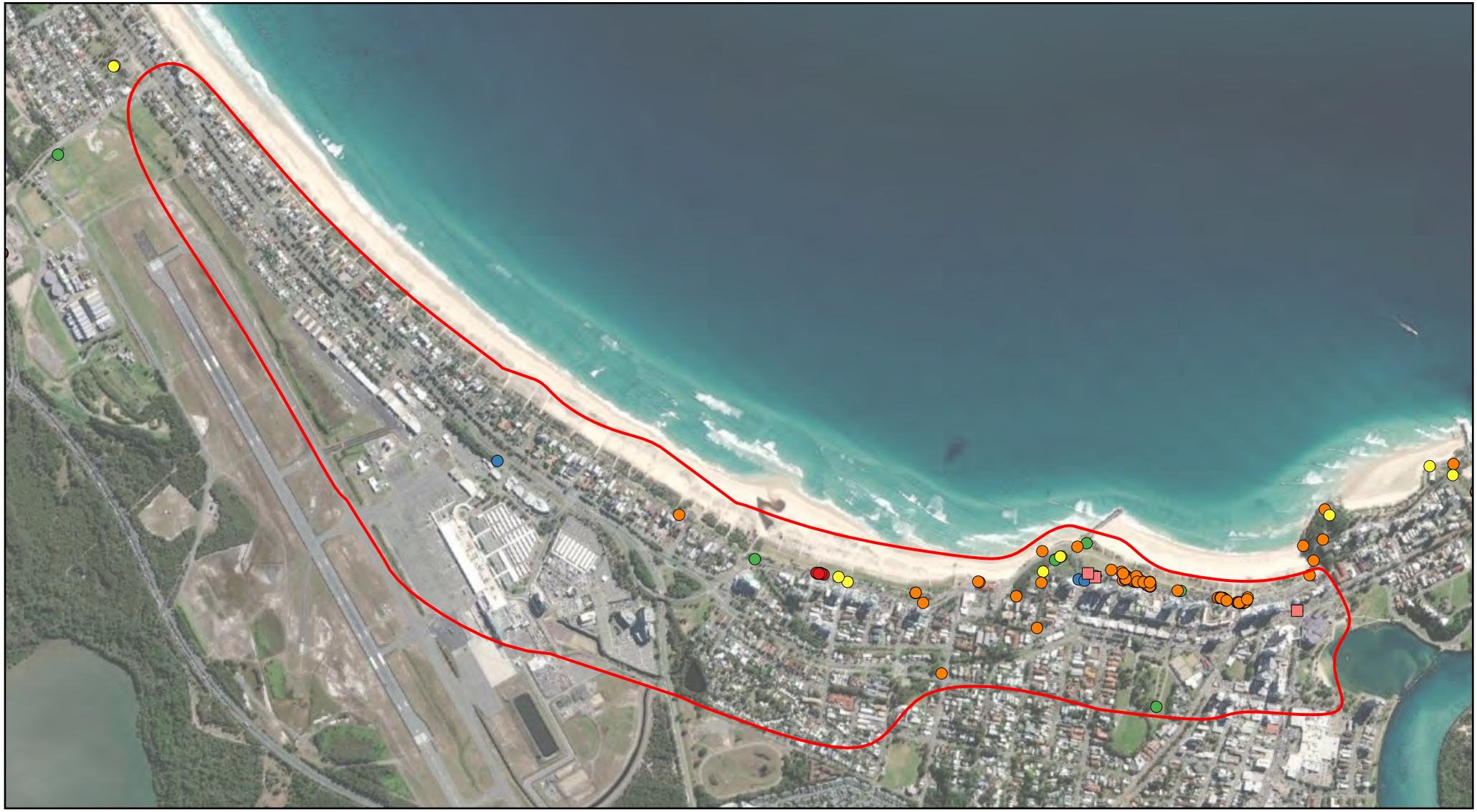
The Aboriginal Cultural Heritage Act 2003 and the Torres Strait Islander Cultural Heritage Act 2003 contain Duty of Care provisions that require those conducting activities in areas of significance to take all reasonable and practicable measures to avoid harming cultural heritage.

As such, a Cultural Heritage Risk Assessment (CHRA) has been completed by TMR for the project areas and is attached as Appendix C

The CHRA determined that the study area includes a range of high risk cultural heritage features including the presence of remnant vegetation in the landscape and the overall land formation of the area, as well as a range of local cultural heritage values. In addition, the CHRA identified two Aboriginal Parties for the study area, including the Gold Coast Native Title Group and the Danggan Balun (Five Rivers).

The CHRA identified that there are no known Aboriginal cultural heritage values present, nor are there State-listed or Commonwealth-listed historic heritage values within the study area. However, there are a range of locally-listed historic heritage values within the study area which are predominantly focused within the foreshore areas of Kirra and Coolangatta (Figure 3-25).

Figure 3.25: Cultural Heritage



LEGEND

- Project study area
- Local heritage place

Local adornment

- Art Wall
- Entry Statement
- Memorial
- Plaque
- Sculpture
- Statue

0 125 250 500
Metres

GDA 1994 MGA Zone 56 A4 1:20,000

Tugun to Coolangatta Multi Modal Corridor Study

Source: GCCC: Local Heritage, Jacobs: Project Area, ESRI: Imagery

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3.2.3.6 Urban canopy trees

CoGC commissioned an Urban Tree Canopy Study to undertake an analysis of tree canopy cover using high resolution LiDAR captured between 2009 and 2018. Urban tree canopy cover is defined in this study as the total area of all branches and leaves of a tree above 3m in height. For the purposes of this study, two tree canopy cover strata categories have been defined, including trees measuring 3-15 metres in height and trees measuring 15m in height and above. Refer to Figure 3-26 for an overview of the canopy coverage per suburb which shows for the suburbs within the study corridor:

- Bilinga has a canopy coverage between 0-10%
- Kirra and Coolangatta have a canopy coverage between 21-30%

The canopy coverage for the study corridor is on the lower range, comparable to the suburbs along the east coast. Given the benefits of urban tree coverage such as cooling, health and wellbeing, economic benefits and community demand for urban tree cover, there is a need to retain the current and increase the urban canopy coverage.

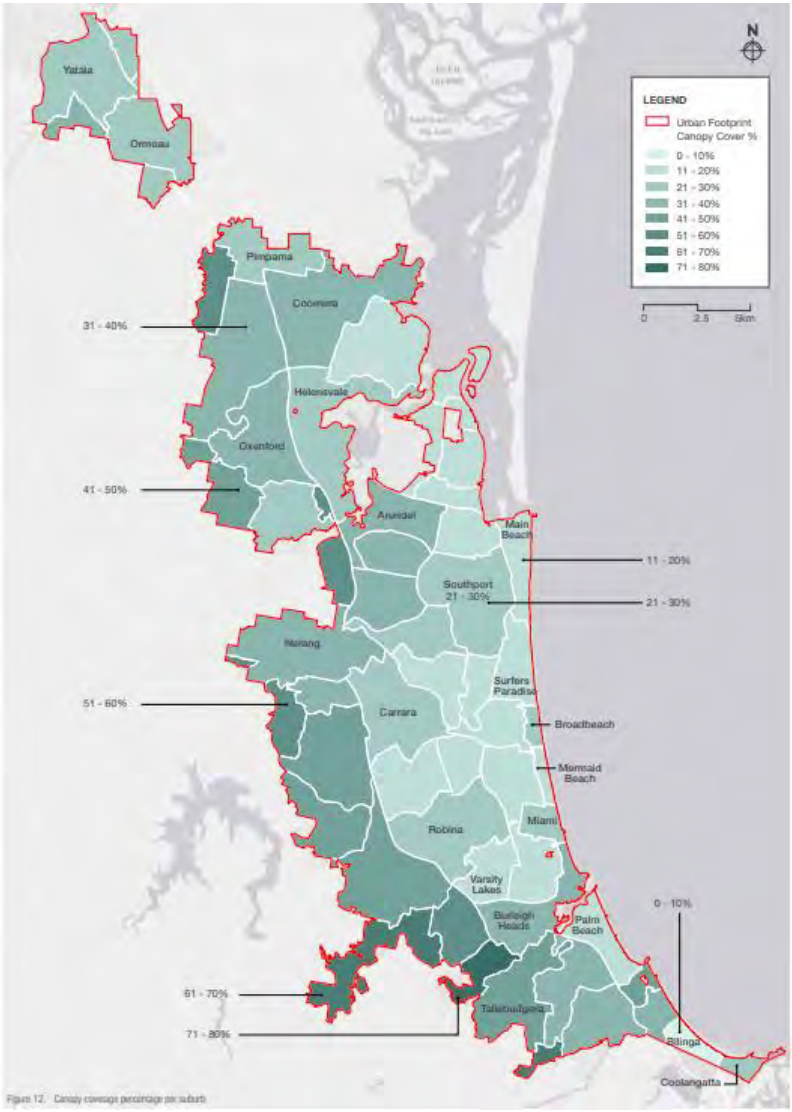


Figure 3-26: Canopy coverage percentage per suburb (Source: Urban Tree Canopy Study,2020)

3.2.4 Public Utility Plant (PUP)

The identification of PUP assets within the project study area was determined from data provided by TMR. This data included utility layout plans and labels in a digital format from Dial Before You Dig (DBYD).

The following utilities listed below were found to have assets within the study corridor.

Electricity. Electrical utilities were divided primarily into two categories: Overhead electrification and underground electrification. Overhead electrification is apparent along the majority of the project areas, from Bilinga to Coolangatta, running parallel along most roads and medians. Underground electrification, from Bilinga section to Gold Coast Airport section generally runs parallel to Gold Coast Highway on the verges of adjacent roads and parts of the eastern and western medians that separate the highway from the adjacent roads. Occasional perpendicular crossings occur at some parts along the corridor, with some cables running in sporadic directions, i.e. western side of Gold Coast Highway near George Street. The majority of cables along these sections are low voltage, however high voltage cables occur along the eastern median that separates the highway from Coolangatta Road and eventually onto the eastern median near Gold Coast Airport. From Kirra section to Coolangatta section, there are similar arrangements in underground electrification, with cables running along the eastern and western verges of most roads. Occasionally, cables cross perpendicular to the direction of the road and run along medians, i.e. Coolangatta Road. Substations are found to be scattered across the whole study area with a few in each section.

Water. Water utilities are generally located within both the eastern and western verges of adjacent roads along the Gold Coast Highway from Bilinga to Gold Coast Airport. A similar arrangement occurs from Kirra to Coolangatta with utilities running along the verges for all roads. Occasional perpendicular crossings occur, though more are common from Gold Coast Airport section to Coolangatta section. The most notable pipe crossing is from the Gold Coast Desalination Plant that crosses along all medians within the Bilinga section from Desalination Plant Road to Short Street.

Gas. Gas pipes from Bilinga to Gold Coast Airport run parallel to the Gold Coast Highway in the eastern verge that separates Gold Four Drive for majority of the alignment, with occasional perpendicular crossings to the western side.

Approaching from Gold Coast Airport, the gas pipe runs in the perpendicular direction along the verge of Lang Street before running parallel to the verge on Pacific Parade, heading south towards Kirra. Besides the gas pipe that deviates in the direction of Creek Street, the general alignment of the gas pipe that follows the corridor alignment, follows the western verge of Winston Street to the eastern verge of Lanham Street, where it then joins the network of pipes at Coolangatta.

Coolangatta contains gas pipes that run parallel to verges, such as those along Lanham Street, Griffith Street, Chalk Street and Marine Parade and occasional gas pipes that run perpendicular.

Sewer. From Bilinga to Gold Coast Airport, sewer pipes run through the eastern and western verges of Golden Four Drive and Coolangatta Road along the alignment of Gold Coast Highway, with only two perpendicular crossings, at Kiewa Avenue and Cahill Street. It should be noted that the perpendicular pipe near Cahill Street is the only pressurised pipe that runs through this area.

From Kirra to Coolangatta majority of the pipes are non-pressurised that run along the eastern verges of streets with some running along the western verges. Perpendicular crossings sometimes occur along the alignment and it should be noted that there is pressurised pipe that runs through Gordon Lane onto the eastern verge of Lanham Street.

Communications/Optical Fibre. Communication and Fibre Optic service providers were identified as being owned by Telstra, Optus, Nextgen, TPG and NBN . Majority of the alignment from Bilinga to Gold Coast Airport contained these services in both eastern and western verges at Coolangatta Road and Golden Four Drive. Services also run along parts of the eastern and western medians of the highway with the occasional perpendicular crossings. Kirra to Coolangatta contain similar arrangements with services running on eastern and western verges of most roads, with the occasional perpendicular crossing and services running along medians.

3.2.5 Geotechnical

A geotechnical desktop study has been undertaken by reviewing the public domain data within the study area. The public domain data include the published geological maps, acid sulfate soils (ASS) risk maps and the published registered water bores.

3.2.5.1 Site geology

The published geological map indicates that majority of the corridor transverses alluvium deposits of Holocene and Pleistocene age. A small section near the eastern end of the corridor is underlain by sedimentary rocks of the Neranleigh-Fernvale beds. The geological map covering the site is presented in Figure 3-27. The relevant surface geology is summarised in Table 3-9.

Based on the geological map, the alluvium deposits are generally coarse-grained material including sand and gravel. Some sections near the western end of the corridor are underlain by man-made deposits associated with landfill and mining. Find-grained swamp deposits are indicated at isolated location potentially associated with waterways.

Figure 3-27: Site geological map (Source; Jacobs GIS Webmap, 2022)

Table 3-9: Geological summary

Symbol	Geological original	Geological Formation	Geological Age	Lithological Summary
Qhh	Man-made deposits	-	Anthropocene	Man-made deposits generally associated with landfill or mining (tailings, dumps and rehabilitated areas)
Qhcb	Alluvium	Holocene Sediments	Holocene	Quartzose to shelly sand and some gravel: beach ridges and cheniers
Qhb	Alluvium	Holocene Sediments	Holocene	Quartzose sand, with variable shell and gravel components, silty to clayey in backbarrier and lacustrine environments
Qhcw	Alluvium	Holocene Sediments	Holocene	Mud, peat; freshwater swamp deposits in coastal areas

Symbol	Geological original	Geological Formation	Geological Age	Lithological Summary
Qhm/ns	Alluvium	Holocene Sediments	Holocene	Quartz sand; near-shore marine sands
Qhe/n	Alluvium	Holocene Sediments	Holocene	Sand, quartzose sand, silt, clay, with variable admixture of organic matter and shell
Qpb	Alluvium	Pleistocene Sediments	Pleistocene	Quartzose sand, silty to clayey in backbarrier environments; commonly leached and/or indurated in parts
DCf	Sedimentary rock	Neranleigh-Fernvale beds	Devonian-Carboniferous	Mudstone, shale, arenite, chert, jasper, basic metavolcanics, pillow lava, conglomerate

3.2.5.2 Groundwater Conditions

Groundwater information is not available for most of the corridor. Based on the published information from Queensland Globe, registered groundwater bores are available within the Tugun desalination plant site, which is located some 500 m west of Bilinga. These groundwater bores indicated groundwater level varies from approximately -2.8 to -3.2 m AHD.

3.2.5.3 Acid sulfate soil potential

The potential for acid sulfate soils (PASS) on site has been assessed based on the Australian Soil Resource Information System's Atlas of Australian Sulfate Soils overlay online mapping (ASRIS, 2014). A great part of the corridor (Bilinga, Airport and Kirra) is marked with high probability of acid sulfate soil potential, while the eastern section (Coolangatta) is marked with extremely low probability. The Acid Sulfate Soil map covering the proposed corridor is presented in Figure 3-28. Table 3-10 summarises the probability and confidence of PASS on the map.

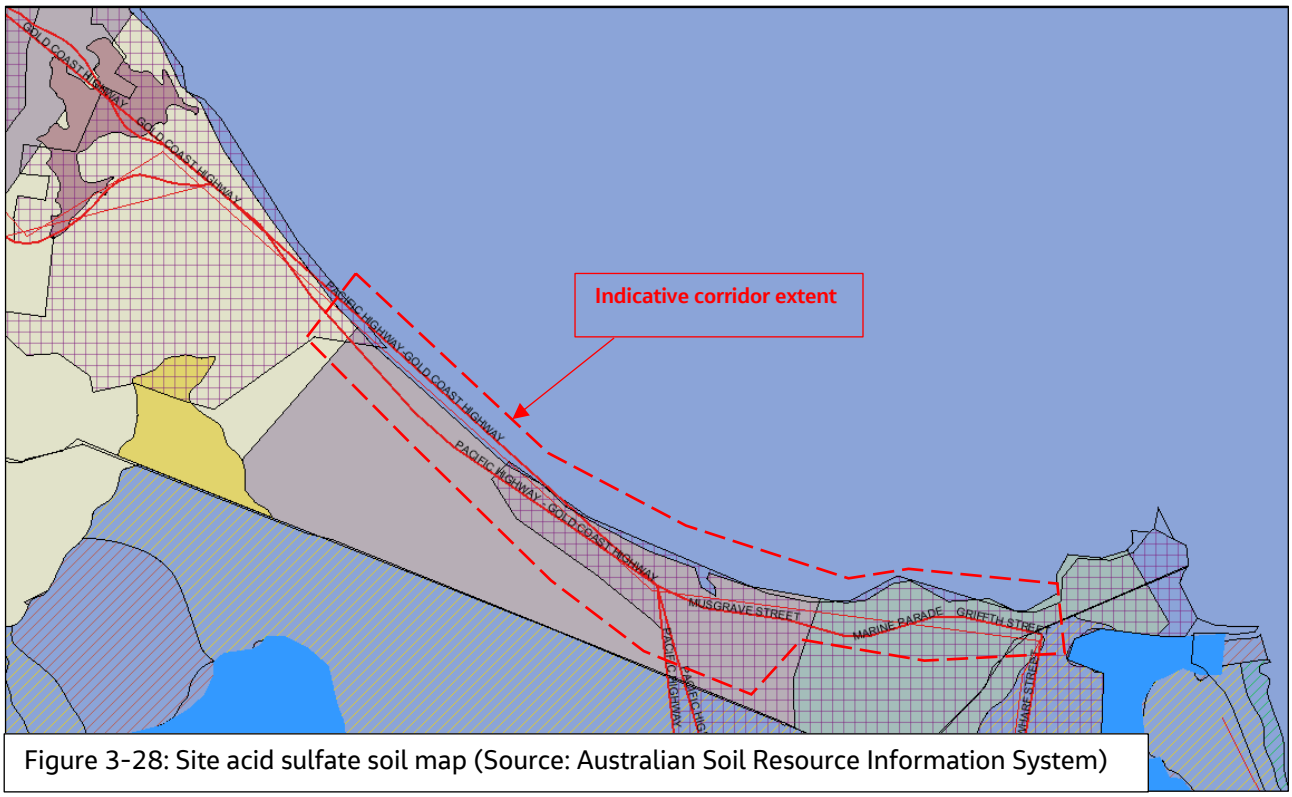


Figure 3-28: Site acid sulfate soil map (Source: Australian Soil Resource Information System)

Table 3-10: Acid sulfate soil potential

Map Colour	Acid Sulfate Soil Probability	Confidence
	High probability of occurrence	Very low confidence
	High probability of occurrence	Low confidence
	Low probability of occurrence	Moderate confidence
	Low probability of occurrence	Very low confidence
	Extremely low probability of occurrence	Very low confidence

3.2.5.4 Geotechnical constraints and opportunities

Based on the desktop study, the key geotechnical risks identified at this stage include the followings:

Further geotechnical investigations. Historical geotechnical investigations were not available either from the public domain data or from TMR along the study corridor at the time of this report. Site-specific investigations will be required to inform future design development in terms of subsurface conditions and groundwater information.

Man-made deposits and landfill sites. Man-made deposits associated with landfill or mining (tailings, dumps and rehabilitated areas) have been identified near the western end of the corridor. The composition and engineering properties of these materials could be highly variable and unpredictable. Further geotechnical investigation will be required to inform foundation, earthwork and pavement design.

These materials are also expected to be related to contaminated/disturbed land. The relevant issues should be further investigated from an environmental perspective.

Acid sulfate soils. Areas with high probability of acid sulfate soil potential have been identified along the corridor. Any disturbance involving excavation, drainage, or water table lowering can pose significant risk to both the environment and design elements involved in the proposed development. These risks may include acidification of groundwater, damage to building foundations, and environmental pollution. This risk maybe lessened by implementing a management scheme that minimises disturbance of the soils (limit earthworks, suspended buildings, etc.) and includes treatment of soil that does become disturbed.

Soft soils. Soft compressible soils could present at locations underlain by Holocene alluvium deposits, which can cause the following problems:

- excessive settlement of structures/embankments.
- stability and movement of structures/embankments.
- relatively long construction period due to long consolidation time.

The geological map indicates that the alluvium deposits along the corridor are generally sandy materials. However, soft soils may present within area underlain by Qhcw and site-specific geotechnical investigations will be required to confirm the subsurface conditions. If soft soils are encountered, ground improvements or deep foundations will be required for road embankments and structures.

Material suitability. The primary site won material is expected to be from cuttings and foundation excavations. Sandy alluvium deposits and man-made deposits (landfill) may require special consideration to allow the site won material to be re-used within fill embankments. Geotechnical investigations and subsequent laboratory testing will be required for assessment of material characteristics and reusability.

3.2.6 Hydraulic

Maps showing the City of Gold Coast flood assessment requirement areas, storm tide hazards and coastal erosion prone areas are depicted in Figure 3-29, Figure 3-30 and Figure 3-31.

Areas identified for flood assessed are primarily located on the North and South zones of Coolangatta Road, the southern extents of Musgrave Road and the southern leg on the Gold Coast Highway. Storm tide hazards also border the southern extents of the Gold Coast Highway. Coastal erosion effects Golden Four Drive, Musgrave Road, Marine Parade and the border of the southern leg of the Gold Coast Highway.

The 1% Annual Exceedance Probability (AEP) flood level is a critical design level for any new infrastructure within the corridor including new road or Light Rail Transit (LRT) facilities as per AS5100.1. However, any new active transport only facility could be designed to achieve a 2% AEP level of immunity.

As well as flood immunity, any new bridge structures would need to be designed to avoid afflux (flooding) impacts to upstream environments and private property. The primary means identified to minimise afflux is to ensure any new bridge piers are of a similar size and in a similar location as existing bridge piers.

Figure 3-29 Areas requiring City of Gold Coast flood assessment (Source: Jacobs GIS Webmap, 2022)

Figure 3-30 Storm tide hazard (Source: Jacobs GIS Webmap, 2022)

Figure 3-31 Coastal erosion prone area (Source: Jacobs GIS Webmap, 2022)

3.2.7 Bridge structure

Within the extents of the Tugun to Coolangatta corridor, only one major bridge has been identified, that is the fly-over from Coolangatta Road to Gold Coast Highway northbound in the vicinity of the airport as depicted in Figure 3-32. This current interchange and intersection arrangement will be assessed as part of this route strategy with various options explored to alter the intersection including potentially to remove the structure.
Observations show limited carriageway width and height beneath the bridge as shown in Figure 3-33. At this stage however, it is not anticipated that Light Rail would need to traverse under or over the structure. As such, no analysis has been undertaken about any structural limitations.

Figure 3-32 Bridge location on interchange (Image source: metromap, 2019)

Figure 3-33 Bridge street view (Source: google streetview)

3.3 Existing transport performance

3.3.1 Safety

Crash data for the study corridor over a six-year period from January 2014 to December 2019 has been retrieved from the Queensland Road Crash Database located on the TMR Open Data Portal and analysed. The data contains information for fatal, hospitalisation, medically treated and minor injury crashes over this period. From analysis it was identified that there were 164 crash events: four fatal, 47 requiring hospitalisation, 83 medically treated and 30 involving minor injury. This has been calculated considering the worst consequence of a crash. The locations and crash DCA[1]s of these incidences are described in Figure 3-34 and Table 3-11.

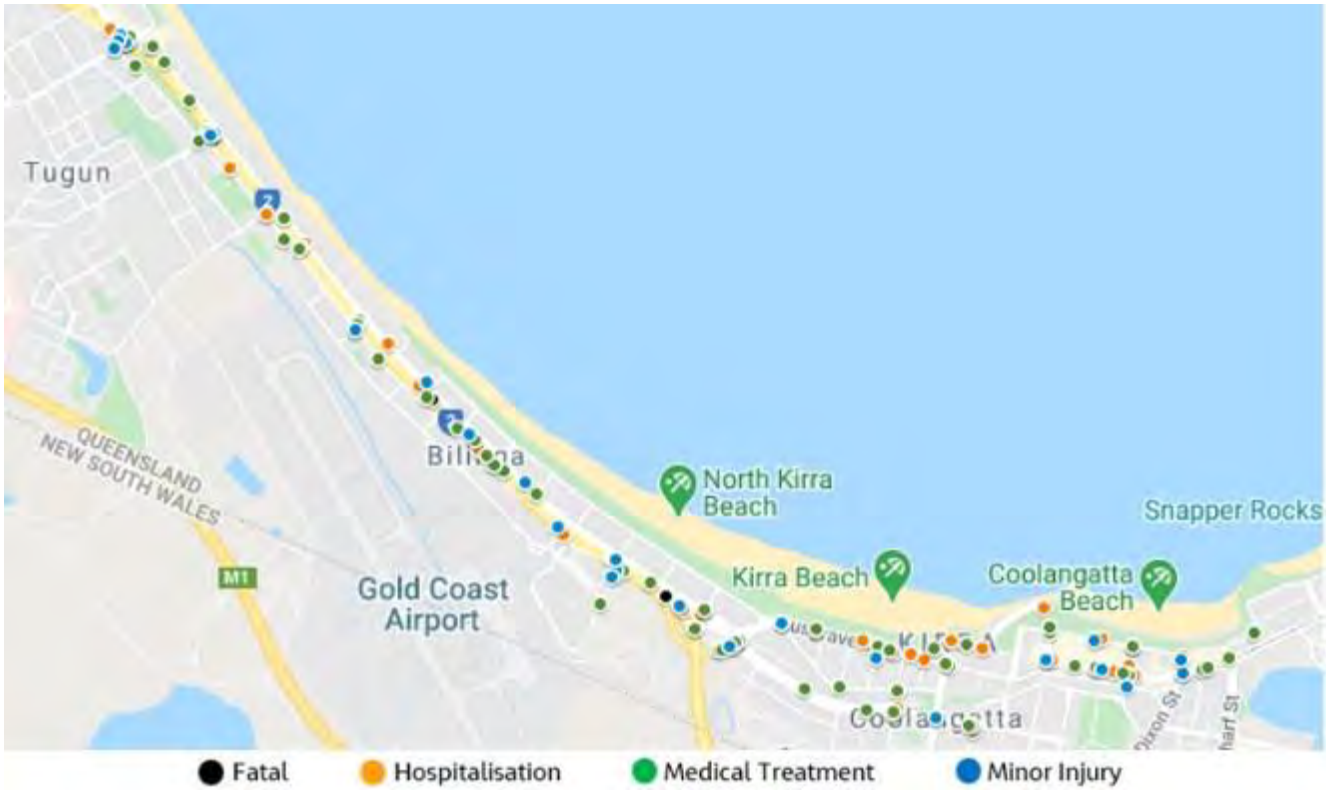


Figure 3-34 Crash Analysis 2014 to 2019[2]

[1] DCA = Definitions for Coding Accidents

[2] https://www.google.com/maps/d/u/0/edit?mid=1mNwsM27z41H421XmDuPcTP65ggCt4xrU&usp=sharing

Table 3-11 Crash Analysis 2014 to 2019

Crash DCA	Description	Fatality	Hospitalised	Medically Treated	Minor injury	Total
0	Ped'N: Hit Other		1	3		4
1	Ped'N: Near Side Vehicle Hit From Right		3	4	1	8
3	Ped'N: Far Side Vehicle Hit From Left	1	8	6		15
7	Ped'N: Hit By Vehicle Enter/Leave D'Way		1			1
101	Veh'S Adjacent Approach: Thru-Thru	1	6	24	6	37
102	Veh'S Adjacent Approach: Right-Thru		1	1		2
104	Veh'S Adjacent Approach: Thru-Right		3		1	4
107	Veh'S Adjacent Approach: Thru-Left			2	3	5
201	Veh'S Opposite Approach: Head On	2	2	1		5
202	Veh'S Opposite Approach: Thru-Right		4	9	4	17
301	Veh'S Same Direction: Rear End		7	32	11	50
302	Veh'S Same Direction: Left Rear		2	12	5	19
303	Veh'S Same Direction: Right Rear			1	2	3
304	Veh'S Same Direction: U-Turn			1	1	2
305	Veh'S Same Direction: Lane Side Swipe		1	1	1	3
306	Veh'S Same Direction: Lane Change Right		1	2		3
307	Veh'S Same Direction: Lane Change Left			1		1
400	Veh'S Manoeuvring: Other		4	4	2	10
406	Veh'S Manoeuvring: Leaving Driveway				3	3
408	Veh'S Manoeuvring: Entering From Footway			4		4
700	Off Path-Straight: Other		1	1		2
703	Off Path-Straight: Left Off Cway Hit Obj		3		2	5
705	Off Path-Straight: Out Of Control On Cway			2		2
708	Off Path-Straight: Mounts Traffic Island	1		1		2
901	Pass & Misc: Fell In/From Vehicle		1	2	2	5

3.3.2 Road traffic

3.3.2.1 Traffic volumes

The Gold Coast Highway performs a key north-south arterial road function carrying an average annual daily traffic (AADT) between Kitchener Street and Boyd Street of 39,000 in 2019 (2019 AADT Report) and 38,000 AADT in 2020 (2020 AADT Report), while the M1 to the west provides a regional and national north-south motorway function, carrying almost 64,000 vehicles per day in 2019 south of Stewart Road (2019 AADT Report). The AADT on the M1 was significantly affected by COVID-19 in 2020 and 2021 due to the QLD/NSW border closure reducing to 38,000 in 2020.

The rest of this section describes transport outputs from the 2019 Gold Coast Strategic Transport Model (GCSTM-MM). Note that these traffic volumes are expressed as average week day traffic (AWDT) and so differ from the count data described above. For more detail on the model please refer to the Transport Modelling Report in Appendix G.

The Gold Coast Highway is modelled to carry between 26,500 and 40,400 vehicles per weekday (AWDT) between Stewart Road and north of the Gold Coast Airport while the M1 (north of Stewart Road) carried 95,700 vehicles per weekday and the M1 (Tugun Bypass section) carried between 67,900.

Therefore, in a situation where the Tugun Bypass (M1) between Stewart Road and Kennedy Drive) is closed (i.e. for maintenance), the Gold Coast Highway may need to accommodate up to an additional 68,000 vehicles.

Figure 3-35: 2019 AWDT volumes (Source: GCSTM-MMv2.2 Model Run: GC_2019_N013d_TW03)

In the AM peak two-hour period (refer to Figure 3-36)

- The peak M1 flow direction is northbound with approximately 500-800 extra trips heading north. This could be attributable to commuter trips from residences in Tweed Heads South to commercial precincts north of Tugun and/or precincts in Kirra.
- Flows on Gold Coast Highway are relatively balanced. The peak direction for Gold Coast Highway, south of Boyd Street, is southbound with volumes in the order of 2,700. Beyond the airport, volumes are relatively balanced but with marginally greater flows northbound (from M1). This is similar to flows on Coolangatta Road and Musgrave Street with flows relatively balanced. This means that destinations and employment centres located near the Airport attract trips from north of Boyd Street and employment centres in Kirra attracting trips from M1 via Gold Coast Highway.
- Northbound direction is the peak direction on Wharf Street and Minjungbal Drive due to local trips heading to key attractors in Coolangatta from residences located in Tweed Heads and Tweed Heads South.

In the PM peak two-hour period (refer to Figure 3-36):

- The M1 peak direction is southbound This is attributable to return trips from commercial precincts north of the study area to destinations within and south of study area.
- Gold Coast Highway peak direction is southbound along the entire study area. This is due to workers returning from the employment centres in Airport and workers from Coolangatta Road heading south and returning to residences in Tweed Heads South. Northbound volumes are also higher on Coolangatta Road and volumes are balanced on Musgrave Street.
- Southbound direction is the peak direction on Wharf Street and Minjungbal Drive due to return trips from key attractors in Tweed Heads and Tweed Heads South to locations south of the study area.

Overall, two-way traffic volumes along Gold Coast Highway south of Boyd Street in the PM period are 20% higher than the AM peak period. Between Boyd Street and the Gold Coast Airport, two-way traffic volumes on Coolangatta Road in the AM period are 30% higher than the PM peak period. In a situation where the Tugun Bypass (Pacific Motorway between Stewart Road and Kennedy Drive) is closed (i.e., maintenance), the Gold Coast Highway may need to accommodation an additional 10,000 vehicles in each peak period (two-way).

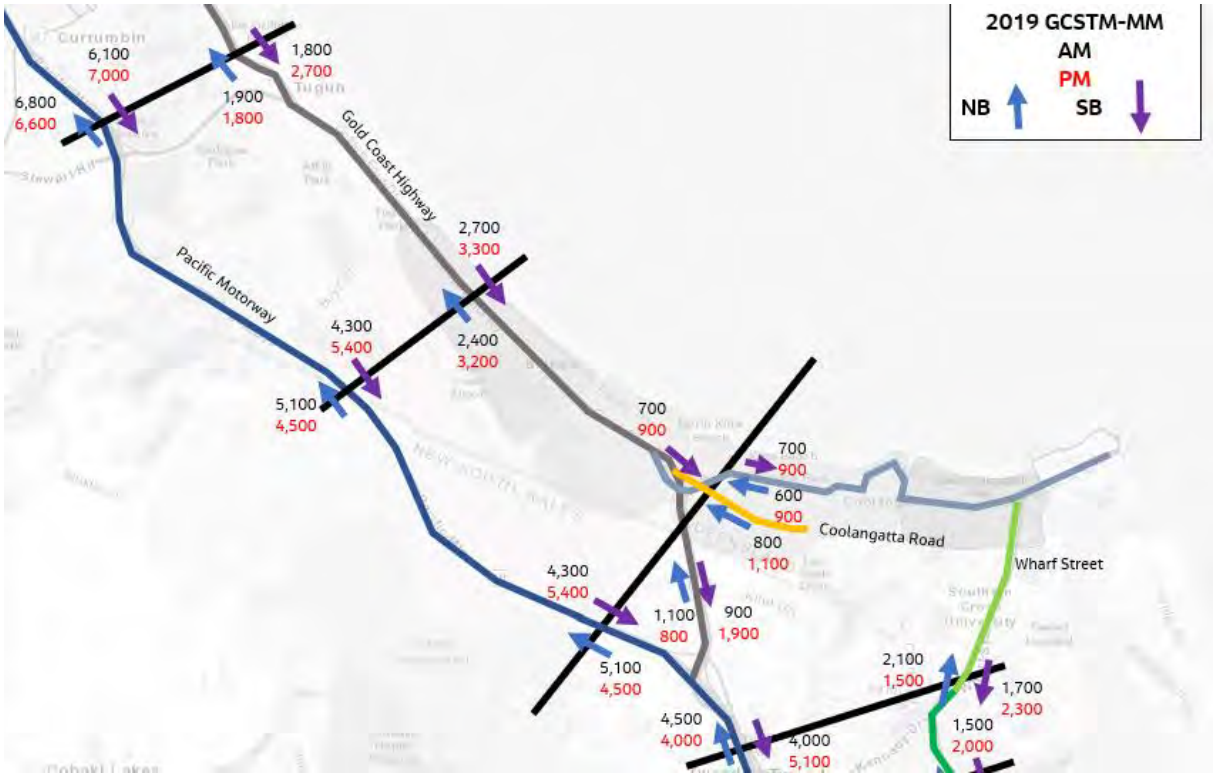


Figure 3-36: 2019 traffic volumes (Source: GCSTM-MMv2.2 Model Run: GC_2019_N013d_TW03)

3.3.2.2 Travel times

Travel time analysis for the peak periods (8-9am and 4-5pm) was undertaken using 2019 HERE (travel time) data for TMR. Refer also to Appendix G for more detail.

In the AM peak:

- Travel times on M1 northbound (peak direction) between Gold Coast Highway on-ramp to Exit 82 (18km) range from around 12 to 20 minutes (55km/hr to 90km/hr). Areas of congestion are observed at Exit 92 as the K P McGrath Drive northbound on-ramp causes queueing on the motorway.
- Low levels of congestion are observed on Gold Coast Highway and Coolangatta Road. Travel times on Gold Coast Highway in both directions range from 14 to 18 minutes (45 km/hr to 60km/hr). Travel times on Coolangatta Road in both directions to/from Griffith Street and Gold Coast Highway (1.8-2km) range from two to four minutes (30 km/hr to 60km/hr).

In the PM peak:

- Travel times on M1 northbound (peak direction north of Stewart Road) between Gold Coast Highway on-ramp to Exit 82, range from around 20 to 35 minutes (30km/hr to 55 km/hr). Same congestion issues as the AM are observed, however travel times are higher in the PM peak which indicates return trips from work are higher than commuter peak to work northbound in the AM peak.
- Travel times on the M1 southbound south of Stewart Road range between 20 to 30 minutes (35km/hr to 55km/hr).
- Travel times on Gold Coast Highway southbound (peak direction) range from 16 to 24 minutes (35 km/hr to 52km/hr). This indicates that compared to the AM peak there is more congestion and unreliability in travel times.
- Travel times on Coolangatta Road northbound (peak direction) from Griffith Street and Gold Coast Highway range from two to three minutes.

3.3.2.3 Freight

Freight routes within the study area are illustrated in Figure 3-37 and Figure 3-38. The M1 is part of the National Land Transport Network Road (NLTN) while the M1 and Gold Coast Highway (from Stewart Road to Pacific Motorway) are also designated 25m B-double Routes.

Figure 3-37: QLD heavy vehicle route map (Source: Queensland Globe)

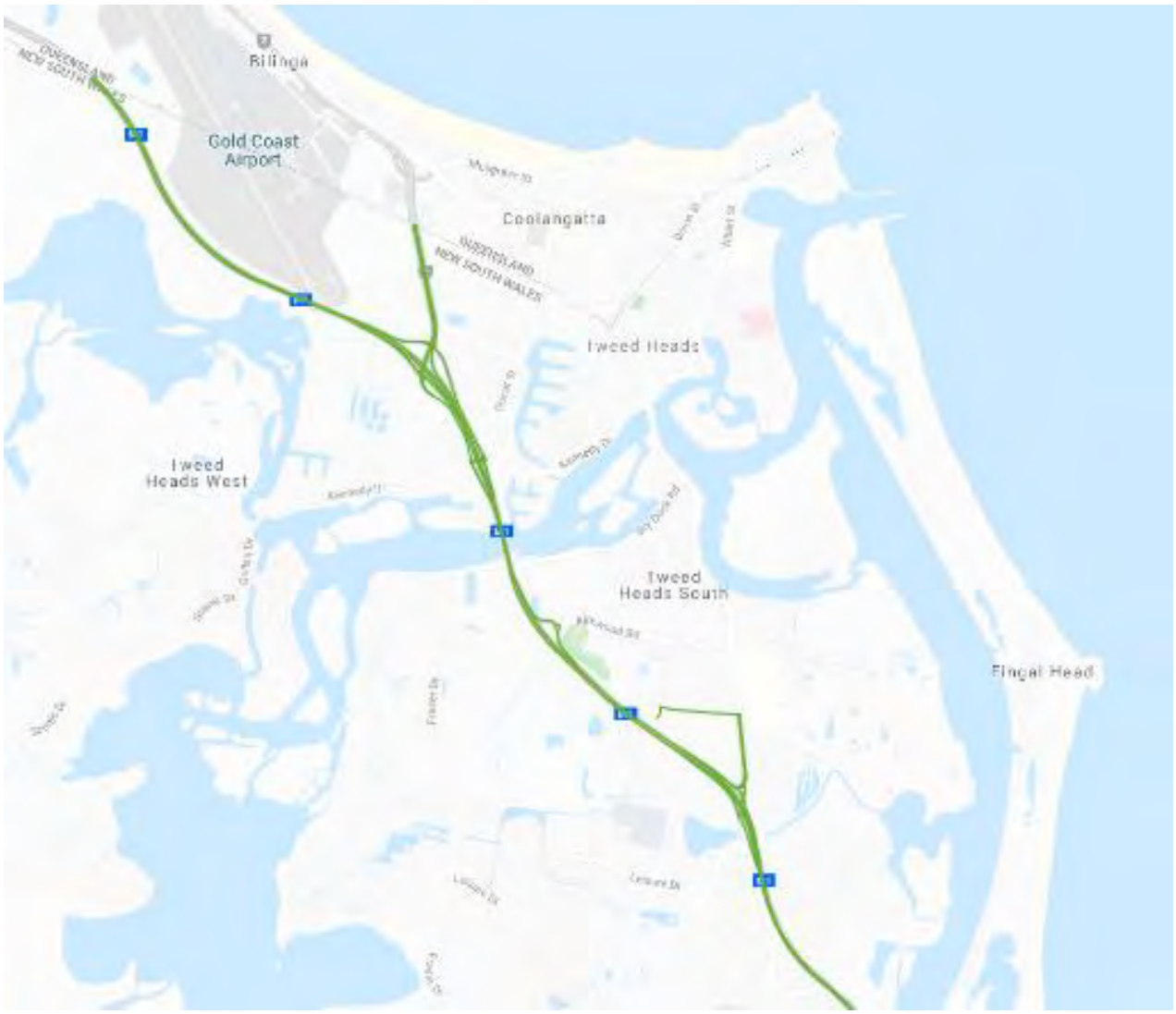


Figure 3-38: NSW heavy vehicle route map – 25/26m B-double Routes (Source: NSW Combined Higher Mass and Restricted Access Vehicle Map)

Based on the GCSTM-MMv2.2 2019 model volumes as illustrated in Figure 3-39, heavy vehicles (HV) account for:

- 10% of total daily volume (6,800 vehicles) on M1. In peak periods, with the proportion of heavy vehicles lower approximately 8% in AM peak and 5% in PM peak.
- 4% of total daily volume (700 to 1,700 vehicles) on Gold Coast Highway
- 6-7% of total daily volume (1,500 to 2,400 vehicles) on Minjungbal Drive

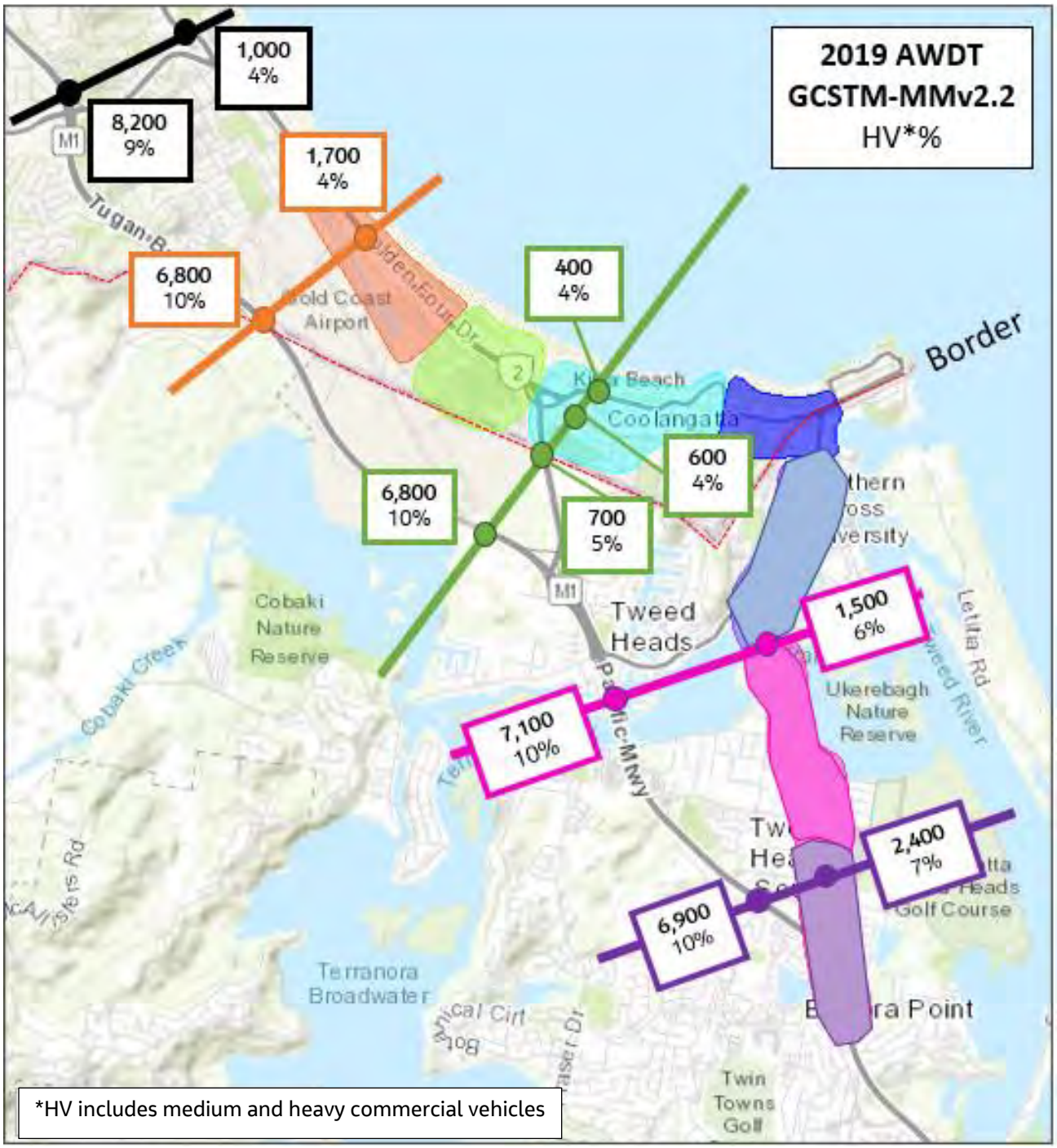


Figure 3-39: 2019 AWDT heavy vehicle volumes (Source: GCSTM-MMv2.2 , Model Run: GC_2019_N011_B003)

3.3.3 Public transport

There are a significant number of bus stops within the study corridor as illustrated in Figure 3-40 with stop spacing ranging from less than 100m to over 500m.

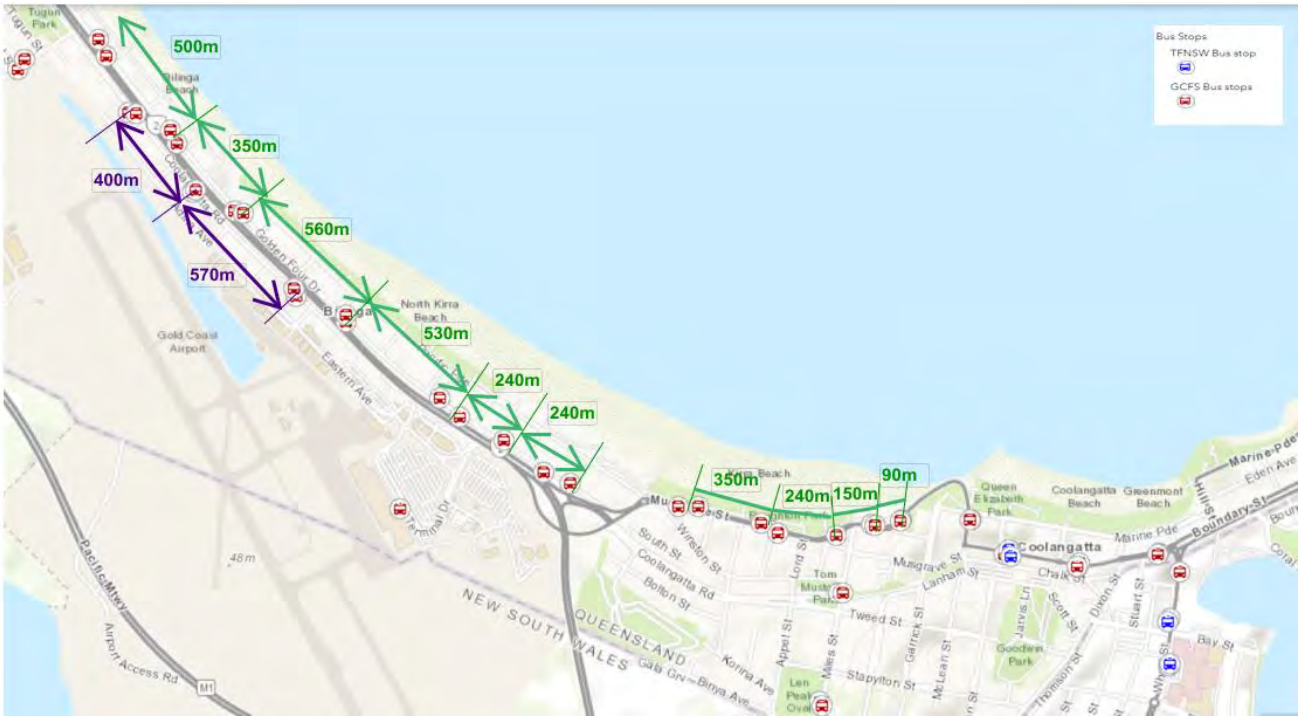


Figure 3-40: Bus stop locations and distances between stops along Golden Four Drive and Coolangatta Road (Source: Jacobs GIS webmap, 2022)

The corridor between Tugun and Coolangatta/Tweed Heads is served by four bus routes namely routes 700, 760, 768 and 777. The characteristics of each of the bus routes is as follows:

- Route 700 is a high frequency service that travels between Tweed Heads and Broadbeach South station (current LRT terminus) up to 8 times an hour (every 7.5 minutes), with stops approximately every 400m.The bus service runs at the same frequency every day (both weekdays and weekends).and runs for 24 hours.
- Route 760 provides a half hourly service between Tweed Heads and Robina Town Centre via Gold Coast Airport and Varsity Lakes Train Station. The bus service runs every day (both weekdays and weekends) between 5am to 7pm.
- Route 768 travels between Tweed Heads and The Pines shopping centre via John Flynn Hospital which operates hourly. This service on Monday to Friday runs between 8am and 4pm, whereas on the weekend it runs between 8am to 3pm.
- Route 777 is an express airport service that runs every 15 minutes between Gold Coast Airport and Broadbeach South station (current LRT terminus) and stops approximately every 1.6 km. The bus service runs between 5am and 11pm every day (both weekdays and weekends).

The public transport network structure is shown in Figure 3-41. The combined frequency between Tugun and Tweed Heads is 15 buses per hour per direction.

Figure 3-41: Public transport network map for Tugun, Bilinga and Coolangatta (Source: Jacobs GIS webmap, 2022)

Ticketing data for the study area was provided by TransLink for the period between 7 October 2019 and 4 November 2019. This data shows that high frequency route 700 has the highest boardings of the bus routes which travel through the study area with an average of 6,565 boardings per day (Figure 3-42). The next busiest is route 777 with an average of 1658 boardings per day and route 760 with an average of 1176 boardings per day. Route 768 has less than 200 boardings per day on average.

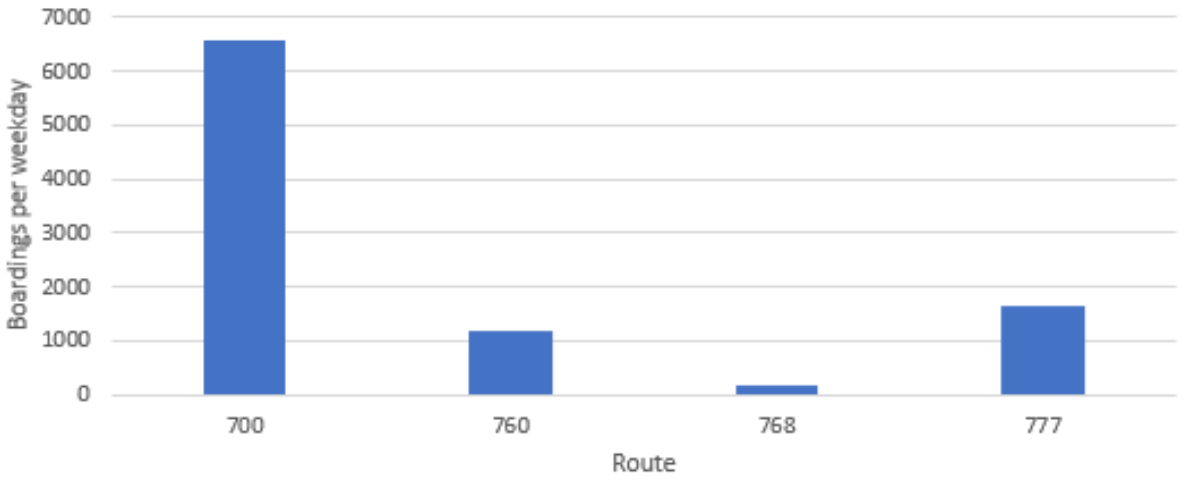


Figure 3-42: Boardings by route for the public transport services which travel through the study area

Further analysis was completed looking at boardings per kilometre for each of the bus routes that travel through the study area as well as the existing Glink Light Rail service (Figure 3-43). In service kilometres for each route was calculated by multiplying the trip distance by the number of trips per weekday. Route 700 generates 1.2 boardings per km compared to 0.8 boardings per km for route 760 and 0.6 boardings per km for routes 768 and

777. The reason why route 700 has higher boardings per kilometre is that passengers can board along the whole route between Tweed Heads and Broadbeach Station.

It is noted that route 700 currently operates between Tweed Heads and Griffith University between approximately midnight and 5AM as a tram replacement service on Sundays through Thursday. In contrast, for route 760 there is a section of motorway running where passengers cannot board and for route 777 the express stop pattern limits where passengers can board. The Glink Light Rail service generates significantly higher boardings per kilometre travelled than the bus services in the study area with 5.9 boardings per km. It is noted that route 760 provides for the only "fast" public transport connection to heavy rail from this part of the Gold Coast.

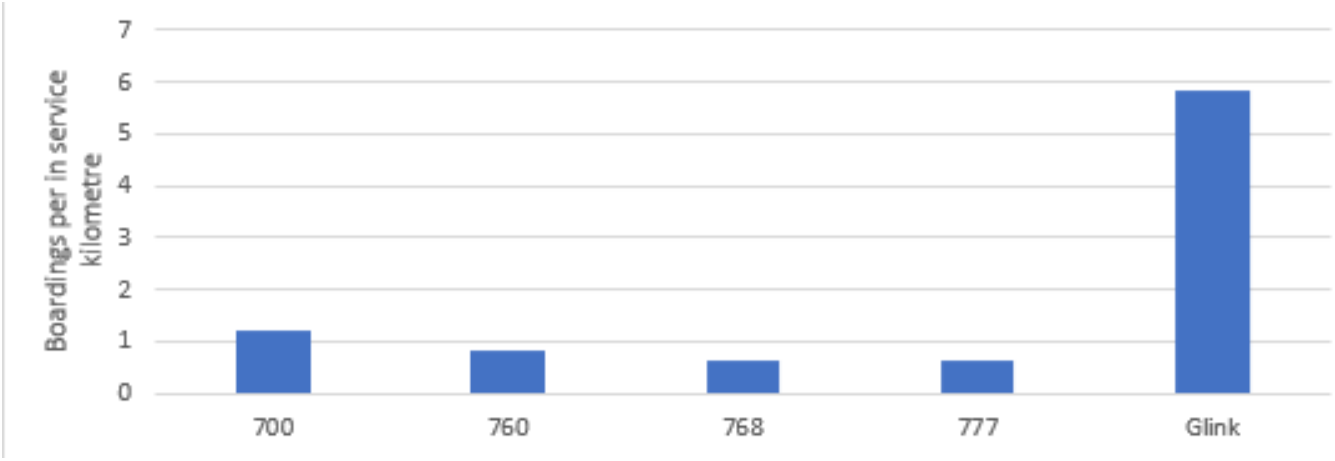


Figure 3-43: Boardings by route per kilometre

The period of the day with the highest public transport boardings is 8am to 9am, 2pm to 3pm and 3pm to 4pm with approximately 840 boardings per hour (Figure 3-44). Boardings in the interpeak are approximately 24% lower than the peak periods with 640 boardings per hour. Route 700 has a half hourly service between midnight and 4:00am with approximately 30 passengers per hour use the after-midnight service.

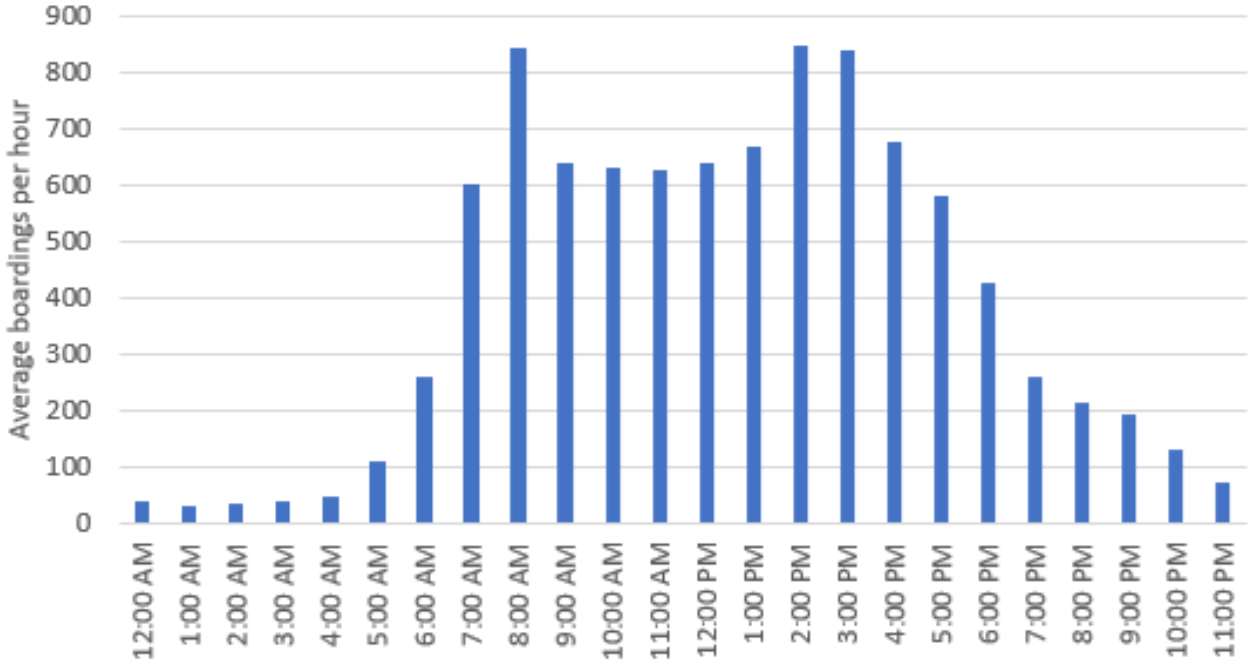


Figure 3-44: Boardings by time of day for routes 700, 760, 768 and 777

The most popular destination within the study area for public transport trips is Gold Coast Airport with 652 boardings per day (Figure 3-45). The bus stop Golden Four Drive nearest to the airport has higher boardings (56 passengers per day) than other stops on Golden Four Drive which indicates that some airport customers may be walking out to catch the route 700. The next most popular destination is Coolangatta with 343 boardings per day and Tweed Heads with 310 boardings per day. Of note is that the boardings at stops along Golden Four Drive (apart from the stop nearest the airport) are comparatively low with less than 30 passengers per day. This could be due to the difficulty for pedestrians in crossing the Gold Coast Highway or this could be due to the relatively narrow catchment of residential land in Bilinga.

Figure 3-45: Map showing boardings per stop between Tugun and Tweed Heads (stops with more than 30 boardings per weekday are labelled) (Source: Jacobs GIS using TransLink data)

An origin and destination analysis (using average daily patronage) at a suburb level show that the most popular destinations for passengers boarding within the study area is Broadbeach. As an example, around 270 passengers per day board in Bilinga and alight in Broadbeach which could be due to passengers transferring onto the Glink Light Rail or travelling to Pacific Fair shopping centre. Other popular destinations are Coolangatta and Palm Beach which indicates that people are also using the public transport network for short trips to local services. Trips with unrecorded destinations occur if the passenger uses a paper ticket or does not tap off. Anecdotally passengers who have concession tickets or passes are less likely to tap off as there is no fare penalty.

Based on the Australian Bureau of Statistics 2016 Census data on *Method of Travel to Work* of the working population located in suburbs within or surrounding the study area, 4% of the working population commute to work via public transport compared to 74% that travel via private vehicle (refer to Table 3-13). Broadbeach reports the highest proportion of public transport users out of all suburbs analysed (10%). The most common form of public transport in Broadbeach was the Light Rail (50% of total public transport usage).

Figure 3-46 and Figure 3-47 display the travel time per hour between Tugun and Tweed Heads (route 768). Travel time and variability is highest in the morning peak with a gradual decrease in the interpeak and afternoon. In the northbound direction, the highest travel time occurs at 10am with a median of 21 minutes and a 75 percentile of 23 min. For the southbound direction, the highest travel time occurs at 7am with a median of 19 minutes and a 75 percentile of 24 minutes. Based on bus timetable data, the travel time between Tugun to Coolangatta (Musgrave Street) is approximately 12 minutes along Gold Coast Highway (compared to six minutes travel time for private vehicles along Gold Coast Highway, see Section 3.3.2).

Table 3-12: 2016 Census Travel to Work Statistics (ABS,2016)

Suburb	Public transport	Vehicle	Active transport	Other mode	Worked at home or did not go to work	Mode not stated	Total (excluding not applicable results)
Bilinga	5%	72%	5%	1%	16%	5%	**767**
Broadbeach	10%	57%	14%	1%	16%	10%	**2,727**
Burleigh Heads	4%	73%	5%	1%	16%	4%	**4,954**
Coolangatta (Qld)	3%	67%	11%	1%	17%	3%	**2,547**
Currumbin	3%	74%	4%	1%	17%	3%	**1,444**
Elanora	2%	79%	2%	1%	16%	2%	**5,545**
Mermaid Beach	6%	72%	7%	1%	14%	6%	**3,851**
Miami	5%	75%	4%	1%	14%	5%	**3,678**
Palm Beach (Qld)	4%	76%	3%	1%	15%	4%	**7,080**
Robina	4%	75%	3%	1%	16%	4%	**11,026**
Tugun	3%	76%	3%	1%	16%	3%	**3,109**
Tweed Heads	2%	76%	4%	1%	15%	2%	**7,267**
Varsity Lakes	4%	77%	4%	0%	14%	4%	**7,138**
Total	**4%**	**74%**	**5%**	**1%**	**15%**	**1%**	**61,133**

		Boarding suburb									
Alighting suburb		Bilinga	Burleigh Heads	Coolangatta	Currumbin	Elanora	Palm Beach	Robina	Tugun	Tweed Heads	Varsity Lakes
	Bilinga	15	31	37	8	16	28	23	19	18	47
	Broadbeach	270	352	104	90	0	188	0	37	82	0
	Burleigh Heads	28	36	40	14	0	53	0	13	20	0
	Coolangatta	26	33	50	10	9	34	13	30	29	22
	Currumbin	9	12	14	6	7	11	3	5	7	6
	Elanora	16	0	10	5	6	5	22	6	8	31
	Mermaid Beach	18	56	14	5	0	26	0	3	6	0
	Miami	13	61	12	4	0	27	0	5	5	0
	Palm Beach	30	57	42	11	2	63	8	22	25	9
	Robina	20	0	15	5	20	6	6	7	11	8
	Tugun	19	13	33	5	13	24	7	12	16	10
	Tweed Heads	21	26	28	9	8	30	12	19	11	26
	Varsity Lakes	50	0	22	6	23	4	7	8	18	3
	Unknown	320	360	351	94	111	481	62	172	265	87

Table 3-13: Origin and destination for passengers on routes 700, 760, 768 and 777. Cells with more than 50 passengers per day are highlighted

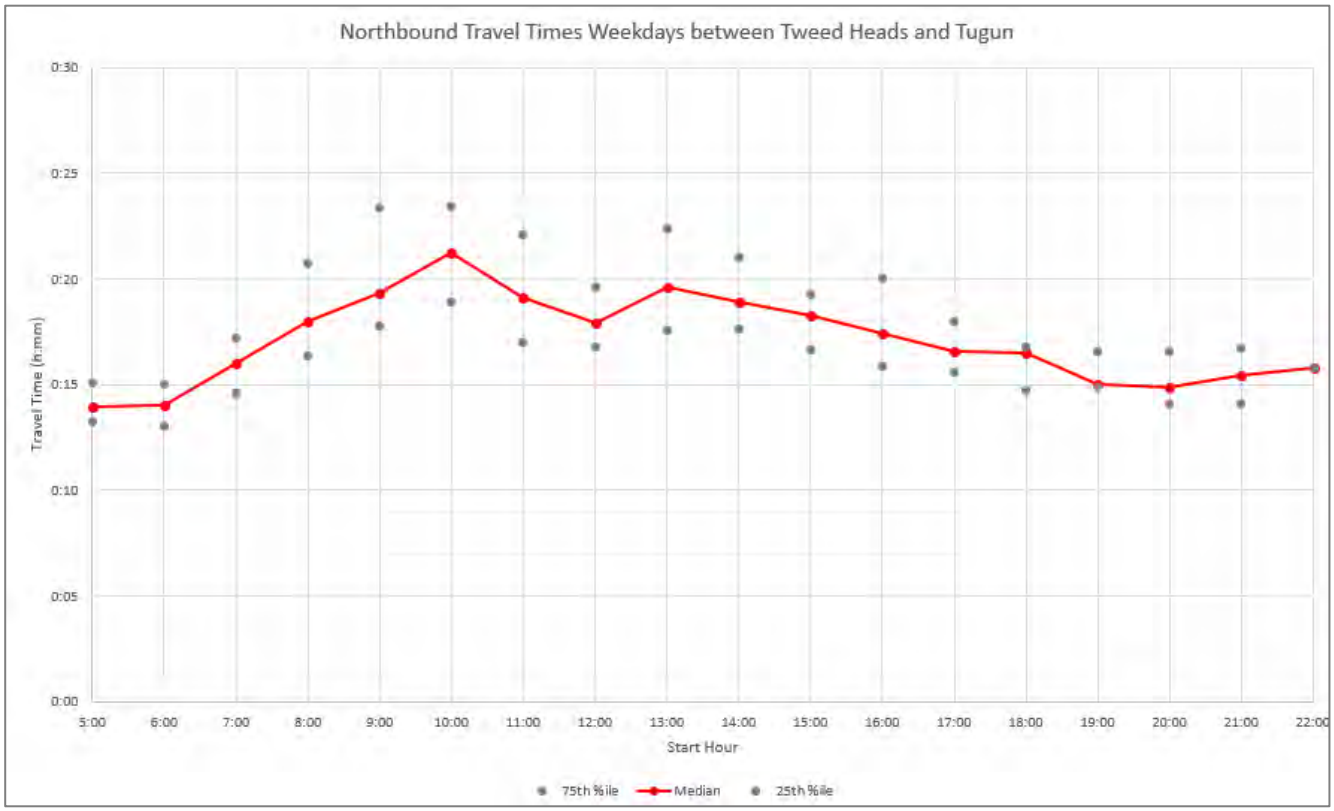


Figure 3-46: Travel time between Tweed Heads and Tugun northbound

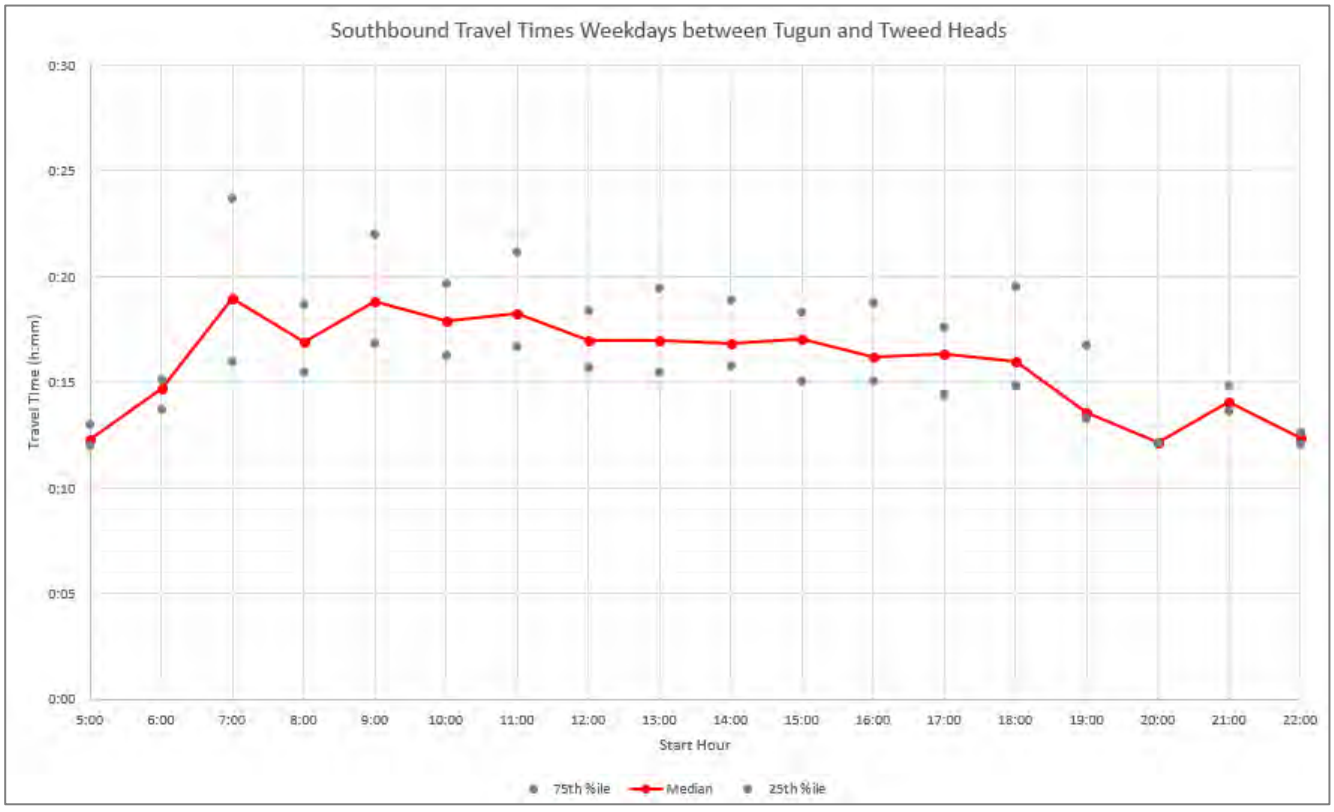


Figure 3-47: Travel time between Tugun and Tweed Heads southbound

3.3.4 Active transport

3.3.4.1 Walking

The areas with the highest pedestrian activity are Coolangatta and the beach front. The Oceanway shared path extends the full length of the study area between Tugun and Tweed Heads which provides a high-quality shared pedestrian and cycle path. Footpaths are not provided along the Gold Coast Highway between Bilinga and Tugun with pedestrians instead using the eastern side of Golden Four Drive or the western side of Coolangatta Road which run parallel to the highway. There are limited pedestrian crossings on Gold Coast Highway with signalised crossings at Terminal Drive, Kirribin Street and Sand Street (Figure 3-48). The wide spacing of pedestrian crossing facilities on the Gold Coast Highway presents a barrier for people to access bus stops on Golden Four Drive and the beach from the west. For example, a pedestrian wanting to cross from Golden Four Drive at Bilinga Beach bus stop to Wanda Avenue would need to walk 1km or 13 minutes via the nearest pedestrian crossing when the direct distance across the Gold Coast Highway is 60m.

Pedestrian volumes were sourced from manual counts undertaken by Austraffic on Thursday 12 September 2019. Refer to Figure 3-49 for an overview of the range in pedestrian traffic within the study area. North of the Gold Coast Airport has low pedestrian activity with pedestrian volumes under 100 pedestrians per day. At the Gold Coast Airport, approximately 650 pedestrians a day cross Terminal Drive / Eastern Avenue / Golden Four Drive / Gold Coast Highway intersection. Further east, 1,000 to 4,000 pedestrians a day visit the major activity centres along Marine Parade and Griffith Street.

Figure 3-48: Pedestrian crossing facilities (Source Jacobs GIS portal, 2022)

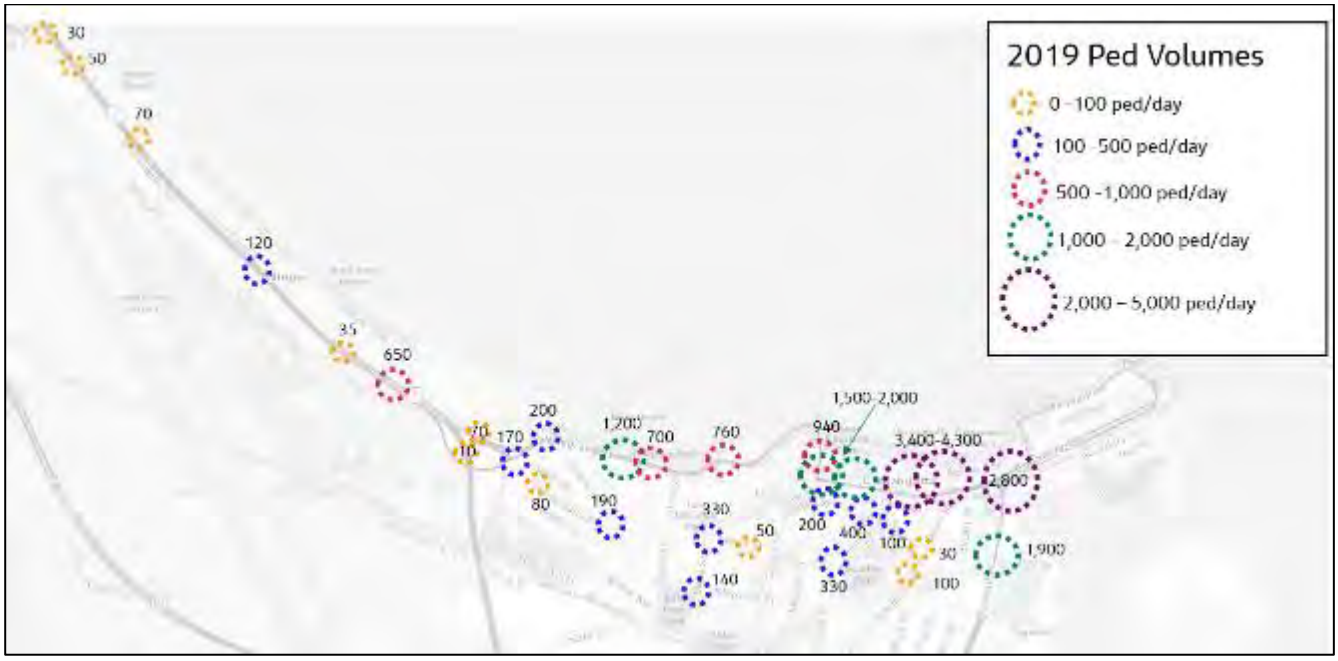


Figure 3-49: Daily pedestrian volumes (10-hour totals)

3.3.4.2 Cycling

The cycling network within the study area is made up of the following routes (**Figure 3-50**):

- The Oceanway which is a shared cycling and pedestrian path along the beachfront
- Golden Four Drive, Musgrave Street and Marine Parade on road cycle lanes
- On road cycle lanes along the shoulder of Gold Coast Highway which is an 80km/h road
- Miles Street has on road cycle lanes at intersections and parking at mid-block sections

The cycling network is characterised by multiple east-west routes (i.e. along the beach or parallel to it) which cater for bike riders of differing confidence levels. The Oceanway would appeal to bike riders of all ages and abilities whilst Gold Coast Highway would only suit confident and experienced bike riders. There is less cycling infrastructure for north-south trips within the study area, with these routes using general traffic lanes or partial on road cycle lanes.

A Strava heat map as shown in Figure 3-51 provides an insight into the routes used by people on bicycles. It should be noted that Strava data tends to over represent confident bike riders who are more likely to track their trips and upload the data to the Strava website. The results show that Golden Four Drive is the most popular east-west cycling route with a proportion of users diverting onto Pacific Parade. The Oceanway is also shown as a popular route with fewer recorded trips using Gold Coast Highway and Coolangatta Road. For north-south cycling routes, Wharf Street and Miles Street are the most popular connections between Tweed Heads and Coolangatta.

Figure 3-50: Cycling network within Tugun, Bilinga, Kirra and Coolangatta (Source Jacobs GIS webmap, 2022)

Figure 3-51: Map showing routes used by people cycling. The brightness of the line indicates the popularity of the route (source: Strava heat map extracted May 2021)

3.4 Summary of current situation

3.4.1 Infrastructure within the corridor

3.4.1.1 Road features

Eight key road environments have been identified within the extents of the study area as follows:

- Gold Coast Highway, Bilinga and Kirra North: 80km/h divided road that is generally four through lanes with two turning lanes. Road shoulders are generally between 2m and 2.5m and includes bike lanes on northbound and southbound shoulders. Along this corridor, there are two priority intersections and two signalised intersections.
- Airport Interchange: Formed from a number of road environments with changing road speeds due to junction of Gold Coast Highway (state district road), distributor roads (Coolangatta Road and Musgrave Street) and local roads such as Terminal Drive.
- Gold Coast Highway, Kirra: 80km/h divided road that is generally four through lanes with two turning lanes. Road shoulders are approximately 1.5m.
- Musgrave Street, Kirra: 50km/h divided distributor road that is generally two through lanes plus turning lanes. Shoulders along westbound direction are 3.5m to 4m with bike lanes and shoulder parking. Shoulders on eastbound are 1.5m to 3m and includes bike lanes. Most auxiliary lanes are unsignalised with one signalised intersection with auxiliary left and right turn lanes on Musgrave Street and Douglas Street.
- Marine Parade, Kirra: 50km/hr divided road that is generally two through lanes. Shoulder widths are 1.5m to 2m with bike lanes. Includes two signalised intersections with single right turn lanes and two roundabouts.
- Coolangatta Road, Kirra: Distributor road with varying speed limits (between 50km/h and 60km/h) that is generally four lanes plus turning lanes. Shoulder width is generally 2m to 2.5m and includes shoulder parking. All auxiliary right turn lanes from Coolangatta Road are single lanes with one signalised intersection connecting Miles St, Coolangatta Rd & Tweed St with auxiliary right turn lanes.
- Tweed Street, Coolangatta: 50km/h divided road that is generally two through lanes plus turning lanes. Shoulder width is generally 0m but varies up to 3.8m in some areas.
- Griffith Street, Coolangatta: 50km/h divided road that is generally two through lanes plus turning lanes. Shoulder width is between 0m to 7.5m dependent on street parking (diagonal and parallel).

3.4.1.2 Bridges/ structures

There is one bridge within the study area located at the Gold Coast Highway/ Coolangatta Road/ Musgrave Street interchange. The interchange zone will be part of the option development process and may be removed. At this stage, it is not considered likely that it would need to accommodate Light Rail on or under it.

3.4.1.3 Public Utility Plant (PUP)

Electricity

- Overhead electrification is apparent along the majority of the project areas, from Bilinga to Coolangatta, running parallel along most roads and medians.
- Underground electrification, from Bilinga section to Gold Coast Airport section generally runs parallel to Gold Coast Highway on the verges of adjacent roads and parts of the eastern and western medians that separate the highway from the adjacent roads.
- Majority of cables along these sections are low voltage, however high voltage cables occur along the eastern median that separates the highway from Coolangatta Road and eventually onto the eastern median near Gold Coast Airport. From Kirra section to Coolangatta section, there are similar arrangements in underground electrification, with cables running along the eastern and western verges of most roads.

Water

- Water utilities are generally located within both the eastern and western verges of adjacent roads along the Gold Coast Highway from Bilinga to Gold Coast Airport. A similar arrangement occurs from Kirra to

Coolangatta with utilities running along the verges for all roads. Occasional perpendicular crossings occur, though these are more common from Gold Coast Airport section to Coolangatta section

Gas

- Gas pipes from Bilinga to Gold Coast Airport run parallel to the Gold Coast Highway in the eastern median that separates Gold Four Drive for majority of the alignment, with occasional perpendicular crossings to the western side.
- Approaching Gold Coast Airport, gas pipe runs in the perpendicular direction along the verge of Lang Street before running parallel to the verge on Pacific Parade, heading south towards Kirra.
- From Kirra to Coolangatta, the majority of the pipes that are non-pressurised run along the eastern verges of streets with some running along the western verges.

Communications / Optical Fibre

- The majority of the alignment from Bilinga to Gold Coast Airport contained these services in both eastern and western verges at Coolangatta Road and Golden Four Drive. Services also run along parts of the eastern and western medians of the highway with the occasional perpendicular crossing.
- Kirra to Coolangatta contain similar arrangements with services running on eastern and western verges of most roads, with the occasional perpendicular crossing and services running along medians.

3.4.2 Transport operations and performance

3.4.2.1 Route function

- Gold Coast Highway and the Pacific Motorway (M1) are the most strategic and highest used transport links.
- Gold Coast Highway is connected to the M1 only in one location within the study area, to the south of the airport.
- East of the airport are two distributor roads connecting the Gold Coast Highway (and M1) to Coolangatta/ Tweed Heads, namely Coolangatta Road/ Tweed Street and Musgrave Street/ Marine Parade.

3.4.2.2 Traffic

- In 2019, The Gold Coast Highway carried between 26,500 and 40,400 vehicles per weekday (AWDT) between Stewart Road and north of the Gold Coast Airport while the M1 (north of Stewart Road) carried 95,700 vehicles per weekday and the M1 (Tugun Bypass section) carried between 67,900.
- The peak direction for Gold Coast Highway, south of Boyd Street, is southbound with volumes in the order of 2,700. Beyond the airport, volumes are relatively balanced. The peak direction is also southbound for Coolangatta Road and Musgrave Street. This means that destinations and employment centres in Kirra and Coolangatta attract trips north of Boyd Street and then distribute to Coolangatta Road (40% of trips) and Musgrave Street (26% of trips). The inverse is observed in the PM peak
- The M1 PM peak direction south of the airport is southbound due to return trips from the employment centres/schools in Coolangatta (from Kennedy Drive) to residences in Tweed Heads South. North of the M1/Gold Coast Highway interchange, the flows are balanced due to an increase in northbound trips originating from Gold Coast Highway. This is attributable to return trips from commercial precincts within the Airport and Bilinga to destinations north of the study area.
- Overall, two-way traffic volumes along Gold Coast Highway in the PM period are 10% to 14% higher than the AM peak period at equivalent locations. Between Boyd Street and the Gold Coast Airport, two-way traffic volumes on Coolangatta Road in the AM period are 30% higher than the PM peak period.
- Travel times on M1 northbound (peak direction) between Gold Coast Highway on-ramp to Exit 82 (18km) range from around 12 to 20 minutes (55km/hr to 90km/hr). Areas of congestion are observed at Exit 92 as the K P McGrath Drive northbound on-ramp causes queueing on the motorway.
- In the AM peak, there are low levels of congestion are observed on Gold Coast Highway and Coolangatta Road. In the PM peak, travel times on Gold Coast Highway southbound (peak direction) range from 16 to 24 minutes (35 km/hr to 52km/hr). This indicates that compared to the AM peak, there is more congestion and unreliability in travel times.

- The M1 is part of the National Land Transport Network Road (NLTN). The M1 and Gold Coast Highway (from Stewart Road to Pacific Motorway) are 25m B-double Routes. Based on the GCSTM-MMv2.2 2019 model volumes, heavy vehicles account for 10% of total daily volume (6,800 vehicles) on M1. In peak periods, HV% is lower at approximately 8% in AM peak and 5% in PM peak and 4% of total daily volume (700 to 1,700 vehicles) on Gold Coast Highway.

3.4.2.3 Safety

From analysis, there were 164 crash events: four fatal, 47 hospitalisation, 83 medically treated and 30 involving minor injury. Key crash locations include:

- Gold Coast Highway (specifically between Kiewa Avenue and Kirribin Street, Bilinga)
- Musgrave Street, Kirra
- Coolangatta Road, Kirra
- Griffith Street, Coolangatta

3.4.2.4 Public transport

- The corridor between Tugun and Tweed Heads is served by four bus routes which are routes 700, 760, 768 and 777.
- Route 700 (high frequency bus service that travels between Tweed Heads and Broadbeach Station) has the highest boardings of the bus routes which travel through the study area with an average of 6565 boardings per day.
- Route 700 generates the highest boardings per kilometre at 1.2, compared to 0.8 boardings per km for route 760 (half-hourly service between Tweed Heads and Robina Town Centre) and 0.6 boardings per km for routes 768 (hourly service between Tweed Heads the Pine Shopping Centre and 777 (runs every 15 minutes between Gold Coast Airport and Broadbeach South).
- The combined maximum number of buses per hour (per direction) between Tugun and Coolangatta/Tweed Heads is 15
- The periods of the day with the highest public transport boardings are 8am to 9am, 2pm to 3pm and 3pm to 4pm with approximately 840 boardings per hour.
- The most popular destination within the study area for public transport trips is Gold Coast Airport with 652 boardings per day and 383 alightings per day.
- The most popular destinations for passengers boarding within the study area is Broadbeach South which could be attributable to passengers transferring to Glink or alighting for Pacific Fair shopping centre.

3.4.2.5 Active transport

- The areas with the highest pedestrian activity are Coolangatta and the beach front with 1,000 to 4,000 pedestrian movements per day at several locations within this activity centre.
- The Oceanway (shared path) extends the full length of the study area between Tugun and Tweed Heads, which provides a high-quality off-road pedestrian and cycle path.
- Footpaths are not provided along the Gold Coast Highway between Bilinga and Tugun, with pedestrians needing to use Golden Four Drive or Coolangatta Road which run parallel to the highway. There are limited pedestrian crossings on Gold Coast Highway with signalised crossings at Terminal Drive, Kirribin Street and Sand Street.
- The wide spacing of pedestrian crossing facilities on the Gold Coast Highway presents a barrier for people to access bus stops on Golden Four Drive and the beach.
- Lack of pedestrian connectivity is a key consideration. Beyond the functional aspects of the road corridor required for walking, the “quality” of experience of pedestrians is as important to be considered and as valuable as those in vehicles.

3.4.3 Land use, place and cultural heritage

3.4.3.1 Land use

Bilinga: Land use has two distinct areas, north-east and south-west of Gold Coast Highway.

- North East of Gold Coast Highway, there is mix of low and medium density developments and short-term accommodation.
- South West of the Gold Coast Highway, there is low density suburban residential pocket along with air transport related industries.

Airport (including Kirra North):

- North East of the Gold Coast Highway, there is a mix of low and medium density residential development, short-term accommodation and commercial land use. With a distinct beach character there is development potential unrealised.
- South West of the Gold Coast Highway are the key nodes of the Southern Cross University and the Airport. This area is dominated by commercial development, airport car-parking and some short-term accommodation.

Kirra:

- Around Musgrave Street, there is medium to high rise development. It is an emerging activity precinct with a mix of residential, short-term accommodation and commercial land use.
- South of Coolangatta Road is largely low to medium density residential development. This is largely unrealised development potential with a range of underutilised sites around Coolangatta State School.

Coolangatta

- Coolangatta is identified as a 'Major Centre' in the Planning Scheme (and part of Southern Gateway REC in *ShapingSEQ*). Current key land uses include high-rise mixed-use development, short term accommodation along Marine Parade.
- Medium rise business and activity precinct are centred on Griffith Street, which offers high place function. There is a transition to low-medium residential zones to the south.
- A key destination node near Coolangatta is the Twin Towns Service Club, located in Tweed Heads.

3.4.3.2 Place value

Bilinga - bisected by the Gold Coast Highway and acts as the entry to Kirra and Coolangatta business centres. Due to the location of the Gold Coast Highway, the local network between the residences to the east and west of the highway are significantly separated. The area is characterised by the beach on the east with a number of surf clubs that are accessible via Pacific Parade or the Oceanway and the airport land uses to the west.

Airport - contains the key trip/economic generators but is lacking a 'sense of place' or a focal point. The area is bisected by the Gold Coast Highway where the south/west is dominated by commercial development and airport car parking creating a car dominated landscape and north/east having a distinct beach character accessible by active transport.

Kirra - As detailed in the *Kirra Place Analysis Study* (CoGC, 2019), has a strong relationship with the beach and waterways and creates a strong sense of entry and arrival. Kirra has a one-sided commercial strip located on Marina Parade and Musgrave Street. The population is subject to seasonal variation, where the distinctive characteristics are the large parkland areas along with an Esplanade Road which runs parallel to the north facing beach and extends around a rocky point to create a publicly accessible beachfront promenade.

Coolangatta - as detailed in the Coolangatta and Kirra Business Centre Master Plan, "Coolangatta retains an essence of the unique, beach focussed culture that has defined it throughout its history. Relatively little redevelopment of the iconic shoreline has occurred in comparison to other locations. This laid-back, small-town feel, is a central element of Coolangatta's local character."

3.4.3.3 Cultural heritage

- Any major changes to transport infrastructure within the corridor could pose a risk to cultural heritage due to the presence of remnant vegetation in the landscape and the overall land formation of the area, as well as the presence of a range of local cultural heritage values within the study area.
- The Cultural Heritage Risk Assessment (CHRA) identified two Aboriginal Parties for the study area, including the Gold Coast Native Title Group and the Danggan Balun (Five Rivers).
- The CHRA identified that there are no known Aboriginal cultural heritage values present, nor are there State-listed or Commonwealth-listed historic heritage values within the study area. However, there are a range of locally listed historic heritage values within the study area which are predominantly focused within the foreshore areas of Kirra and Coolangatta.

3.4.4 Environmental and natural

3.4.4.1 Climate and Hazard

BoM data suggests that winds in the study area shift from a prevailing southerly direction at 09:00 am to relatively variable range of directions at 03:00 pm (BoM, 2021).

Key natural hazard that impact study area includes:

- Land subject to inundation as a result of flooding
- Land prone to storm tide hazard
- Land subject to bushfire risk and areas directly adjoining these areas
- Land subject to erosion as a result of coastal processes

3.4.4.2 Water

- There are no waterways for the purposes of the Water Act 2000 (Water Act) presently identified within the study area. However, there are a number of 'unmapped' features located within and directly adjoining the study area which would require investigation.
- A review of the DAF Queensland Waterways for Waterway Barrier Works spatial layer has identified that there are no waterways providing for fish passage within the Queensland portion of the study area.
- The Planning Scheme identifies a local waterway that is a Matter of Local Environmental Significance (MLES) at the southern extent of the Airport and Kirra sections of the study area, adjoining the Queensland and New South Wales Border.
- A review of the DSDILGP SPP IMS has identified the presence of several high ecological significant wetlands that are Matters of State Environmental Significance (MSES) within and adjoining the study area. These wetlands are located within the Gold Coast Airport site and in the coastal areas of Kirra Beach and Snapper Rocks Beach. The Planning Scheme also identifies locally significant wetland features that are MLES within the Gold Coast Airport site.
- The study area directly adjoins a significant portion of the coastal environment of the Southern Gold Coast, including Bilinga, North Kirra, Kirra, Coolangatta and Greenmount beaches. The whole extent of the coastal environment adjoining the study area is identified as being within the Coastal Management District.

3.4.4.3 Soils and land management

- The study area is characterised by a generally flat environment located below 10m AHD. There are some undulating areas to the east of Kirra Beach and Greenmount Beach.
- The Atlas of Australian Soils Queensland (Queensland Globe, 2021) has identified that soils within the project area are predominantly characterised by dermosols, ferrosols and hydrosols
- The Gold Coast Airport Master Plan identifies several sites within and adjoining the Gold Coast Airport that are considered to be potentially contaminated sites
- Given that the majority of the study area is located at or below 20 m AHD, the probability of acid sulfate soils (ASS) being present is considered likely.

3.4.4.4 Biodiversity

- Regional ecosystem (RE) mapping for the study area identifies mapped remnant vegetation including Category B 'of concern' remnant vegetation in the vicinity of the Gold Coast Airport runway; Category B 'of concern' remnant vegetation within R.T Peak Memorial Park and at Pat Fagan Park and Category B 'least concern' remnant vegetation in along the foreshore of Bilinga and North Kirra beaches.
- Searches of the EPBC Act PMST identified 22 Commonwealth-listed flora species as being potentially present within and adjoining the study area. The Queensland Government's Wildlife Online Database identified 30 State-listed flora species as being recorded within 10 km of the study area.
- Regional ecosystem (RE) mapping for the study area identifies mapped remnant vegetation occurring
- A review of the Queensland Government Protected Plants Trigger Map identified land in the vicinity of the Gold Coast Airport as potentially containing protected flora species.
- The EPBC Act PMST has identified a range of Commonwealth-listed fauna species as being potentially present within and adjoining the study area, including 64 terrestrial fauna species; 76 migratory species; 103 listed marine species and 13 whales and other cetaceans.
- The EPBC Act PMST has identified 38 invasive species are likely to occur within and adjacent to the study area

3.4.4.5 Urban canopy trees

- Bilinga has a canopy coverage between 0-10% while Kirra and Coolangatta have a canopy coverage between 21-30%
- The canopy coverage for the study corridor is on the lower end of the range, comparable to the suburbs along the east coast. Given the benefits of urban tree coverage such as cooling, health and wellbeing, economic benefits and community demand for urban tree cover, there is a need to retain the current and increase the urban canopy coverage wherever possible.

3.4.4.6 Geotechnical

Key geotechnical risks identified at this stage include the followings:

- Artificial deposits and landfill sites. Artificial deposits associated with landfill or mining (tailings, dumps and rehabilitated areas) have been identified near the western end of the corridor. The composition and engineering properties of these materials could be highly variable and unpredictable. Further geotechnical investigation will be required to inform foundation, earthwork and pavement design. These materials are also expected to be related to contaminated/disturbed land. The relevant issues should be further investigated from an environmental perspective.
- Acid sulfate soils. Areas with high probability of acid sulfate soil potential have been identified along the corridor. Any disturbance involving excavation, drainage, or water table lowering can pose significant risk to both the environment and design elements involved in the proposed development. These risks may include acidification of groundwater, damage to building foundations, and environmental pollution. This risk maybe lessened by implementing a management scheme that minimises disturbance of the soils (limit earthworks, suspended buildings, etc.) and includes treatment of soil that does become disturbed.
- Soft soils. Soft compressible soils could present at locations underlain by Holocene alluvium deposits, which can cause excessive settlement of structures/embankments; stability and movement of structures/embankments; or relatively long construction period due to long consolidation time. The geological map indicates that the alluvium deposits along the corridor are generally sandy materials. However, soft soils may present within area underlain by Qhcw and site-specific geotechnical investigations will be required to confirm the subsurface conditions. If soft soils are encountered, ground improvements or deep foundations will be required for road embankments and structures.
- Material suitability. The primary site won material is expected to be from cuttings and foundation excavations. Sandy alluvium deposits and man-made deposits (landfill) may require special consideration to allow the site won material to be re-used within fill embankments. Geotechnical investigations and subsequent laboratory testing will be required for assessment of material characteristics and reusability.

- Uncertainty and risk. Historical geotechnical investigations are not available either from the public domain data or via TMR for the study corridor. Site-specific investigations will be required to inform future design development in terms of subsurface conditions and groundwater information.

3.4.4.7 Hydraulic

- Areas identified for flood assessed are primarily located on the North and South zones of Coolangatta Road, the southern extents of Musgrave Road and the southern leg on the Gold Coast Highway.
- The 1% AEP flood level is a critical design level for any new infrastructure within the corridor including new road or Light Rail Transit (LRT) facilities as per AS5100.1. However, any new active transport only facility could be designed to achieve a 2% AEP level of immunity

4. Route planning pressures

4.1 Factors influencing transport demand

4.1.1 Land use change and population growth

Population projections for Queensland are developed by the Queensland Government Statisticians Office (QGSO) for forecast years including 2041. Both City of Gold Coast and TMR then allocate these forecasts to specific "zones" to be used for transport model forecasting purposes based on their future planning. For this study, the TMR (QGSO2018) population and employment growth forecasts were adopted. Zones inside the red dashed line as illustrated in Figure 4-1 were defined as being within the study area for the purposes of this analysis.

Over a 22-year period between 2019 and 2041, the residential population of the study area is projected to rise from 7,200 to 11,800 (a 64% increase) and employment to rise from 5,700 to 7,700 (a 35% increase). Most of the population growth within the study area is along the coastal strip straddling the Gold Coast Highway however we also note that substantial growth is also forecast in Cobaki Lakes[3]a new residential estate in Tweed Shire. Whilst outside of the defined study area, transport demands to and from this development will impact on the T2C corridor. Conversely, employment growth appears to be evenly spread across existing employment centres at the Airport, Kirra and Coolangatta. See Table 4-1 and Table 4-2 for an overview of the forecast growth between 2019 and 2041.

Table 4-1: Population growth from 2019 to 2041 (based on QGSO projections at the zonal level).

Area/ zone	2019	2041	Growth
Coastal strip (east of Gold Coast Highway between Boyd Street and Musgrave St)	1,700	3,200	88%
Airport	400	400	0%
Kirra and Coolangatta	5,100	8,200	61%
Study area total	**7,200**	**11,800**	**64%**

Table 4-2: Employment growth from 2019 to 2041 (based on QGSO projections at the zonal level).

Area/ zone	2019	2041	Growth
Coastal strip (east of Gold Coast Highway between Boyd Street and Musgrave St)	60	80	35%
Airport	2,800	3,800	36%
Kirra and Coolangatta	2,700	3,800	38%
Study area total	**5,700**	**7,700**	**35%**

[3] Cobaki development information - https://www.tweed.nsw.gov.au/CobakiDevelopment

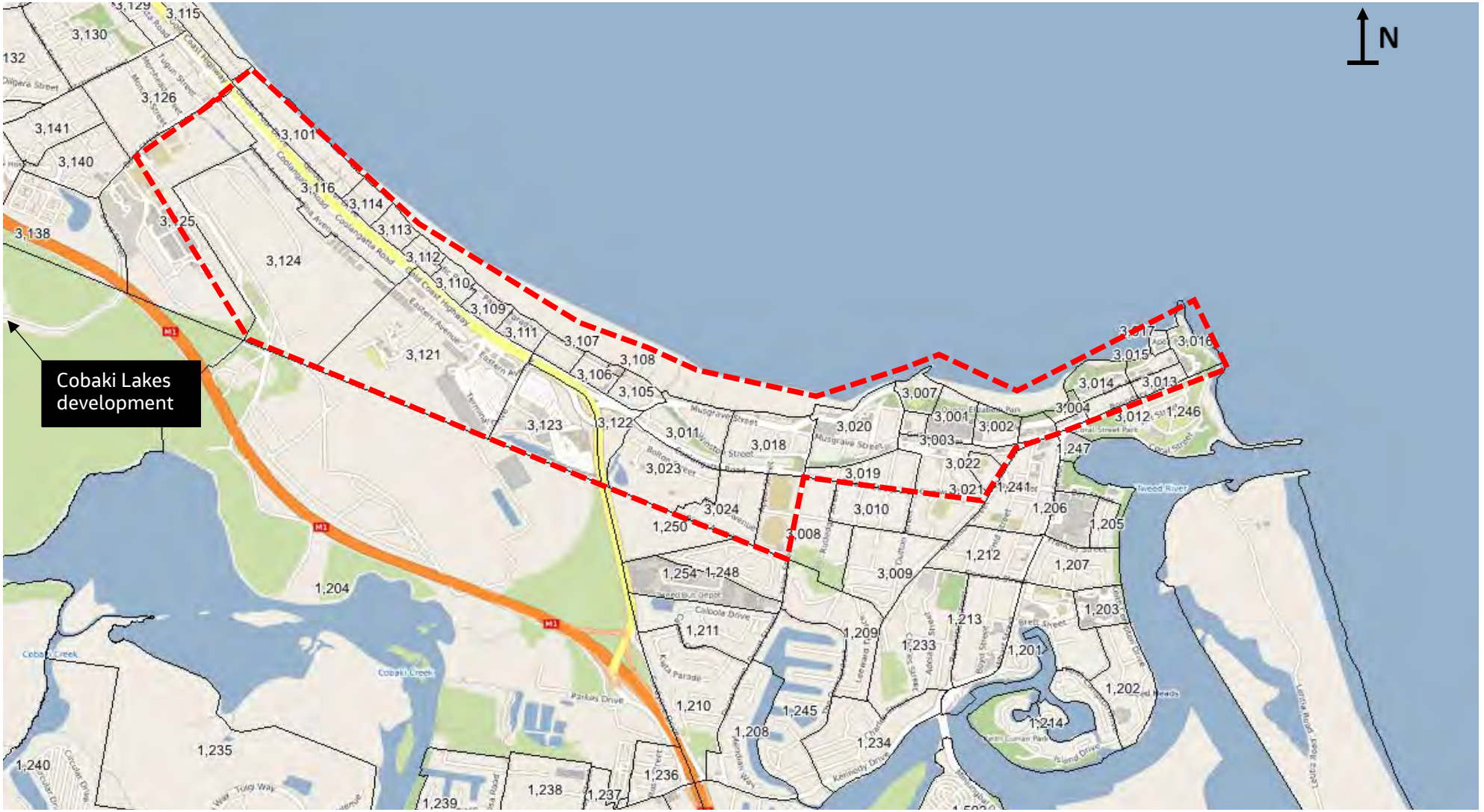
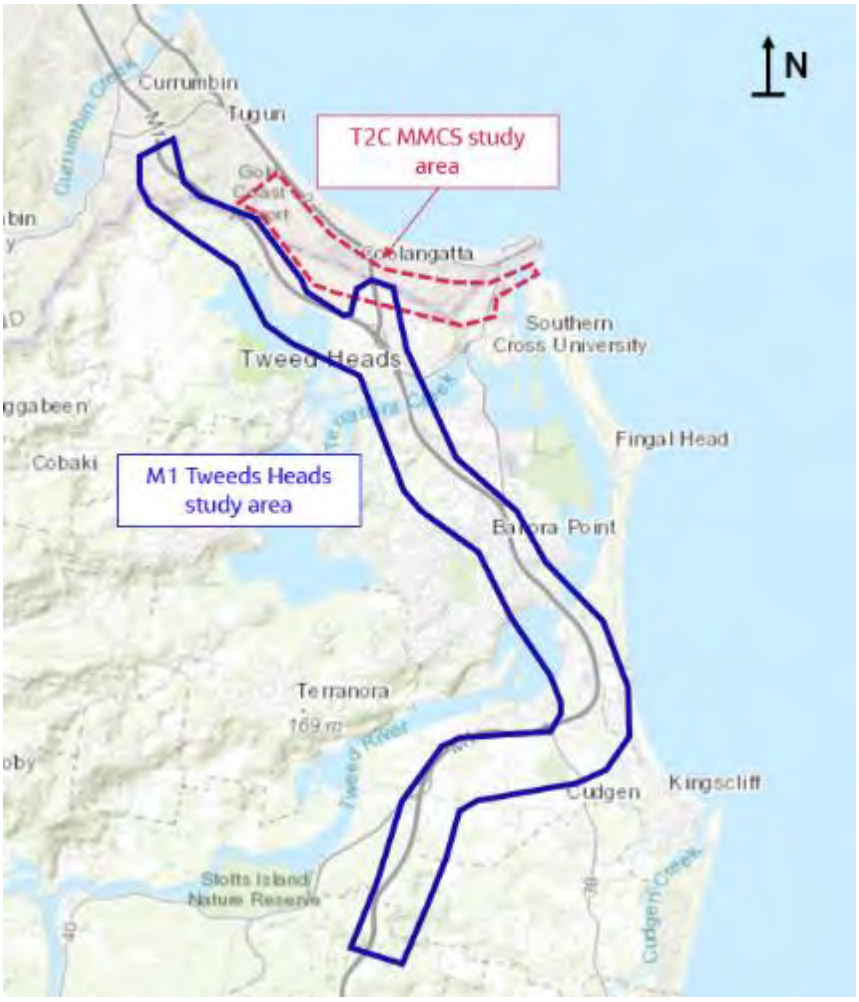


Figure 4-1 Transport model zones considered to be within the overall study area (Source: Jacobs GIS)

4.1.2 Wider transport network changes

The Tugun to Coolangatta route strategy is being developed in parallel with changes that will impact on the wider transport network, either in the short or long term, as outlined in the sections below.

4.1.2.1 Pacific Motorway from Stewart Road to 2km south of the Tweed Valley interchange.



Heads study (TfNSW)

As discussed in Section 2, TfNSW are undertaking planning to identify ways to manage future demands on the Pacific Highway in Tweed Heads to complement the motorway upgrade works now under construction north of Tugun in Queensland. The length of the project is 20km and includes (south to north):

- Tweed Valley Way interchange
- Chinderah Road interchange
- Fingal Road interchange
- Barneys Point interchange
- Darlington Drive South Tweed Interchange (includes Minjungbal Drive)
- Kirkwood Road interchange
- Kennedy Drive interchange
- Gold Coast Highway interchange

The extent of these works is illustrated in Figure 4-2. Potential changes to the Pacific Motorway are likely to include providing additional traffic lanes to tie into the widening proposed in Queensland from Robina to Stewart Road as well as interchange upgrades and potential service roads in some locations.

Figure 4-2: Pacific Highway – Tweed

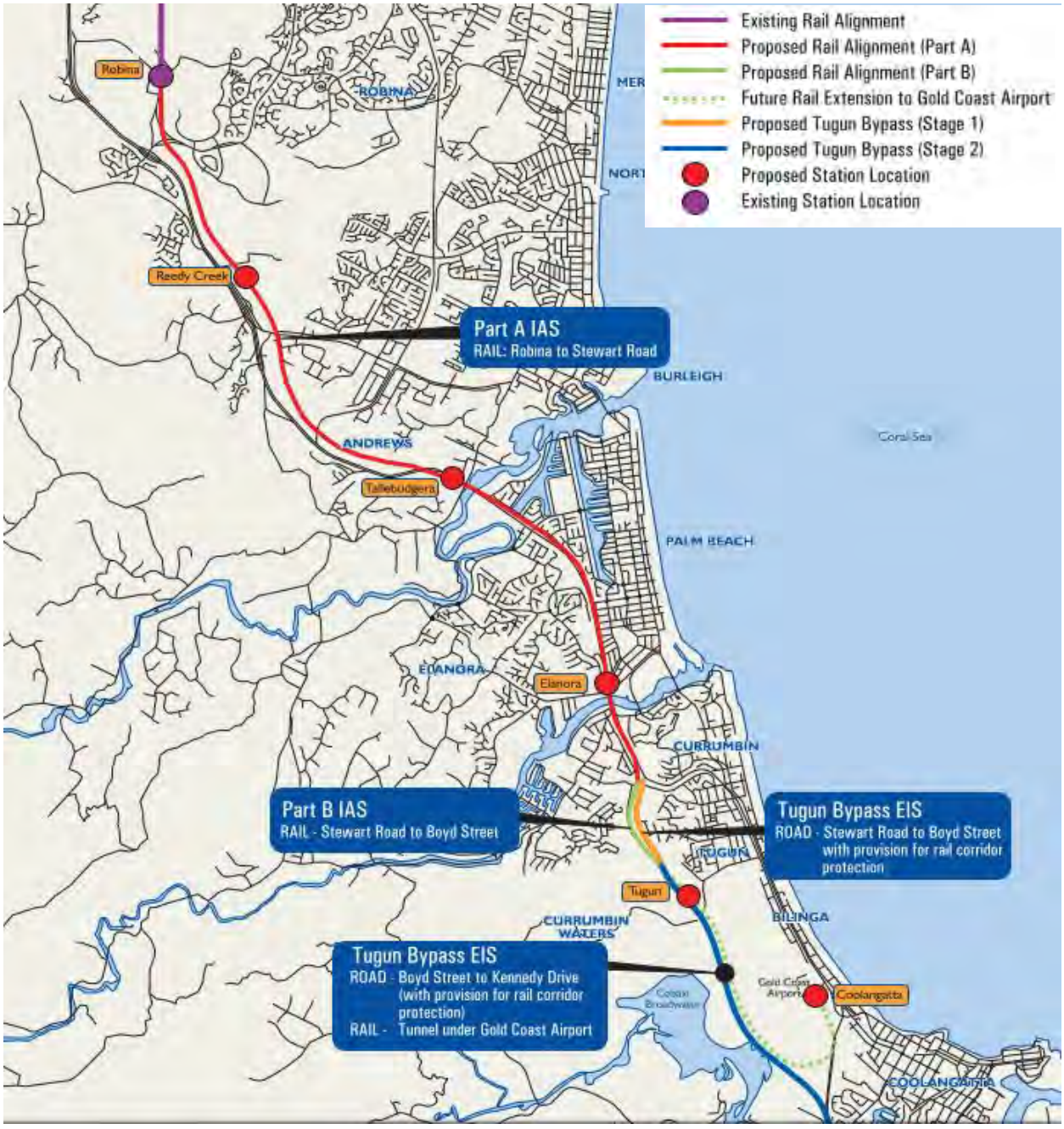
4.1.2.2 Heavy Rail Extension to Gold Coast Airport

In 2005, a proposed corridor to extend heavy rail south of Robina to Tugun was identified. Following community consultation, a preferred corridor between Robina and Tugun was preserved in 2008. The first stage between Robina and Varsity Lakes (previously known as Reedy Creek) was then constructed in 2009. Further investigations were also conducted in 2009 as part of a wider Robina to Tugun Rail Impact Assessment Study that considered technical, environmental, social and economic impacts on a preferred rail alignment. Refer to Figure 4-3.

Key components of the potential future rail extension include a new railway station at the Gold Coast Airport which could form part of a regionally significant multi-modal passenger transport interchange facility for the southern Gold Coast and Tweed Shire. It was identified in the project's environmental impact statement that the rail extension to Gold Coast Airport will make a significant contribution to the achievement of the Gold Coast mode share target, reducing the number of car trips on the road network.

The South East Queensland Regional Transport Plan 2021 confirms the Varsity Lakes to Gold Coast Airport rail extension as part of long-term planning.

Figure 4-3: Robina to Tugun Rail and Road proposal (Parson Brinckerhoff, 2009[4])



4.1.2.3 Cobaki Lakes

Cobaki was identified within the NSW State Government's Far North Coast Regional Strategy and Tweed Shire Council's "Tweed Urban and Employment Lands Release Strategy 2009" as one of the largest contributors for the provision of new housing and employment within the Tweed Shire over the next two decades. Seventeen residential precincts with a mix of housing types including detached houses, townhouses and multi-unit housing to a maximum of 3 storeys, comprising approximately 5,500 dwellings are proposed for the area.

[4] Robina to Tugun Rail Impact Assessment Study, Parson Brinckerhoff 2009)

Refer to Figure 4-4 for an overview of the Cobaki Lakes development. As part of this development, Boyd Street and Piggabeen Road are the principal connections to the wider urban road network. Of particular interest to the Tugun to Coolangatta study is the extent of additional traffic that this community will generate on the Gold Coast Highway where it is intended to (in the future) intersect directly with Boyd Street. Overall, the development is estimated to generate approximately 5,400[5] additional daily trips on Boyd Street, requiring an upgrade to Boyd Street and widening of Gold Coast Highway between Toolona and Boyd Street to six through lanes to cater for the increase in demand.

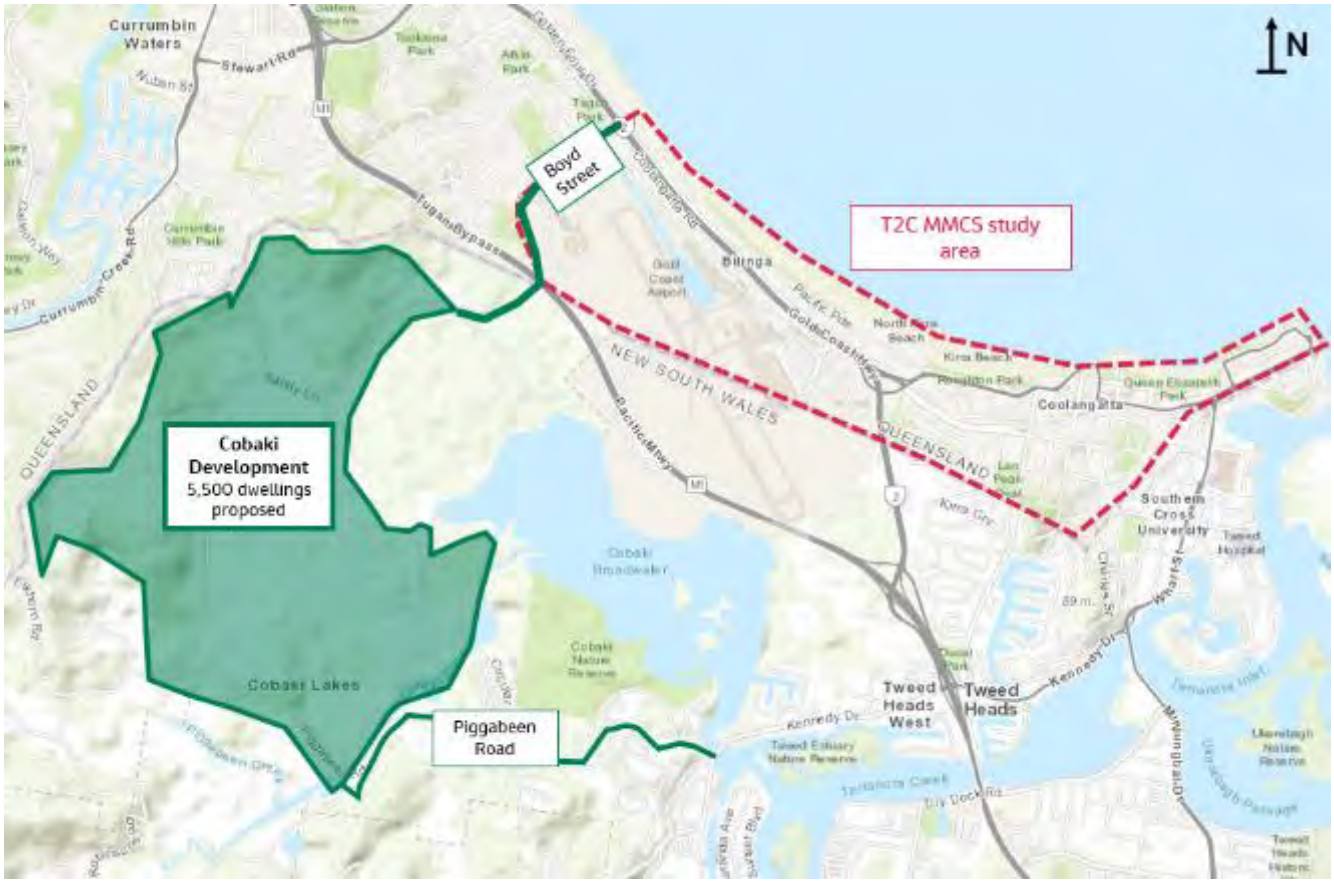


Figure 4-4: Cobaki development site location as identified in NSW Department of Planning, Director-General's Report Part 3A Approval of Cobaki, December 2010 (Basemap: Jacobs GIS, 2022)

[5] Sourced from Gold Coast Highway Multi Modal Transport Study – Boyd Street intersection investigations

4.1.2.4 Gold Coast Airport – second access to Gold Coast Highway at QLD/NSW border

A second access point to the Gold Coast Highway is proposed for the Gold Coast Airport as part of the Gold Coast Airport Master Plan. By providing an additional entry/exit point to the Gold Coast Airport, this would reduce congestion and delays at the Terminal Drive / Gold Coast Highway intersection by relocating some traffic further south on the Gold Coast Highway to a new intersection. This project is in detailed planning with funding committed and it is therefore expected to be operational in the short term (within the next 5 years).

Figure 4-5: Location of proposed new southern access point as identified in Gold Coast Airport Master Plan 2017 (Basemap: Jacobs GIS, 2022)

4.2 Future transport demand

Analysis of future traffic volumes and passenger movements was undertaken to inform the scale of change and growth in transport demands between 2019 to 2041. Refer to The analysis found that between 2019 and 2041:

- North of Stewart Road, trips on the Gold Coast Highway are estimated to increase by 10% (increase of 2,800 trips) however Pacific Motorway (M1) volumes increase by 76% from 95,700 trips in 2019 to 168,100 in 2041. Public transport trips account for 18% of total trips on the Gold Coast Highway in 2019 but reduce to 14% of total trips in 2041 (as vehicle trips increase while public transport trips remain similar).
- All trips on the Gold Coast Highway south of Stewart Road are estimated to increase substantially:
  - North of Boyd Street traffic volumes are estimated to increase by 85%, carrying up to 74,900 vehicles per day.
  - South of Boyd Street: traffic volumes are estimated to increase by 62% (from 40,400 vehicle trips per day in 2019 to 65,600 in 2041) and by 156% south of the Gold Coast Airport (to 37,900 private vehicle trips per day in 2041)
- Coolangatta Road and Musgrave Street in Kirra each increase by around 50% with volumes approximately 17,900 vehicles per day on each corridor.

These transport analyses illustrate that there will be substantial traffic growth in the network, without enhanced public transport especially on Gold Coast Highway south of Stewart Road (85% - 156% growth within Bilinga) and on the M1 Pacific Motorway north of Stewart Road (59%-76% growth and approx. 168,100 trips). This reinforces the opportunity that enhanced public transport could play in managing the growth in transport demand on the southern Gold Coast and reduce pressure on the road network by 2041. A key conclusion is the need to protect the corridor to allow for Light Rail to be implemented, in some form, at some point in the future.

Table 4-3 for the AWDT vehicle trips in 2019 and 2041. These are sourced from the Gold Coast Strategic Transport Model (GCSTM-MM v2.2) including the calibrated 2019 Base model and 2041 Base Case (Scenario A – with Light Rail to Burleigh Heads only).

The analysis found that between 2019 and 2041:

- North of Stewart Road, trips on the Gold Coast Highway are estimated to increase by 10% (increase of 2,800 trips) however Pacific Motorway (M1) volumes increase by 76% from 95,700 trips in 2019 to 168,100 in 2041. Public transport trips account for 18% of total trips on the Gold Coast Highway in 2019 but reduce to 14% of total trips in 2041 (as vehicle trips increase while public transport trips remain similar).
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Table 4-3: AWDT vehicle trips (Source – GSTM-MMv2.2, Model Runs: GC_2019_N013d_TW03 and GC_2041_N007d_TMR05_Burleigh)

Road	2019	2041 Option A (Light Rail to Burleigh Heads)	Difference
	Vehicle	Vehicle	Vehicle
North of Stewart Road			
Pacific Motorway	95,700	168,100	72,400
Gold Coast Highway	26,500	29,000	2,500
North of Boyd Street			
Gold Coast Highway	40,400	74,900	34,500
South of Boyd Street			
Pacific Motorway	67,900	107,900	40,000
Gold Coast Highway	40,400	65,600	25,200
South of Gold Coast Airport			
Pacific Motorway	67,900	107,900	40,000
Gold Coast Highway	14,800	37,900	23,100
Coolangatta Road	11,900	17,900	6,000
Musgrave Street	11,400	17,800	6,400
Over Terranora Creek			
Pacific Motorway	73,400	111,100	37,700
Minjungbal Drive	29,800	34,900	5,100

4.3 Future transport issues and opportunities

The process of identifying issues and opportunities involved Jacobs presenting initial findings at a technical working group workshop (held on 24th March 2021) to key stakeholders. This workshop utilised a collaborative tool called MURAL where workshop attendees were asked to identify issues and opportunities along the corridor. From this activity, key themes were identified for individual sections of the corridor which will be taken forward for consideration in the option development process. Refer to Figure 4-6 for an overview of the four corridor sections.

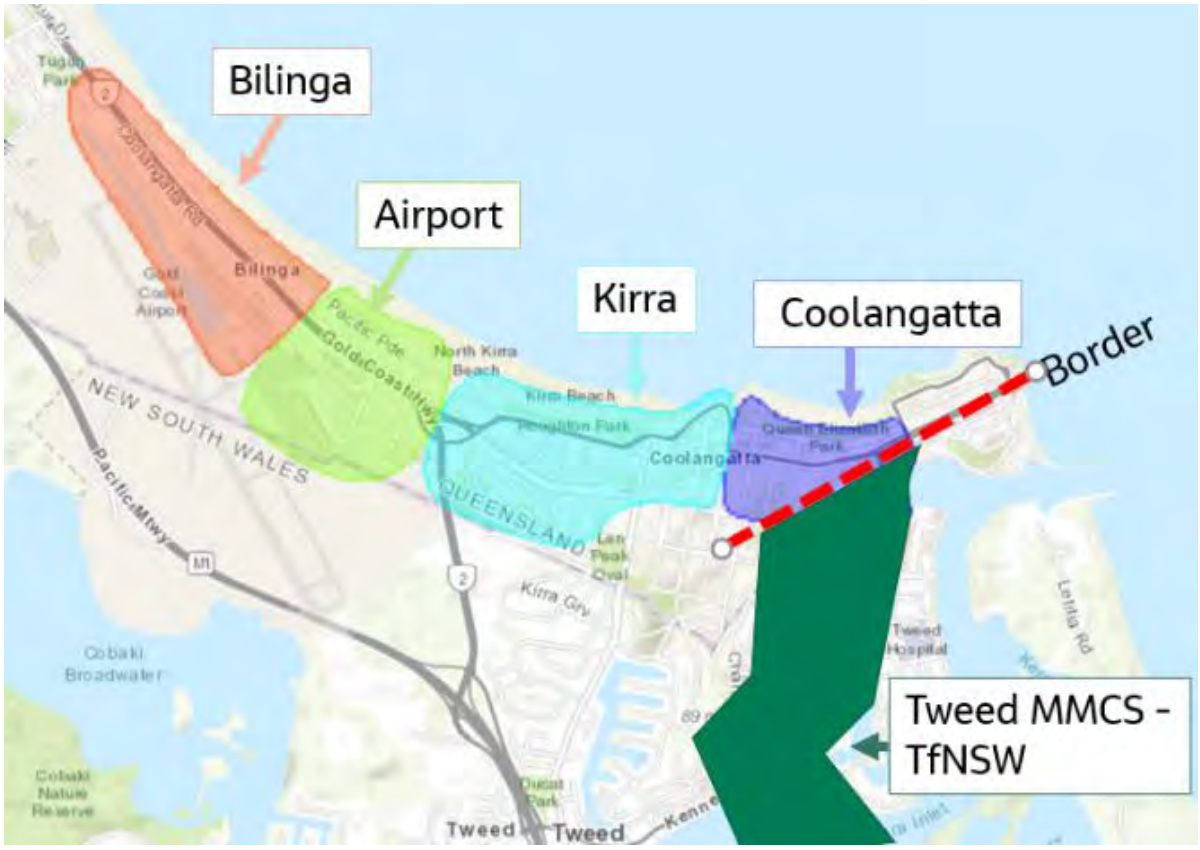


Figure 4-6: Individual corridor sections of Tugun to Coolangatta MMCS study area (source Jacobs GIS)

4.3.1 Public transport issues and opportunities

The public transport issues and opportunities identified through the pre-workshop analysis by the project team and by additional contributions from workshop attendees include:

Corridor-wide public transport issues and opportunities:

- Provide attractive, comfortable and legible (easy to find) Light Rail stations
- Provide attractive bus-Light Rail interchange opportunities
- Highly accessible stations (for all users) – going above and beyond minimum compliance standards
- High frequency and reliable bus and rail services (minimisation of delays along corridor)
- Catering for a range of first mile/ last mile access solutions including personal transport or rideshare/taxi options.
- Enhanced connectivity to key attractors – considering both existing and future trip generators
- Complementing and shaping land use growth by building Light Rail stations that create "destinations" and distinct activity nodes. Beyond creating destinations, the stations design and location should identify and capitalise on existing potential place making opportunities.
- The corridor planning framework should facilitate the delivery of places that provide a superior experience for the passengers as they travel through them.
- Light Rail stations should provide a sense of engagement with the place where they are located.
- Pedestrian movement networks around the stations and connecting stations to destinations should be legible, safe, secure and with high quality streetscape amenity

Additional opportunities specific to each section include:

Bilinga

- Need for improved connectivity to John Flynn Hospital and future Tugun heavy rail. There are key attractors along Boyd Street (specifically John Flynn Hospital) that should be considered in the development of a public transport solution.
- Number of stations. To consider increase in station spacings where catchment is not wide (making use of 400m-800m walking distances that are north south orientated). In addition, additional stop/s and a new bus route or extension of an existing route is required on Boyd Street to connect to the emerging Cobaki Lakes development.
- Potential for side running (not centre running) to maximise pedestrian connections to the east which has the greatest existing and future catchment potential

Airport

- Integrated multi-modal transport hub (Light Rail, bus and future heavy rail) in the airport precinct. Potentially including airport type amenities at the interchange
- Minimisation of delays in and out of the airport for Light Rail (minimise the diversion, maximise operating speed and efficiency)
- Improved connectivity from LRT stop to Airport and Southern Cross University (e.g. upgraded walk links with shelter/ protection)
- Address major barrier effect of Gold Coast Highway for pedestrians which cuts off the North Kirra catchment from a potential transport hub on the airport side of the highway

Kirra

- Improved access to schools and land uses south of Coolangatta
- Need for suitable and attractive connection from Light Rail stop to beach.
- Potential for Light Rail stop along Coolangatta Road given proximity to beach (200-250m) and land uses to the south.

Coolangatta

- Enhanced connectivity to key attractors in Coolangatta AND Tweed Heads
- Potential for a beach station (e.g. Marine Parade) and opportunity to create a Light Rail precinct or destination or
- Potential for a more southern station (e.g. Chalk St) to pick up the large residential catchment to the south
- A station in Coolangatta should consider station locations either side (e.g. in Kirra and Tweed Heads).

4.3.2 Active transport issues and opportunities

The active transport issues and opportunities identified through the pre-workshop analysis by the project team and by additional contributions from workshop attendees include:

Corridor-wide active transport issues and opportunities:

- Opportunity to enhance and improve connectivity to the Oceanway through upgrading existing cycle infrastructure and/or improving pathways.
- Improve safety – e.g. reduce speed environment adjacent to active transport links
- Strengthen existing active transport routes particularly at intersections and crossings
- Transform existing pedestrian paths to "pedestrian boulevards" with enhanced shade
- Adopting Crime Prevention Through Environmental Design (CPTED) measures to create safer pedestrian links (may include more active land uses alongside some key paths)

Additional opportunities specific to each section include:

Bilinga

- Width of road corridor is a barrier to cross corridor active transport movements. Large distances between pedestrian crossing locations and spacing of Gold Coast Highway intersections create limitations on cross corridor movement between east and west of carriageway. This study may create opportunities to reduce spacing or crossing distances through development of new intersections that create key links between the beachside and residences on the west.
- Speed and volume of traffic on Gold Coast Highway is an impediment to safe, all ages and abilities cycling facilities. May be better to reinforce Golden Four Drive as the 'commuter' cycle route with more recreational trips on the Oceanway.
- Potential to create better active transport linkages to public transport nodes via upgraded pathways and proper wayfinding as this is a last mile area.

Airport

- Need to create more pedestrian friendly connections, specifically from Airport/ transport node towards the beach. This may be in the form of a grade separated crossing to cater for the increase in demand due to the heavy rail extension. Potential to also explore additional at grade crossings in conjunction with new LRT-actuated intersections/ crossing points.
- Potential to reduce crossing width of the corridor to improve pedestrian and cycle movements. This may be through intersection movement rationalisation (potentially as a result of some traffic to/ from the south being diverted to the new southern airport access

Kirra

- Design safer paths through rail cutting – wider, better surveillance, better lighting
- Providing improved pedestrian and cycling links within Kirra alongside the Light Rail

Coolangatta

- Create a successful pedestrian link from residential to the south to Griffith Street through to the beach – the potential of Dutton Street to be transformed into a pedestrian boulevard was identified as it is already well located relative to the wider catchment and includes a narrow pedestrian laneway between Chalk and Griffith Streets which could be widened.

4.3.3 Traffic operational issues and opportunities

The traffic operational issues and opportunities identified through the pre-workshop analysis by the project team and by additional contributions from workshop attendees include:

Corridor-wide traffic issues and opportunities:

- Ensure sufficient capacity on the Gold Coast Highway to accommodate the Tugun Bypass traffic in event of a tunnel closures and for hazardous goods/ over dimension vehicles.
- Efficiency for all modes of travel (including taxi/rideshare) particularly on the Gold Coast Highway as a strategic (higher order) road
- Strengthening road hierarchy (i.e. Gold Coast Highway for through trips, Golden Four Drive and Coolangatta Road for local trips/ access)
- Enhance connectivity from Bilinga ("Gateway to the Gold Coast") to Tweed Heads

Additional opportunities specific to each section include:

Bilinga

- Ensure accessibility to John Flynn Hospital – e.g. reconfigured intersection of Boyd St/ Gold Coast Highway will create more direct access removing trips from Coolangatta Road
- Consideration of a Boyd Street park and ride for LRT, but ensure it is not used simply as free satellite parking for Airport passengers

Airport

- Efficiency for all modes of travel in/out of airport to reduce delays – given the strategic nature of this major airport
- New second access to the south is a major opportunity to redistribute traffic in a way that takes unnecessary trips off Gold Coast Highway and redirects them to the M1. Maximise that opportunity through a better internal road network configuration and signage/ wayfinding.
- Opportunities for the complicated road network at GCH/ Coolangatta Road/ Musgrave Street to be rationalised/ simplified while still maintaining adequate capacity – e.g. flatten the interchange and create a more legible T intersection
- Resolving internal airport access road issues – simpler and more legible road network, with clearer, more direct pedestrian connections including between a new transit stop and surrounding destinations

Kirra

- Enhanced connectivity to Coolangatta Road via all modes of travel
- Support and grow Musgrave Road and Marine Parade as a tourist location
- Improve safety on Musgrave Road caused by distracted drivers and pedestrians
- Improve access to local activity centres and schools.

Coolangatta

- Ability to connect through to Tweed Heads – all modes including vehicles.

4.4 Future land use and place making issues and opportunities

The land use and place-making issues and opportunities identified through the pre-workshop analysis by the project team and by additional contributions from workshop attendees include:

Corridor-wide land use and placemaking issues and opportunities:

- Responsibly accommodate growth while preserving the valued lifestyle, amenity, heritage and neighbourhood character.
- Stimulating economic clusters at Light Rail stations
- Serving/ reinforcing higher density, higher amenity residential area
- Potential for residential and commercial uplift adjoining the Light Rail corridor
- Land use change between the Airport and Coolangatta Road from residential to commercial could create a buffer to the higher density residential precinct to the east of the highway
- Protecting and enhancing character of neighbourhood.
- The GC Highway from Tugun, through Bilinga to Kirra is a wide corridor with multiple roadways extending up to 110 metres wide. The opportunity exists to review the operation and spatial layout of this corridor in conjunction with the proposed Light Rail in order to achieve a more 'place oriented' environment.
- Opportunity to implement the Coolangatta and Kirra Business Centre Placed Based Master Plan, visions such as improve getting into the centre, getting around and parking; improving the experience; and feeling safe

Additional opportunities specific to each section include:

Bilinga

- Investigate opportunities for land use changes south west of the Gold Coast Highway. This included suggestions of an "Aerotropolis" including specialist services that capitalises on location and growth of aviation-based development opportunities.
- Opportunities for retail and commercial in close proximity to a 'Bilinga' station (or stations).
- Opportunity to repurpose portions of the 100 m wide Gold Coast Highway Road reserve for public space.
- Protect and enhance the lifestyle, amenity, heritage and character of the neighbourhoods
- Taking advantage of the location – proximity to transport AND amenity (beach etc).

Airport

- Transforming the airport corridor to a destination.
- Create an "Aerotropolis" – a specialist centre that capitalises on location and growth of aviation-based development opportunities. Focussing in particular on underutilised land on the south-western side of the Gold Coast Highway which will have direct access to airport, university and regionally significant passenger transport interchange facility
- Consultation with the Gold Coast Airport and alignment with the Gold Coast Airport Master Plan.

Kirra

- Kirra is limited by aircraft noise and flight path restrictions, though potential to investigate opportunities for land use changes.
- Encouraging a shift in mode share for all residents (in both high-rise and low-rise areas).
- Opportunity to expand existing neighbourhood centres further south – become more of a local activity centre not just about beach cafes but supporting a more diverse retail street hierarchy.
- Refocusing planning 'behind the beach'
- Adopting a multi-modal Coolangatta Road corridor.

Coolangatta

- Significant uplift potential was identified within the Coolangatta area, particularly around Griffith Street and Chalk Street to the south.

- Supporting employment precincts that will grow the economy and deliver jobs
- Significant placemaking opportunities in and around a proposed Coolangatta Light Rail station.
- Significant regeneration potential in the Chalk Street area where the at grade car parking and building 'back doors' form a barrier between the residential/ parkland/ community use to the south and the retail heart/ beach/ recreation to the north
- Above mentioned opportunities that identify a preference for increased densities and building height within the corridor are consistent with the findings of the City of Gold Coast Building Height Study (City of Gold Coast and Urbis, 2017), which identified areas in the southern Gold Coast as an 'area of significant opportunity'. Of relevance to the project, the study identified:
- opportunities for building height along the Bilinga beachfront and at the southern end of the Gold Coast Airport
- opportunities for a contained urban neighbourhood within and around Coolangatta

4.5 Future environmental and social issues and opportunities

The environmental and social issues and opportunities identified through the pre-workshop analysis by the project team and by additional contributions from workshop attendees include:

Corridor-wide environment and social issues and opportunities:

- Adopting Water Sensitive Urban Design (WSUD) opportunities
- Retain and support the existing beach value and existing vegetation
- Maximising urban canopy tree coverage
- Opportunities to incorporate indigenous themes that can blend into the Light Rail design
- Achieve a stronger connection to Cultural Heritage values (aboriginal and historic)
- Protection of foreshore and popular viewing spots/ vistas
- Maximise benefits accrued from Light Rail to deliver greater equity of access (e.g. more stops) and/or opportunities to support/ stimulate more affordable housing (e.g. by serving catchments slightly further away from the high amenity beachfront corridor).
- Maximise corridor resilience to natural hazards and events

Additional opportunities specific to each section include:

Bilinga

- Opportunity to create a green boulevard with WSUD in median of Gold Coast Highway with additional planting and landscaping.
- Setting a tree canopy target to ensure sufficient shade is provided for users/pedestrians.

Airport

- Provide sufficient shade for pedestrians within the airport precinct.

Kirra

- Retaining iconic vista from Kirra Hill lookout
- Preservation of Kirra Beach and heritage

Coolangatta

- Retention of existing green areas.
- Inclusion of shade on key pathways to the beach

4.6 Summary of future issues and opportunities

Table 4-4 summarises the route planning pressures along the corridor.

Table 4-4: Corridor themes

Route planning pressures	Corridor themes
Factors influencing transport demand	Over a 22-year period between 2019 and 2041, the residential population of the study area is projected to rise from 7,200 to 11,800 (a 64% increase) and employment to rise from 5,700 to 7,700 (a 35% increase). Most of the population growth is along the coastal strip straddling the Gold Coast Highway or in Cobaki Lakes (a new residential estate to the west of the M1). The employment growth is forecast to be evenly spread across existing population, employment centres and Cobaki Lakes. Wider transport network changes include: ▪ Pacific Motorway upgrade Varsity Lakes to Tugun (under construction – short term) and from Tugun to Tweed Valley interchange (planning underway, timing unknown). ▪ Heavy Rail Extension at Gold Coast Airport (longer term, likely beyond 2041) ▪ Cobaki Lakes development (early construction works now underway) ▪ Gold Coast Airport – second access to Gold Coast Highway at QLD/NSW border (short term)
Future transport demand	Analysis of future traffic volumes and passenger movements using the Gold Coast Strategic Transport Model (GCSTM) was undertaken to inform the scale of change and growth in transport demands between 2019 to 2041. These transport analyses illustrate that there will be substantial traffic growth in the network, without enhanced public transport especially on the Gold Coast Highway south of Stewart Road (85% - 156% growth within Bilinga) and on the M1 Pacific Motorway north of Stewart Road (59%-76% growth and approx. 168,100 trips). These analyses highlight the opportunity that enhanced public transport could play in managing the growth in transport demand on the southern Gold Coast and reduce pressure on the road network by 2041.
Future public transport issues and opportunities	▪ Attractive, comfortable and legible (easy to find) Light Rail stations ▪ Highly accessible stations (for all users) – going above and beyond minimum compliance standards ▪ High frequency and reliable bus and rail services (minimisation of delays along corridor) ▪ Catering for a range of first mile/ last mile access solutions including personal transport options ▪ Enhanced connectivity to key attractors – considering both existing AND future trip generators ▪ Complementing and shaping land use growth by building Light Rail stations that create “destinations” and distinct activity nodes.
Active transport issues and opportunities	▪ Opportunity to enhance and improve connectivity to the Oceanway through upgrading existing cycle infrastructure and/or improving pathways. ▪ Improve safety – e.g. reduce speed environment adjacent to active transport links ▪ Strengthen existing active transport routes particularly at intersections and crossings ▪ Transform existing pedestrian paths to “pedestrian boulevards” with enhanced shade

Route planning pressures	Corridor themes
	▪ Adopting Crime Prevention Through Environmental Design (CPTED) measures to create safer pedestrian links. This may include more active land uses alongside some key paths.
Traffic operational issues and opportunities	▪ Ensure sufficient capacity on the Gold Coast Highway to accommodate the Tugun Bypass traffic in event of a tunnel closures and for hazardous goods/ over dimension vehicles. ▪ Efficiency for all modes of travel particularly on the Gold Coast Highway as a strategic (higher order) road ▪ Strengthening road hierarchy (i.e. Gold Coast Highway for through trips, Golden Four Drive and Coolangatta Road for local trips/ access) ▪ Enhance connectivity from Bilinga ("Gateway to the Gold Coast") to Tweed Heads
Land use and place making issues and opportunities	▪ Supporting land use growth by building Light Rail stations that create "destinations" and distinct activity nodes. ▪ Stimulating economic clusters at Light Rail stations ▪ Providing diversity of housing stock to meet changing demographics ▪ A multi-modal public transport network that connects people with new jobs and businesses – driving economic growth and opportunity. ▪ Investigate opportunities for additional employment lands in the areas adjoining the airport. ▪ Protect and enhance the lifestyle, amenity, heritage and character of the neighbourhoods. ▪ Addressing emerging potential CPTED issues and consider mitigation of risks. ▪ Opportunity to implement the Coolangatta and Kirra Business Centre Placed Based Master Plan, visions such as improve getting into the centre, getting around and parking; Improving the experience; and feeling safe
Environmental and social issues and opportunities	▪ Adopting Water Sensitive Urban Design (WSUD) opportunities ▪ Retain and support the existing beach value and existing vegetation ▪ Opportunities to incorporate indigenous themes that can blend into the Light Rail design ▪ Achieve a stronger connection to Cultural Heritage values (aboriginal and historic) ▪ Protection of foreshore and popular viewing spots ▪ Maximise benefits accrued from Light Rail to deliver greater equity of access (e.g. more stops) and/or opportunities to support/ stimulate more affordable housing (e.g. by serving catchments slightly further away from the high amenity beachfront corridor). ▪ Maximise corridor resilience to natural hazards and events

5. Route vision and service requirements

5.1 Route vision process and stakeholder input

The process of developing a vision for the corridor that could be used to guide the future option development and option assessment involved inputs from the technical working group at workshop 1 held on 24th March 2021. Subject matter experts from Jacobs, TMR, City of Gold Coast and the wider working group including planning, traffic, environment, cultural heritage and design/ engineering specialists contributed. Participants identified the key opportunities and constraints in the corridor throughout the workshop, and finally developed key vision elements and ideas of what they saw as the potential for the corridor. These key vision elements and vision statement ideas are shown in Figure 5-1 and Figure 5-2.

Figure 5-1 Key vision elements

Figure 5-2: Ideas for vision statement

5.2 Corridor-wide vision

Building on the first workshop and the stakeholder inputs, the project team developed a draft overarching vision statement for this project's study corridor capturing these themes. This draft vision was circulated as part of Working Paper 1 with feedback incorporated into a revised vision statement read as follows:

"The Tugun to Coolangatta corridor will connect the southern Gold Coast and its collection of distinct and unique places, with their varied character, density and scale. The corridor and communities along it will connect seamlessly through cross-corridor connections and to the wider city and region with enhanced public and active transport facilities as alternatives to private vehicle travel. Light Rail stations served by frequent, reliable G:link services, will integrate with and further activate key precincts, villages and centres (including the airport precinct). Appropriate and diverse land uses will establish within a comfortable walking distance of the stations, contributing to more vibrant and affordable communities. High quality active transport infrastructure will complement major public transport investment to help in sustainably accommodating more people as the corridor becomes a more desirable place in which to live, work, learn and play."

This vision statement was then broken down into key (transport) service requirements or priorities per corridor segment.

5.3 Service requirements

5.3.1 Bilinga:

- Maintain efficient through movement for traffic on the Gold Coast Highway – a higher order arterial road
- Improve cross corridor pedestrian connectivity (improve safety, convenience and reduce pedestrian delays)
- Improve cycle facilities along the Gold Coast Highway corridor, focussing on Golden Four Drive for safe, attractive cycle facilities serving longer distance cycle trips and commuters to complement the already completed Oceanway shared path which better serves local and recreational trips.
- Maintain local traffic access between GCH and service roads – but potentially reconfigure and relocate where providing all current movements at existing location is not feasible or desirable (due to other impacts)
- Develop a trunk LRT spine along the Gold Coast Highway corridor, replacing current frequent bus routes 700 and 777. This is a regional mass transit spine that should have competitive journey times with expected walk catchments in the order of 400-800m allowing for station spacing >1km. LRT will have priority over general traffic at intersections delivering a high level of reliability
- Maintain bus stops for local bus services along Golden Four Drive such as those that access John Flynn Hospital/ The Pines/ Robina (760/ 768). Such bus services will help fill any catchment gaps left by LRT.

5.3.2 Airport

- Maintain efficient through movement for traffic on the Gold Coast Highway – a higher order arterial road
- Maintain efficient vehicle access in and out of the airport – a regionally significant destination
- Maximise opportunities related to a new southern entrance to redistribute traffic away from the Gold Coast Highway/ Terminal Drive intersection
- Improve cross corridor pedestrian connectivity (improve safety, improve convenient and reduce delays) particularly in the vicinity of Terminal Drive where a strong desire line will develop between PT/ airport/ university of one side of GCH and residential apartments/ tourist accommodation/ beach on the other
- Improve cycle facilities along the Gold Coast Highway corridor focussing on Golden Four Drive for safe, attractive cycle facilities serving longer distance cycle trips and commuters to complement the already completed Oceanway shared path which better serves local and recreational trips.
- Maintain local traffic access between GCH and service roads – but potentially reconfigure and relocate where providing all current movements at existing location is not feasible or desirable (due to other impacts)
- Develop a trunk LRT spine that leaves the Gold Coast Highway corridor to serve the airport before crossing the highway again to head south east as efficiently as possible – minimising journey time while optimising stop location (relative to airport terminal/ university/ multi-modal interchange)

- Develop a regionally significant (premium/ iconic) multi-modal passenger transport hub serving the airport/ university/ North Kirra precinct accommodating LRT, local public buses and future heavy rail. This interchange will provide the highest level of customer experience and amenities and be seamlessly connected to the surrounding destinations (including weather protected and activated walkway links).
- Enhance efficiency of access in and out of the airport precinct for buses including to/ from Golden Four Drive as buses will still need to access local destinations such as John Flynn Hospital/ The Pines/ Robina (prior to heavy rail extension) and potentially to/ from Gold Coast Highway south (new access) should there be new local services to Tweed Shire in the future

5.3.3 Kirra

- Musgrave Street and Coolangatta remain relatively low order distributor type roads providing general vehicle access to Coolangatta/ Tweed Heads from the north – Musgrave Street continuing to serve more tourist and recreational trips (beach/ park/ cafes) with Coolangatta Road serving more local residential trips in southern Coolangatta.
- Improve road safety outcomes on Musgrave Street (currently 50 km/h) where there are higher levels of pedestrian activity greater levels of side friction and distraction (parking/ side roads etc)
- Develop a trunk LRT spine between the Airport and Coolangatta sections through Kirra in a way that provides an attractive mass rapid transit service with good travel times and high reliability replacing the route 700.
- The location of a station serving Kirra would need to balance access to the current dominant land uses and trip destinations along the beach with the wider catchment to the south including community facilities and more affordable housing opportunities.
- Enhance cross corridor pedestrian connections on Coolangatta Road and Musgrave Street particularly in the vicinity of a potential Kirra LRT station to provide excellent pedestrian linkages both north (to the beach) and south (to the residential and community catchment)
- Develop safe attractive cycle facilities on or parallel to the Coolangatta Road corridor, linking to Golden Four Drive and/ or Oceanway cycle facilities to provide onward connections for longer distance cycle trips and commuters
- Develop safe, attractive cycle facilities on Miles Street a key north-south connector to both Coolangatta Rd and Oceanway cycle facilities.
- Maintain access for local buses including the service to / from Tweed Shire (route 601 via Miles St) and local services between Coolangatta/ Tweed and John Flynn hospital/ The Pines / Robina (760/ 768) – these bus services may use a different corridor to Light Rail to maintain coverage for those area more distant from LRT stations

5.3.4 Coolangatta

- Marine Parade, Griffith Street and Lanham Street remain relatively low order distributor type roads providing general vehicle access to Coolangatta/ Tweed Heads from the north/ west and through the town centre– Marine Parade caters more for beach and parkland access, Griffith Street performing a 'high street' function with high levels of pedestrian activity, with Lanham Street providing access to parking and southern residential catchments.
- Improve road safety outcomes for vulnerable road users throughout the town centre, including consideration of reduction in posted travel speeds such as on Griffith Street (currently 50km/h).
- Develop a trunk LRT spine between the Airport and Coolangatta in a way that provides an attractive mass rapid transit service with good travel times and high reliability replacing the route 700. Develop the LRT alignment in a way that allows for an efficient and simple onward extension towards Tweed Heads
- The location of a station serving Coolangatta will balance access to the current dominant land uses and trip destinations between the beach and Griffith Street with the wider catchment to the south including parks, community facilities and more affordable housing opportunities.
- Enhance north-south pedestrian connections to better connect the southern residential catchments to the town centre and beach, leveraging of existing links particularly in the vicinity of the future LRT station

- Develop safe attractive cycle facilities that connect Coolangatta Road (Kirra) to the west, with Tweed Heads to the east via Coolangatta, providing a facility that better serves longer distance cycle trips and commuters to compliment the already completed Oceanway shared path which better serves local and recreational trips
- Maintain efficient access to and through Coolangatta for local buses including the service to / from Tweed Shire (route 601) and local services between Coolangatta/ Tweed and John Flynn hospital/ The Pines / Robina (760/ 768) – these bus services may use a different corridor to Light Rail to maintain coverage but will be designed to provide efficient transfer opportunities at the Coolangatta LRT station.

6. Longlist option development and shortlisting

This chapter documents the process of option generation and shortlisting is illustrated in Figure 6-1. Each step of the process is explained in detail within this chapter.

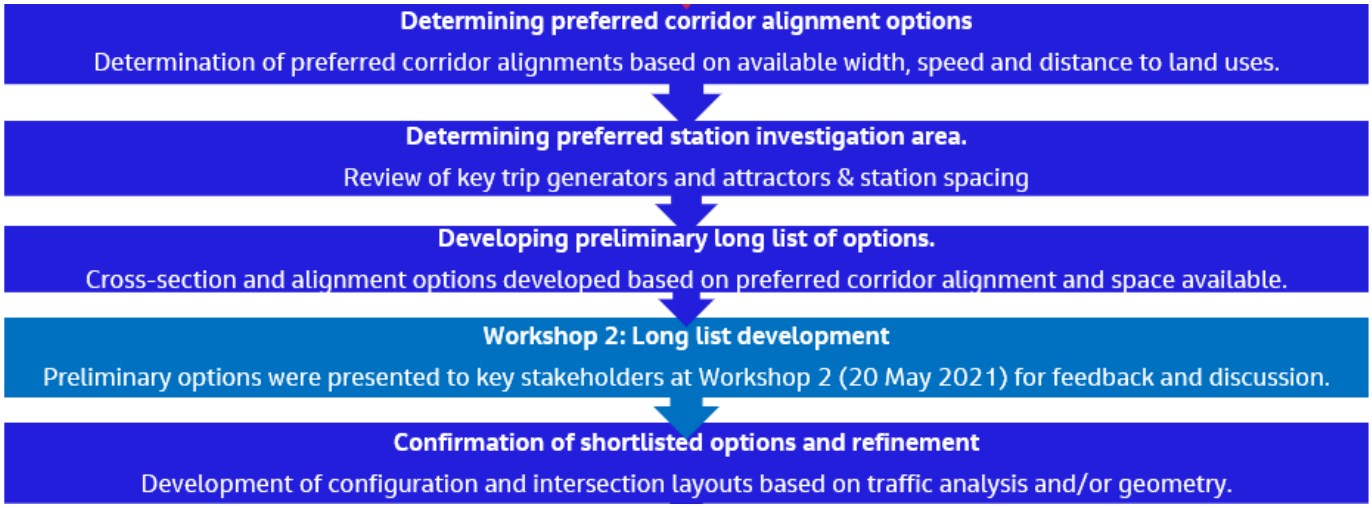


Figure 6-1: Option generation and shortlisting process

6.1 Corridor alignment options.

The first step in option generation involved identifying and assessing the most feasible and viable corridor alignment(s) within each corridor segment between Boyd Street in Tugun and the NSW/QLD border in Coolangatta. This involved identifying potential corridors and understanding the impacts and opportunities created by the Light Rail transport (LRT) within that corridor.

The LRT alignment north of Boyd Street, Tugun is based on the corridor planning from the earlier Gold Coast Highway (Burleigh Heads to Tugun) Multi Modal Corridor Study. The development and assessment of corridor options south of Boyd Street were undertaken on a section-by-section basis. The key requirement of this study (as identified in the corridor-wide vision) is that LRT must serve the airport precinct, therefore all options within the Airport section are aligned to travel to the airport. Refer to Figure 6-2 for an overview of all corridor options identified.

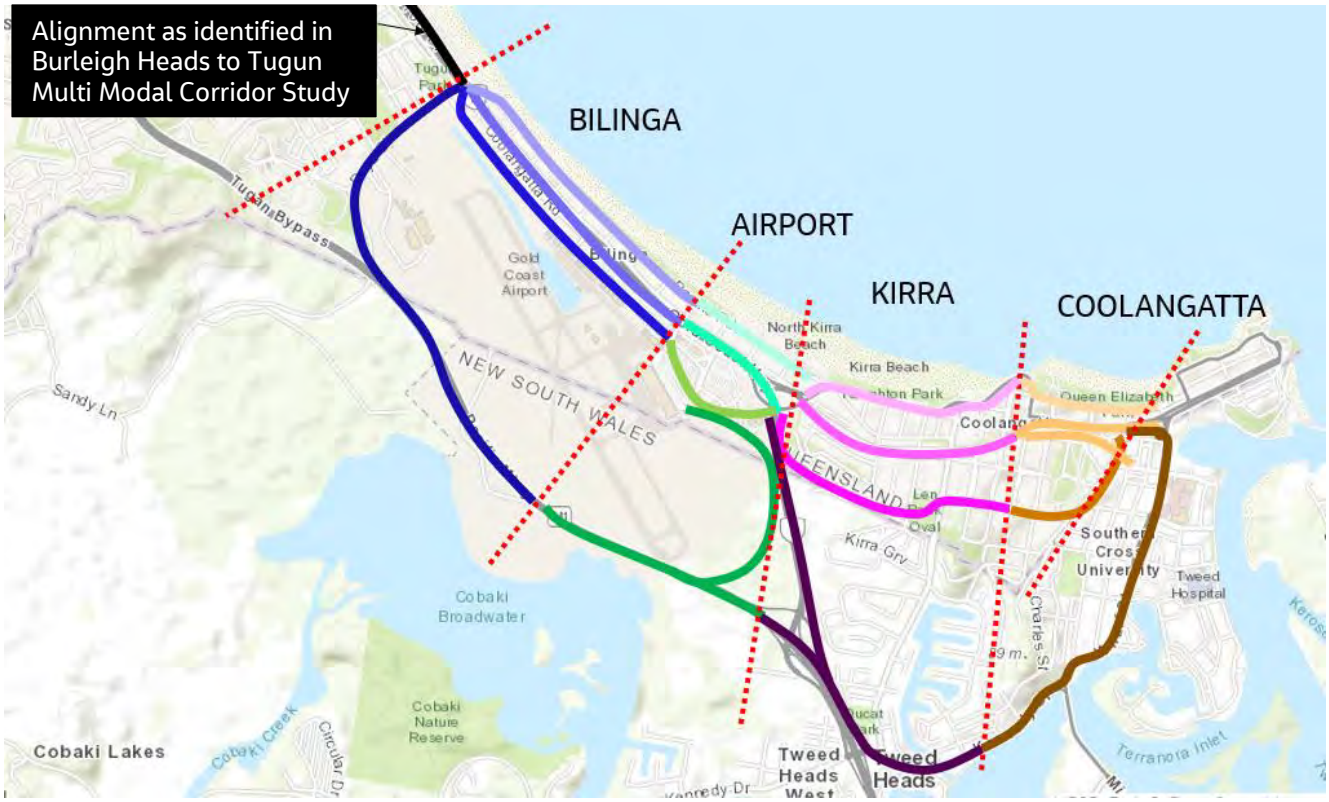


Figure 6-2: Corridor options identified and assessed (Tugun to Coolangatta)

6.1.1 Bilinga

The corridors analysed within Bilinga (between Boyd Street and Terminal Drive) include:

- East of Gold Coast Highway
- Gold Coast Highway (including Coolangatta Road / Golden Four Drive)
- West of Gold Coast Highway (Adina Avenue / Eastern Avenue)
- Pacific Motorway (M1)

The results of the high-level assessment are summarised in Table 6-1. Overall, the Gold Coast Highway corridor was selected as the only viable option to be taken forward.

Table 6-1: High level assessment of Bilinga corridor options

Options	Decision	High level assessment
East of Gold Coast Highway	DO NOT PROCEED	This corridor was not taken forward because the corridor has insufficient width (10 to 20m), is not a continuous road corridor, is exposed to extreme weather events and is not resilient.
Gold Coast Highway (including Coolangatta Road / Golden Four Drive)	PROCEED	This corridor was selected as it is very wide (up to 110m in some places), is the already established transport corridor in this location, including public transport and active transport links and can serve higher speeds that allows for better Light Rail rapid transit.
West of Gold Coast Highway (Adina Avenue / Eastern Avenue)	DO NOT PROCEED	This corridor was not taken forward as the corridor width is insufficient (10m) is lower speed which does not allow for a higher speed Light Rail rapid transport.

Options	Decision	High level assessment
Pacific Motorway (M1)	DO NOT PROCEED	The M1 corridor was not taken forward as it is located too far west (2km from land uses in Bilinga) and conflicts with the corridor already allocated for future heavy rail.

6.1.2 Airport

The corridors analysed within Airport (between Terminal Drive and Musgrave Street) include:

- East of Gold Coast Highway (Pacific Parade)
- Gold Coast Highway (including Coolangatta Road / Golden Four Drive)
- West of Gold Coast Highway (east of Airport terminal)
- Pacific Motorway (M1)

The results of the high-level assessment are summarised in Table 6-2. The Gold Coast Highway and west of Gold Coast Highway corridors were selected, as documented below.

Table 6-2: High level assessment of Airport corridor options

Options	Decision	High level assessment
East of Gold Coast Highway	DO NOT PROCEED	This corridor was not taken forward because the corridor has insufficient width (10 to 20m), is not continuous road corridor, is exposed to extreme weather events and is not resilient. Furthermore, this corridor means the LRT alignment would essentially bypass the airport, inconsistent with a key project requirement
Gold Coast Highway (including Coolangatta Road / Golden Four Drive)	PROCEED	This corridor was selected as it is very wide (up to 110m in some places), is the already established transport corridor including public transport and active transport links and can serve higher speeds that allows for better Light Rail rapid transit.
West of Gold Coast Highway (east of airport terminal)	PROCEED	This corridor was selected as it creates a direct connection to the airport terminal and surrounding land uses. It also takes advantage of the airport extension as identified in the Airport Master Plan and aligns with the proposed Light Rail alignment.
Pacific Motorway (M1)	DO NOT PROCEED	The M1 corridor was not taken forward as it is located at a significant distance west of the airport (1km from airport), creating a longer LRT distance to travel in/from airport. This corridor is also allocated for future heavy rail.

6.1.3 Kirra

The corridors analysed within Kirra (between Musgrave Street and Miles Street) include:

- Musgrave Street / Marine Parade
- Coolangatta Road
- Binya Avenue / Stapylton Street
- Pacific Motorway (M1)

The results of the high-level assessment are summarised in Table 6-3. The Musgrave Street/Marine Parade and Coolangatta Road Light Rail corridor options were chosen based on their proximity to major land uses.

Table 6-3: High level assessment of Kirra corridor options

Options	Decision	High level assessment
Musgrave Street / Marine Parade	PROCEED	This corridor was taken forward as it is in close proximity to the major land uses including retail facilities and the beach and although it has a carriageway width ranging from 10m to 18m, there is potential to increase available space utilising open space land along the foreshore.
Coolangatta Road	PROCEED	This corridor was taken forward as it is in close proximity to the land uses, is a key distributor road and is a continuous road corridor.
Binya Avenue / Stapylton Street	DO NOT PROCEED	This corridor was not taken forward because the corridor is not continuous, requires crossing of Miles Street and is located approximately 700m (significant walking distance) from the major land uses within Kirra.
Pacific Motorway (M1)	DO NOT PROCEED	The M1 corridor was not taken forward as it is located at a significant distance to the west (2km from the Kirra beach and the airport options). The M1 corridor is also already allocated for future heavy rail.

6.1.4 Coolangatta

The corridors analysed in Coolangatta (between Miles Street and the NSW/QLD border) includes:

- Marine Parade
- Griffith Street
- Chalk Street or Lanham Street / Gerrard Street
- Tweed Street / Jarvis Lane / Chalk Street
- Stapylton Street / Dixon Street
- Kennedy Drive / Wharf Street

The results of the high-level assessment are summarised in Table 6-4. The Marine Parade, Griffith Street and Chalk Street / Lanham Street / Gerrard Street Light Rail corridor options were chosen based on their proximity to major land uses.

Table 6-4: High level assessment of Coolangatta corridor options

Options	Decision	High level assessment
Marine Parade	PROCEED	This corridor was taken forward as it is in close proximity to the major land uses including retail facilities and the beach and also has a carriageway width of 20m.
Griffith Street	PROCEED	This corridor was taken forward as it is located in close proximity to the Griffith Street land uses and walking distance from the beach via a number of direct pedestrian corridors.
Chalk Street / Lanham Street / Gerrard Street	PROCEED	This corridor was taken forward as it is a direct LRT alignment in close proximity to the Griffith Street land uses and beach.
Tweed Street / Jarvis Lane / Chalk Street	DO NOT PROCEED	This corridor was not taken forward as it creates an indirect transport connection, requiring the LRT to take several turns through Coolangatta Road via narrow road corridors.
Stapylton Street / Dixon Street	DO NOT PROCEED	This corridor was not taken forward as it creates an indirect transport connection via local roads that serve a lower speed that

Options	Decision	High level assessment
		does not create a suitable environment for a high-speed Light Rail transport. In addition, it is located a significant distance from the major land uses approximately 700m from the beach.
Kennedy Drive / Wharf Street	DO NOT PROCEED	This corridor was not taken forward due to the significant distance between the alignment and the Coolangatta land uses (2km), catering for the Tweed Heads catchment.

6.1.5 Preferred corridor options

The corridor options for each section that were taken forward into the alignment long list process are illustrated in Figure 6-3.

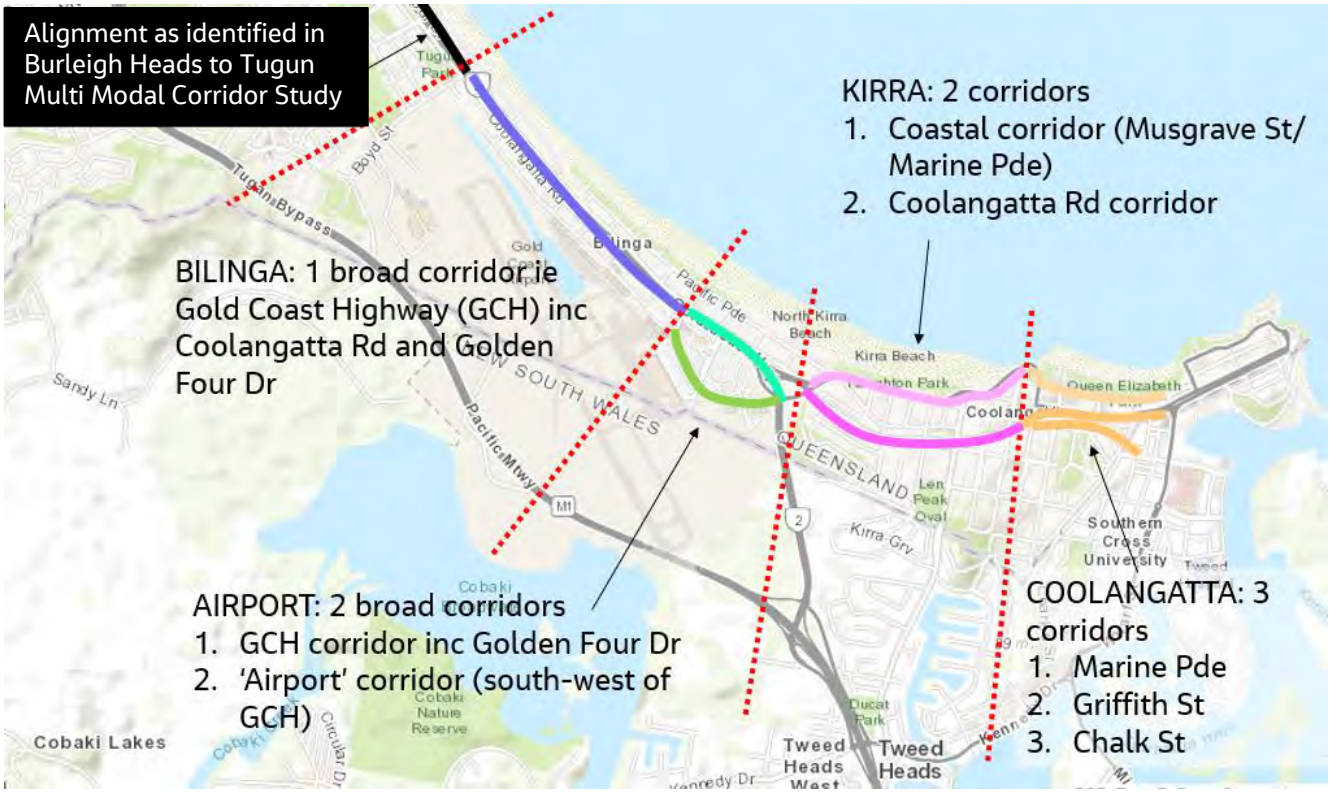


Figure 6-3: Preferred corridor alignment options

6.2 Station investigation areas

The process of developing the station location investigation areas included:

- Determination of the "key anchors" (non- negotiable station locations)
- Investigation and confirmation of benchmarked station spacing philosophy
- Identification of catchment areas and local area issues.

6.2.1 Key anchor stations

Refer to Figure 6-4 for an illustration of the key anchor stations identified for this study area. The key anchor stations include:

- Tugun station at Boyd Street – as confirmed through the previous Burleigh Heads to Tugun MMCS. This station is in proximity to a Knowledge and Technology precinct (John Flynn Hospital) as identified in the SEQ Regional Plan (ShapingSEQ).
- Airport – identified in the SEQ Regional Plan (ShapingSEQ) as another Knowledge and Technology precinct. It is also identified as a required stop in the corridor-wide vision "Light Rail stations served by frequent, reliable Glink services will knit together and form a focal point for key precincts, villages and centres (including the airport precinct)" and
- Coolangatta – identified as a "Major Regional Activity Centre" (Shaping SEQ, 2017)

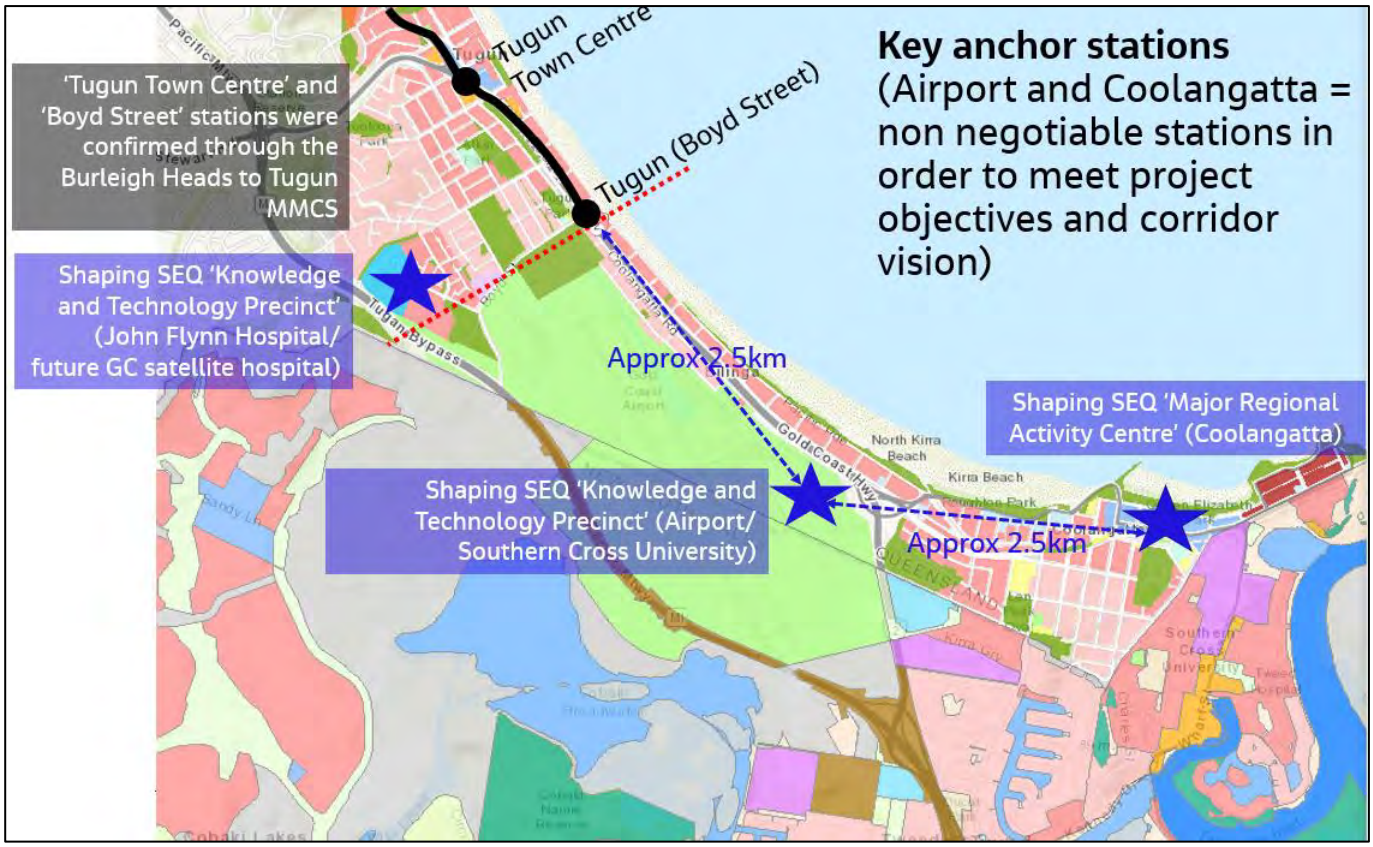


Figure 6-4: Key anchor stations

6.2.2 Station spacing philosophy

Station investigation zones were based on the key trip generators and attractors within each corridor segment and adopted the same methodology used for the Burleigh Heads to Tugun Multi-Modal Study (BH2T MMCS). That is, that Light Rail stations tend to best balance walk up access and rapid transit function where spacing, on average, is around every 800m. This 800m spacing appears to offer an effective balance between speed and accessibility, consistent with the constructed or planned urban segments of the overall GCLR and consistent with typical practice around the world. Table 6-7 documents this high-level assessment.

This spacing enables all currently well used bus stops and their catchments to be served by LRT either through direct replacement in a substantially similar location or through the amalgamation of 2-3 bus stop pairs into a single, centrally placed LRT station with a minor increase in walk distance.

It should be noted that the recommended 800m spacing is an average value and will need to vary along the corridor to enable each station to be in an optimum location. For example, stations may be located closer in key activity areas to cater for denser catchments and where trip ends (destination) are more tightly packed, while wider spacing may be more appropriate in lower density catchment areas.

Table 6-5: Assessment of station spacing options (process sourced from GCH MMCS)

Station spacing	Pros	Cons
Wide (approx. 2-3km+ capturing only the highest order "district centre" trip generators)	Typical of station spacing for heavy rail or express bus operations (as well as GCLR stage 2) it provides the fastest journey times	Does not meet the identified high priority functional requirement of maintaining good access for local catchments in this urbanised area. Not typical of stop spacing for urban LRT systems around the world and inconsistent with stages 1 and 3 (i.e., the urban coastal sections).
Close (approx. every 400m aligning largely with existing bus stop pairs)	Provides high level of accessibility especially for relatively consistent levels of density along a built-up arterial road corridor. Typical of frequent all stops urban bus services in Australasia	For long routes, journey times become uncompetitive with car and likely to be even longer than all stops bus route (700) it replaces as buses only stop on request, not at every stop. Generally, this stop spacing is less than most modern LRT systems (other than in CBD areas) and is lower than the GCLR stage 3 spacing.
Medium (approx. every 800m through built up parts of the corridors with stops more widely spaced elsewhere)	Meets the identified high and medium priority functional requirement identified above including good accessibility while maintaining reasonable journey times. Stop spacings in the order of 800m are common for modern LRT systems around the world	Will not provide as fast a journey time as the widely spaced option. Minor reduction in accessibility compared to the closely spaced option. Creates concerns for accessibility for people with mobility issues who would seek to rely on public transport - potential reduction in customer base results.

6.2.3 Catchment areas and local area trip attractors and generators

The wider network connections and other potential attractors along the corridor are detailed in Table 6-6. The table summarises the local trip attractors and generators within each section that were considered in choosing appropriate station investigation areas.

Table 6-6: Local trip generators and attractors

Section	Local trip generators and attractors
Bilinga	▪ Prominent land uses within the vicinity of the Bilinga section include: ▪ Bilinga Beach ▪ the Bilinga Surf Lifesaving Club ▪ John Flynn Private Hospital.
Airport	▪ The station at airport is to be developed as a regionally significant multi-modal passenger transport hub serving the airport/ university/ North Kirra precinct accommodating Light Rail transport, local public buses and future heavy rail. ▪ Other land uses located in the Airport section include Southern Cross University, tourist accommodation, retail (fronting the Gold Coast Highway) and aviation related businesses. ▪ Development of the airport land is subject to the Gold Coast Airport Master Plan and subsequent Major Development Plan process.
Kirra	Prominent land uses within the vicinity of the Kirra section include: Kirra Beach ▪ The Kirra Beach Surf Club ▪ The Kirra Beach Hotel (redevelopment) ▪ Coolangatta State School ▪ Kirra Beach Tourist Park ▪ Kirra Hill Lookout ▪ Aged care facilities – Kirrahaven Residential Care Centre, Blue Care Kirra Aged Care Facility, Kirra Beach Care Community and Kirra Haven Residential Care Centre.
Coolangatta	Coolangatta is a major regional activity centre and the prominent attractors located in this section include: ▪ Coolangatta Beach ▪ The Coolangatta Hotel ▪ Coolangatta Surf Club ▪ TAFE Queensland Coolangatta Campus ▪ Griffith Street – shop and retail properties ▪ The Strand ▪ Twin Towns Services Club (inc conference and event facility) ▪ Tweed Heads Public School

6.2.4 Recommended station investigation areas

Based on understanding of the key anchor stations, then reviewing the specific land uses located within each section, preferred station areas were taken forward as illustrated in Figure 6-5. In the section between Tugun and the Airport this analysis recommends wider station spacing than the 800m average discussed earlier (i.e., around 1,100m), due the narrow and limited catchment area being limited by the Ocean and the Airport and the LRT needing to provide a rapid transit connection. Between the Airport and Coolangatta, this analysis recommends a slightly closer station spacing than the 800m average discussed earlier (i.e., around 750m), due to a significantly greater extent of and potential density of catchment area. Overall, a five-station strategy as recommended here would result in an average station spacing of between 900-950m. The specific station locations within these general areas will be assessed at a finer level of detail on a section-by-section basis in the following sections.

Figure 6-5: Station investigation areas taken forward

6.3 Longlist options

Once a preferred corridor was determined for each section, and key station investigation areas were locked down, basic corridor option concepts (alignment and cross sections) were developed using CAD and Streetmix respectively. Key alignment features and cross section arrangement were identified, with consideration for the issues and opportunities for each option that require further investigation during the shortlisting if the option is preferred. A preliminary long list of options was developed for presentation at the TWG Workshop 2 held on 20 May 2021. Similar to Workshop 1, MURAL was used to record feedback on each option and to gain an understanding of how key stakeholders would assess each option. Feedback from that workshop was used to finalise the long list before evaluation.

6.3.1 Bilinga

Key inputs to the development of a longlist of options in Bilinga included:

- The transport requirements identified in Section 5.3
- LRT alignment options only within the preferred corridor of Gold Coast Highway (including Golden Four Drive and Coolangatta Rd) as discussed in Section 6.1
- A single station investigation area in the vicinity of George Street resulting in a 1.0 to 1.3km station spacing to the north and 1.0 to 1.2km to the south

Figure 6-6 and Table 6-7 summarises the long list of broad alignment options developed for Bilinga that sit within the preferred Gold Coast Highway corridor.

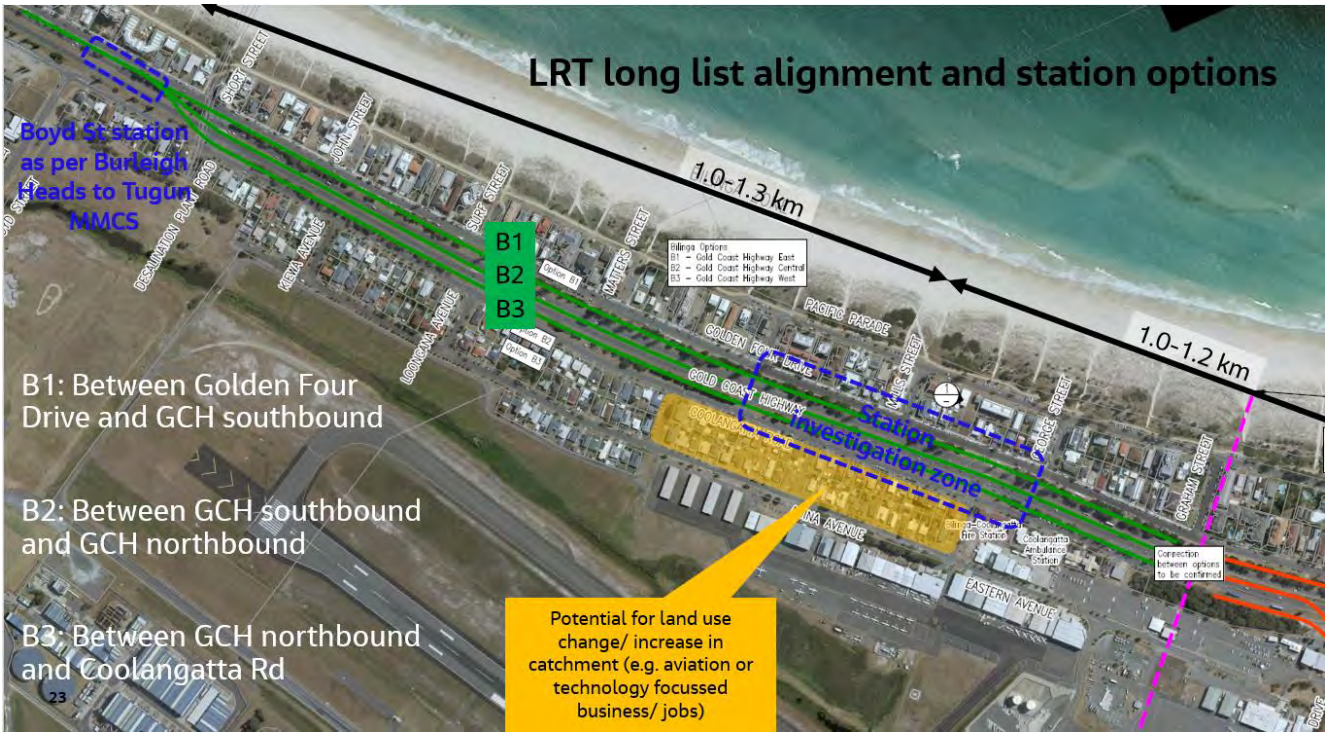


Figure 6-6: Bilinga long list of alignment options and station locations

Table 6-7: Bilinga long list of alignment options overview

Option	Key features (high level), issues and opportunities
B1 (east of Gold Coast Highway)	▪ Sits in between Golden Four Drive (two lane distributor road, 50 km/h) and Gold Coast Highway (typically four lane arterial road, 80 km/h) **Issues and Opportunities:** ▪ May require localised 'shifting' of southbound Gold Coast Highway at LRT stops/ bus stops/ intersections ▪ Connections between Gold Coast Highway and Golden Four Drive to be controlled/ rationalised ▪ Form of cycle facility on Golden Four Drive to be determined (cycle lanes vs protected one-way vs off road two way) ▪ Extent of on road parking on western side of Golden Four Drive to be determined Refer to Figure 6-7 for an indicative cross section.
B2 (centre of Gold Coast Highway)	▪ Within median of Gold Coast Highway (typically four lane arterial road, 80 km/h) ▪ Cycle facility relocated from Gold Coast Highway onto Golden Four Drive (in line with TMR cycle policy to avoid 80km/h road environment) ▪ Will require localised 'shifting' of carriageways at intersections and LRT **Issues and Opportunities:** ▪ All cross-corridor movements (including right turns) need to be signal controlled ▪ Additional pedestrian crossings will be required at stations Refer to Figure 6-8 for an indicative cross section.
B3 (west of Gold Coast Highway)	▪ Sits in between Coolangatta Road (two lane distributor Road, 50 km/h) and Gold Coast Highway (typically four lane arterial road, 80 km/h) **Issues and Opportunities:** ▪ Connections between Gold Coast Highway and Coolangatta Road to be signal controlled and some movements may need to be rationalised/ relocated

Option	Key features (high level), issues and opportunities
	▪ Form of cycle facility on Coolangatta Road to be determined (cycle lanes not currently continuous) ▪ Extent of on road parking on eastern side of Coolangatta Road to be determined. Refer to Figure 6-9 for an indicative cross section.

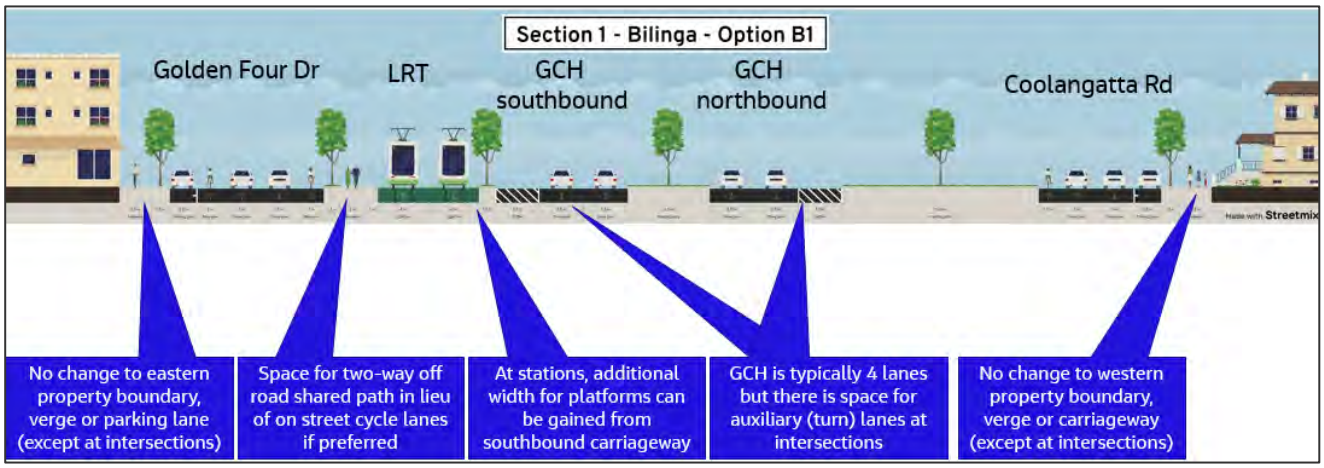


Figure 6-7: Alignment B1 proposed cross section (looking south)

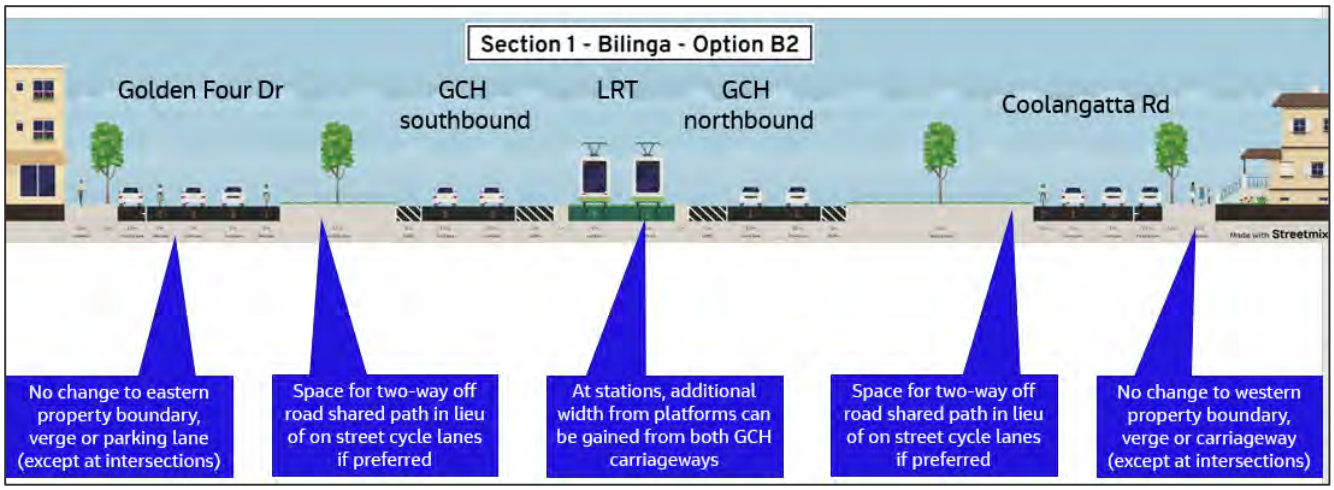


Figure 6-8: Alignment B2 proposed cross section (looking south)

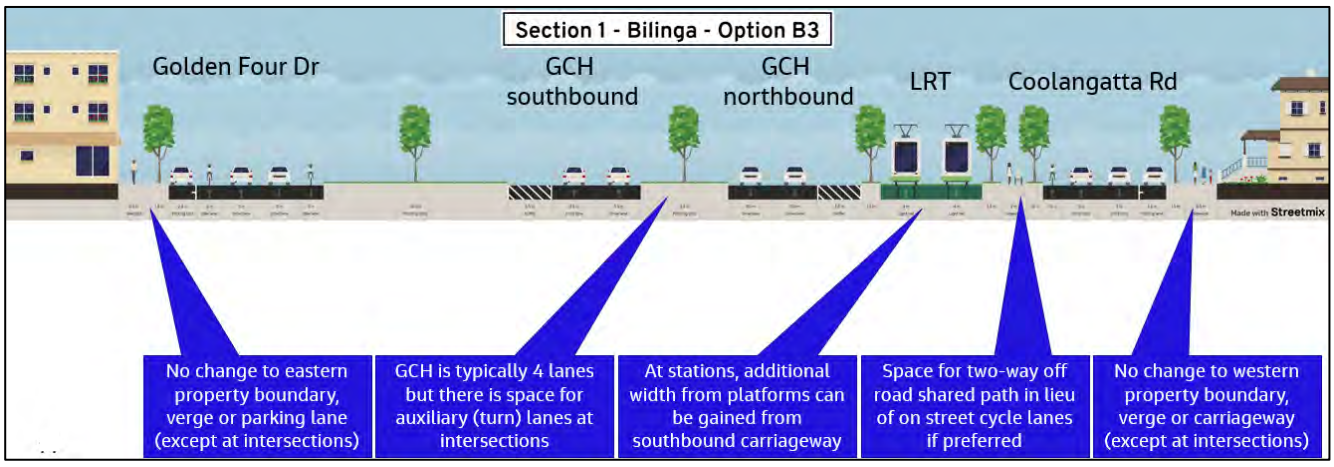


Figure 6-9:Alignment B3 proposed cross section (looking south)

6.3.2 Airport

Key inputs to the development of a longlist of options in the Airport included:

- The transport requirements identified in Section 5.3
- LRT alignment options only within the reduced airport zone notably south and west of the Gold Coast Highway
- A single station investigation area within the airport precinct to align with the emerging precinct planning by Queensland Airport Limited, to best serve the airport/ university/ future multi-modal interchange and other surrounding land uses.

The process of developing the long list of LRT alignment options, however, also involved the identification and combination of three different option components:

- Alignment options for Airport North (AN) - north of the terminal between Graham Street and Johnston Street)
- Alignment options for Airport South (AS) - south of the terminal between Johnston Street and Musgrave Street)
- Connection to a potential future heavy rail station (R). Two nominal rail station options were identified and agreed with TMR at the time as being indicative on ongoing planning work, namely a heavy rail station option 1 (R1) located closer to Gold Coast Highway; and a heavy rail station option 2 (R2) located closer to airport terminal

Figure 6-10 illustrates an overview of the airport options. A preliminary assessment of the most feasible combination of the option components (AN, AS and rail) was then undertaken to develop the long list of options (refer to Table 6-2). These options are summarised in Table 6-9 with nine options taken forward.

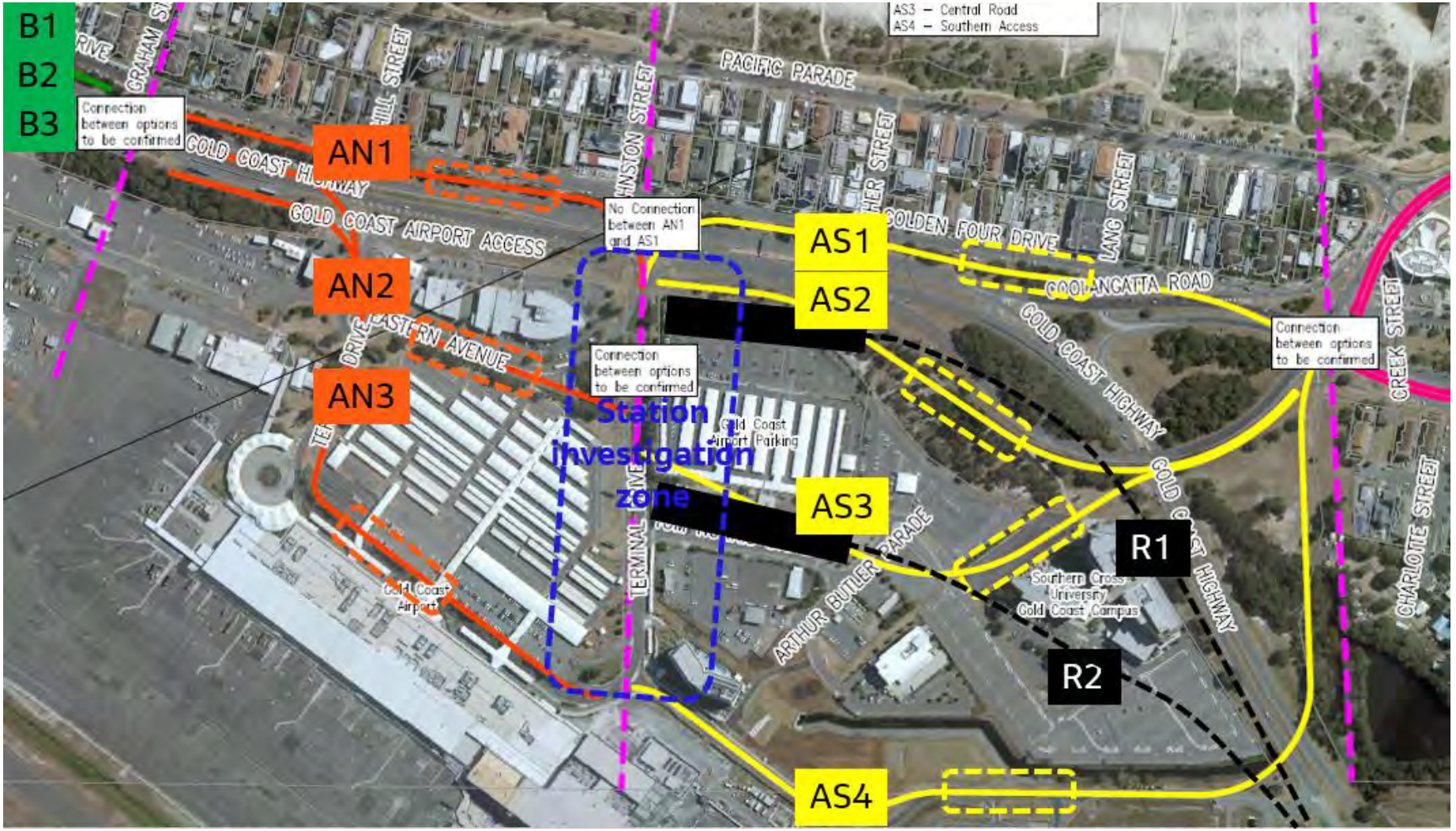
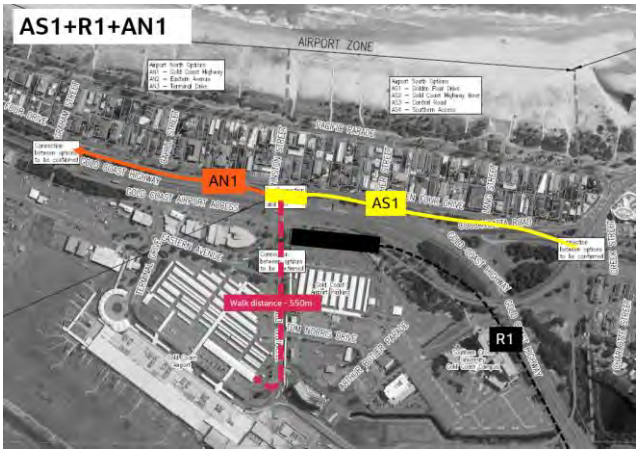
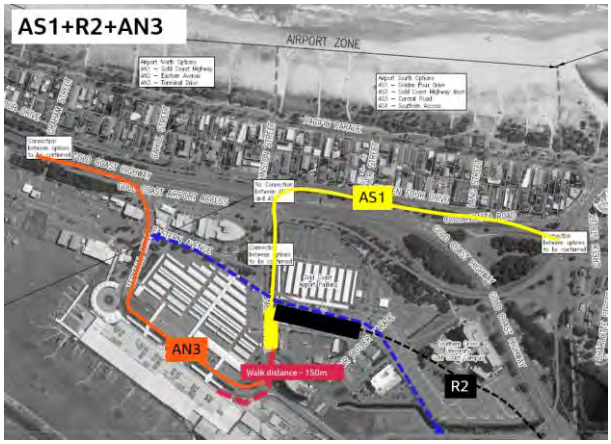
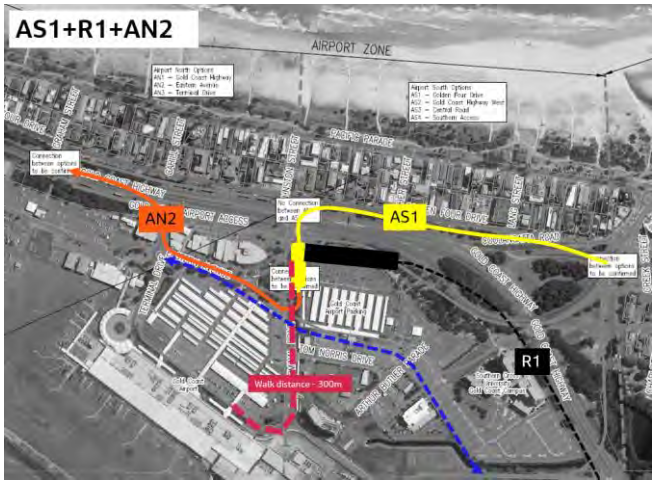
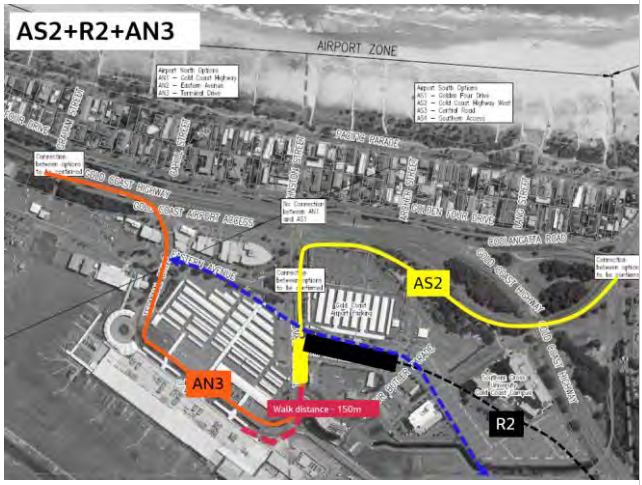
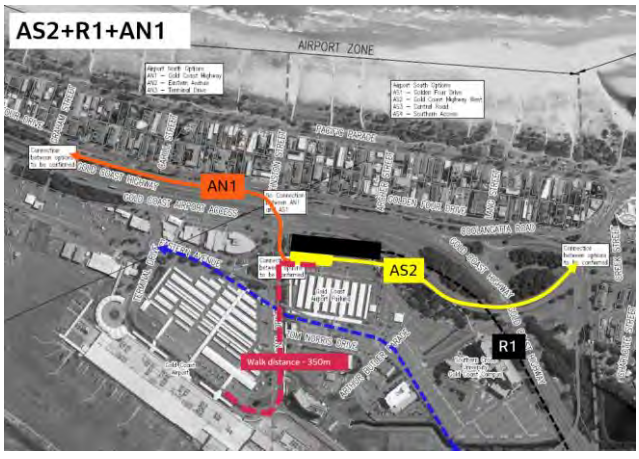
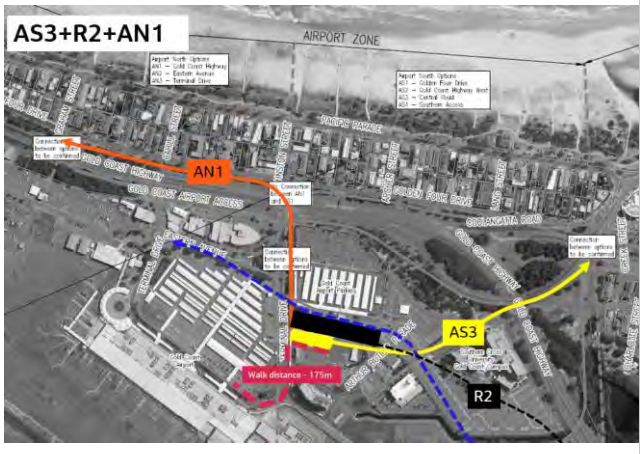


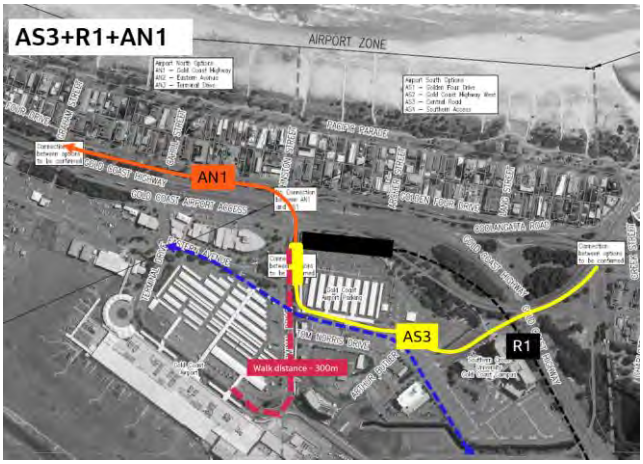
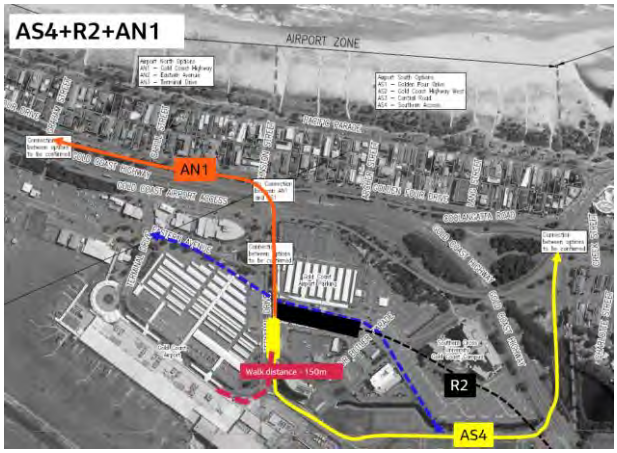
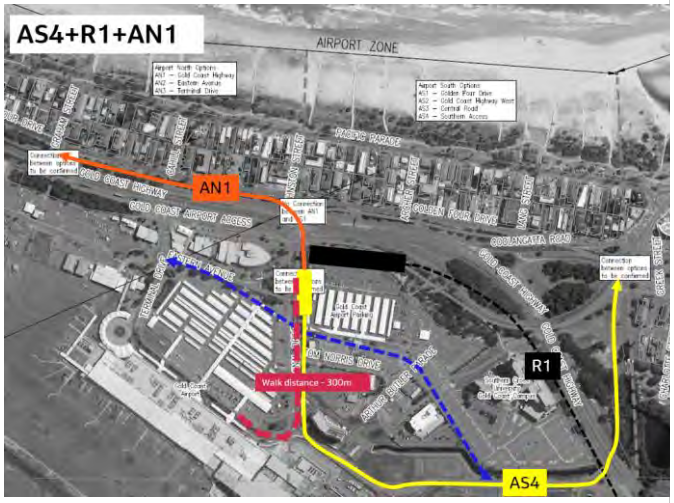
Figure 6-10: Airport alignment options (Image source: Metromap 2020)

Table 6-8: Airport longlist alignment option development

		Rail corridor alignment option R1 – closer to Gold Coast Highway			**Rail corridor alignment option R2** – closer to Airport terminal		
Option		**AN1**	**AN2**	**AN3**	**AN1**	**AN2**	**AN3**
		Gold Coast Highway	Eastern Avenue	Terminal Drive	Gold Coast Highway	Eastern Avenue	Terminal Drive
AS1	Golden Four Drive	**AS1+AN1+R1** ✓	**AS1+AN2+R1** ✓	Does not align with service requirements of creating a multi-modal passenger transport hub given significant distance between LRT and heavy rail (R1 alignment).	Does not align with service requirements of creating a multi-modal passenger transport hub given distance between LRT and heavy rail (R2 alignment).	Does not align with service requirements of creating a multi-modal passenger transport hub given distance between LRT and heavy rail (R2 alignment).	**AS1+AN3+R2** ✓
AS2	Gold Coast Highway - west	**AS2+AN1+R1** ✓	Does not align with service requirements of creating a trunk LRT spine that utilises Gold Coast Highway, instead majority of track is located within airport land.				**AS2+AN3+R2** ✓
AS3	Central road through airport	**AS3+AN1+R1** ✓			**AS3+AN1+R2** ✓		Does not align with service requirements of creating a trunk LRT spine that utilises Gold Coast Highway, instead majority of track is located within airport land.
AS4	Via new southern access within airport	**AS4+AN1+R1** ✓			**AS4+AN1+R2** ✓		

Table 6-9: Airport long list of alignment options (combination of AS, AN and rail options)

R1 alignment options (closer to Gold Coast Highway)	R2 alignment options (closer to Airport terminal)
AS1 + R1+ AN1 Light Rail distance – 1.21km & Walk distance to airport – >300m	**AS1 + R2 + AN3** Light Rail distance – 2.17km & Walk distance to airport – 150m
	
AS1 + R1 + AN2 Light Rail distance – 1.77km & Walk distance to airport - <300m	**AS2 + R2 + AN3** Light Rail distance – 2.18km & Walk distance to airport – 150m
	
AS2 + R1 + AN1 Light Rail distance – 1.53km & Walk distance to airport – 350m	**AS3 + R2 + AN1** Light Rail distance – 1.72km & Walk distance to airport – 175m
	

R1 alignment options (closer to Gold Coast Highway)	R2 alignment options (closer to Airport terminal)
AS3 + R1 + AN1 Light Rail distance – 1.68km & Walk distance to airport – <300m	**AS4 + R2 + AN1** Light Rail distance – 2.28km & Walk distance to airport – 150m
	
AS4 + R1 + AN1 Light Rail distance – 2.27km & Walk distance to airport – <300m	
	

6.3.3 Kirra

Key inputs to the development of a longlist of options in Kirra included:

- The transport requirements identified in Section 5.3
- LRT alignment options only within the preferred corridor of preferred corridors of Musgrave Street / Marine Parade or Coolangatta Road as discussed in Section 6.1
- Two potential station investigation areas, taking into account the location of an airport station to the north-west and theoretical 800m (10 min) catchment areas. Two station investigations areas, namely North Kirra and South Kirra, were considered appropriate to provide sufficient coverage to the extensive catchment area to the south and to serve a relatively high density of trip attractors s.

Figure 6-11 and Table 6-10 summarises the long list of alignment options developed for Kirra that sit (at least in part) within the preferred Musgrave Road / Marine Parade and Coolangatta Road corridors.

Figure 6-11: Kirra alignment options

Table 6-10: Kirra long list of alignment options overview

Option	Key features (high level), issues and opportunities
K1 (Musgrave Street / Marine Parade)	**Musgrave Street:** ▪ 15m road reserve with carriageway and car parking extended into parkland (18m) ▪ Total width required = 23m (extends into current angled parking area, impacting on trees) ▪ Includes on road cycle lanes ▪ Mixture of parallel and angled parking with significant friction **Marine Parade:** ▪ Approximately 10m carriageway including on road cycle lanes ▪ Constrained on both sides (Oceanway shared path and Kirra Hill) ▪ Total length = 1.56km ▪ Road reserve not able to accommodate both a dedicated LRT and other traffic (without need for additional structures). **Issues and opportunities:** ▪ To avoid tree/ park impacts likely to need to remove traffic/ parking in one direction on Musgrave St. ▪ Corridor widening limited by buildings / active uses and pine trees/ park ▪ Potential for LRT and active modes only along Marine Parade, east of Miles Street Refer to Figure 6-12 and Figure 6-13 for indicative cross sections.
K2 (Musgrave Street and	**Musgrave Street (esplanade):** ▪ 15m road reserve but carriageway and car parking extend into parkland (18m)

Option	Key features (high level), issues and opportunities
mined tunnel or cut-and-cover tunnel and retained cut)	▪ Includes on road cycle lanes ▪ Mixture of parallel and angled parking with significant friction ▪ Total width required = 23m (extending into current angled parking & impacting on trees) **Musgrave Street (mined tunnel or cut-and-cover tunnel or retained cut):** ▪ Approximately 30m road reserve – local traffic only ▪ Total length = 1.39km ▪ Road reserve 30m wide but needs to accommodate LRT transition into tunnel while local traffic diverges around tunnel portals to access ridgeline. **Issues and opportunities:** ▪ Musgrave Street - corridor widening limited by buildings / active uses and pine trees/ park ▪ To avoid tree/ park impacts on Musgrave Street likely to need to remove traffic/ parking in one direction ▪ LRT along Musgrave Street (tunnel) assumed to be in cut and cover tunnel due to steep grades. Refer to Figure 6-12 and Figure 6-14 for indicative cross sections.
K3 (Coolangatta Road/cutting - former rail corridor)	**Coolangatta Road:** ▪ Approximately 40-45m wide corridor with wide median and two to four through traffic lanes and parking ▪ Some sections with cycle lanes (not continuous) ▪ Mixture of 40 km/h (school), 50km/h and 60km/h **Cutting:** ▪ Total length = 1.45km ▪ 18-20m wide corridor but narrow formed cutting likely requiring widening and retaining structures **Issues and opportunities:** ▪ Some sections with cycle lanes (not continuous) ▪ Requires relocation of Coolangatta Police Station ▪ Combination of retaining walls and battered slopes required to provide a 14m right of way for two-way LRT and separated pedestrian/cycle paths (shared path slightly narrower). Refer to Figure 6-15 and Figure 6-16 for indicative cross sections.
K4 (Coolangatta Road/ Tweed Street)	**Coolangatta Road:** ▪ Approximately 40-45m wide corridor with wide median and two to four through traffic lanes and parking ▪ Some sections with cycle lanes (not continuous) ▪ Mixture of 40 km/h (school), 50km/h and 60km/h **Tweed Street (tunnel):** ▪ Total length = 1.39km ▪ Road reserve 30m wide but needs to accommodate LRT transition into tunnel while general traffic diverges around tunnel portals. **Issues and opportunities:** ▪ Tweed Street road reserve of 30m wide corridor but with significant elevation requiring large cutting or tunnel. Significant property access impacts to manage during construction. Refer to Figure 6-15 and Figure 6-17 for indicative cross sections.
K5 (Winston Street/ cutting	As per K3 but located along Winston Street. **Winston Street:**

Option	Key features (high level), issues and opportunities
-former rail corridor	▪ Approximately 20m wide corridor with no median and two traffic lanes and parking ▪ Some sections with cycle lanes (not continuous) ▪ 50km/h speed **Cutting:** as per K3

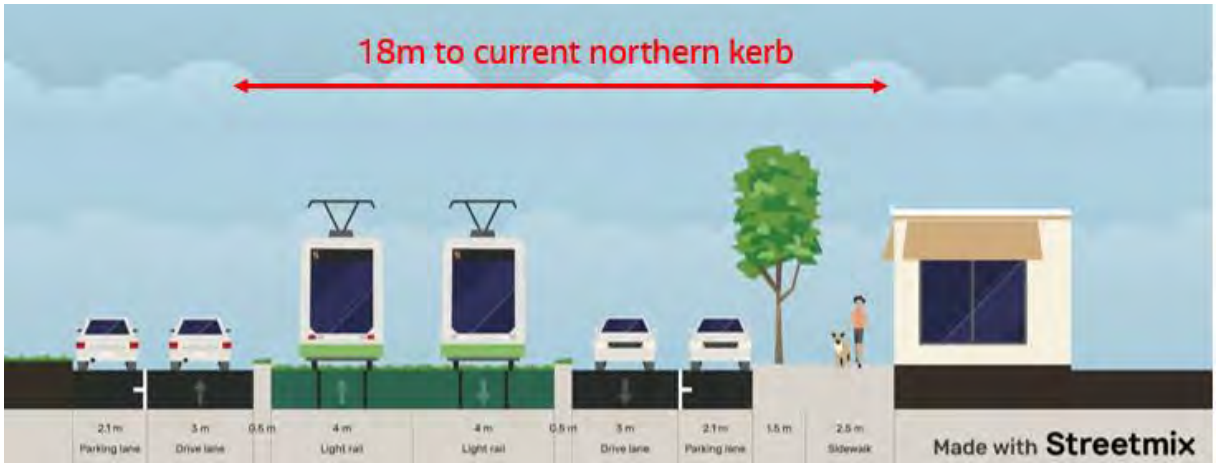


Figure 6-12: Musgrave Street – Alignment K1/K2 indicative cross section

Figure 6-13: Marine Parade – Alignment K1 indicative cross section

Figure 6-14: Musgrave Street tunnel – Alignment K2 indicative cross section

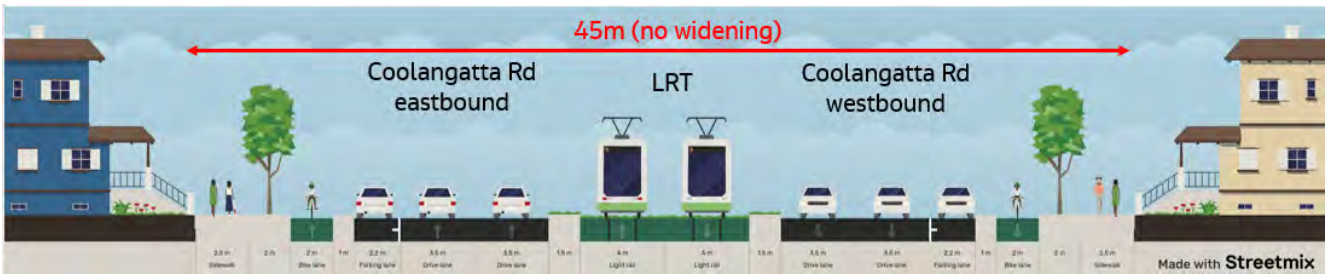


Figure 6-15: Coolangatta Road – Alignment K3/ K4 indicative cross section

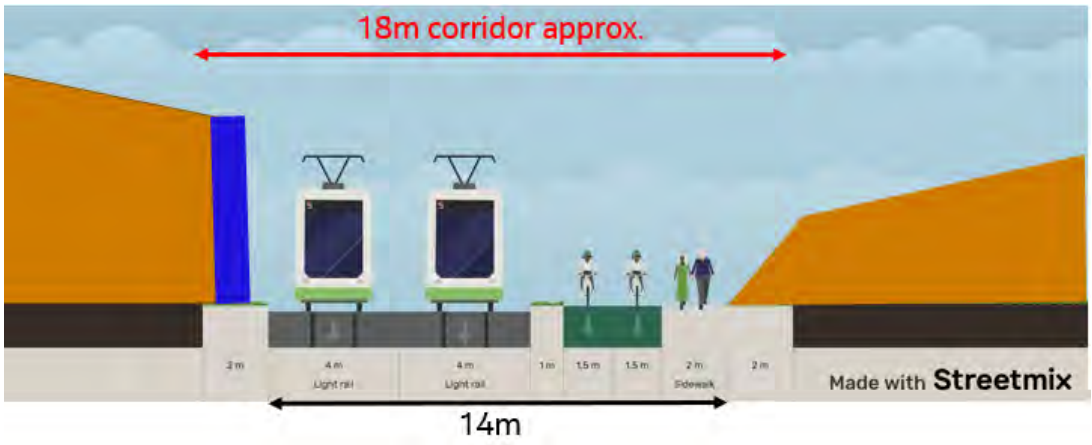


Figure 6-16: Coolangatta Road railway cutting – Alignment K3/ K4 indicative cross section

Figure 6-17: Tweed Street tunnel – Alignment K4 indicative cross section

6.3.4 Coolangatta

Key inputs to the development of a longlist of options in Coolangatta included:

- The transport requirements identified in Section 5.3
- LRT alignment options only within the preferred corridor of preferred corridors of Marine Parade, Griffith Street or Chalk Street / Lanham Street / Gerrard Street as discussed in Section 6.1
- One potential station investigation area. From the 800m station spacing methodology and noting the need to serve the Coolangatta Major Regional Activity Centre, a Coolangatta station investigation area is proposed to be located between Lanham Street, Marine Parade, Dutton Street and Warner Street. Based on feedback from stakeholders during Workshop 2, the long list of option diagram identifies the potential for an optional additional LRT station towards the eastern end LRT alignment on either Marine Parade or Griffith Street to serve the catchment further east.

Figure 6-18 and Table 6-11 summarises the long list of alignment options developed for Coolangatta that sit within the preferred Marine Parade, Griffith Street and Chalk Street/ Gerrard Street corridors.

Figure 6-18: Coolangatta alignment options

Table 6-11: Coolangatta long list of alignment options overview

Option	Key features (high level)
C1 (Marine Parade)	▪ Assumed to be compatible with **option K1 only** ▪ 22m overall including 90-degree parking - 12m carriageway including on road cycle lanes south of Norfolk Pines ▪ 40km/h zone with high pedestrian volumes and six zebra crossings ▪ 1.16km (to Bay/ Wharf) **Issues and opportunities:** ▪ Significant street activation – restaurants/ shops on southern side ▪ Highly valued Norfolk Pines to north limits/ prevents road widening ▪ Significant 'side friction due to angled parking Refer to

Option	Key features (high level)
	Figure 6-19 for an indicative cross section.
C2 (Griffith Street)	▪ Assumed to be compatible with **options K2 or K3** ▪ 30m corridor with carriageway varying from 9m to 22m where 45-degree parking on both sides and 'cycle lanes' ▪ No opportunity to widen corridor ▪ 50km/h zone but with high pedestrian volumes and eight zebra crossings (more suited to 40 km/h) ▪ 1.12km (to Bay/ Wharf) **Issues and opportunities:** ▪ No opportunity to widen corridor ▪ 'High street' environment with street activation and landscaping Refer to Figure 6-20 for an indicative cross section.
C3 (Chalk Street – former heavy rail corridor)	▪ Assumed to be compatible with **options K2 or K3** ▪ Approximately 20m corridor with potential to widen into adjacent at grade car parking to south. ▪ 50km/h zone with low ped crossing volumes and three zebra crossings ▪ 0.88km (to Bay/ Wharf) **Issues and opportunities:** ▪ Approximately 20m corridor with potential to widen into adjacent at grade car parking to south. ▪ Currently exists as rear service lane to Griffith Street shops Refer to Figure 6-21 for an indicative cross section.
C4 (Tweed Street / Goodwin Park / Chalk Street)	▪ Compatible with **option K4 only** ▪ Narrow corridor with significant side friction/ level differences ▪ Total route = 1.15km (to Bay/ Wharf) **Issues and opportunities:** ▪ Tweed Street gradients likely unsuitable for LRT especially at eastern end connecting to Goodwin Park. ▪ Limited opportunity for segregated LRT corridor in park. ▪ Route through Goodwin Park likely to be low speed with side friction.

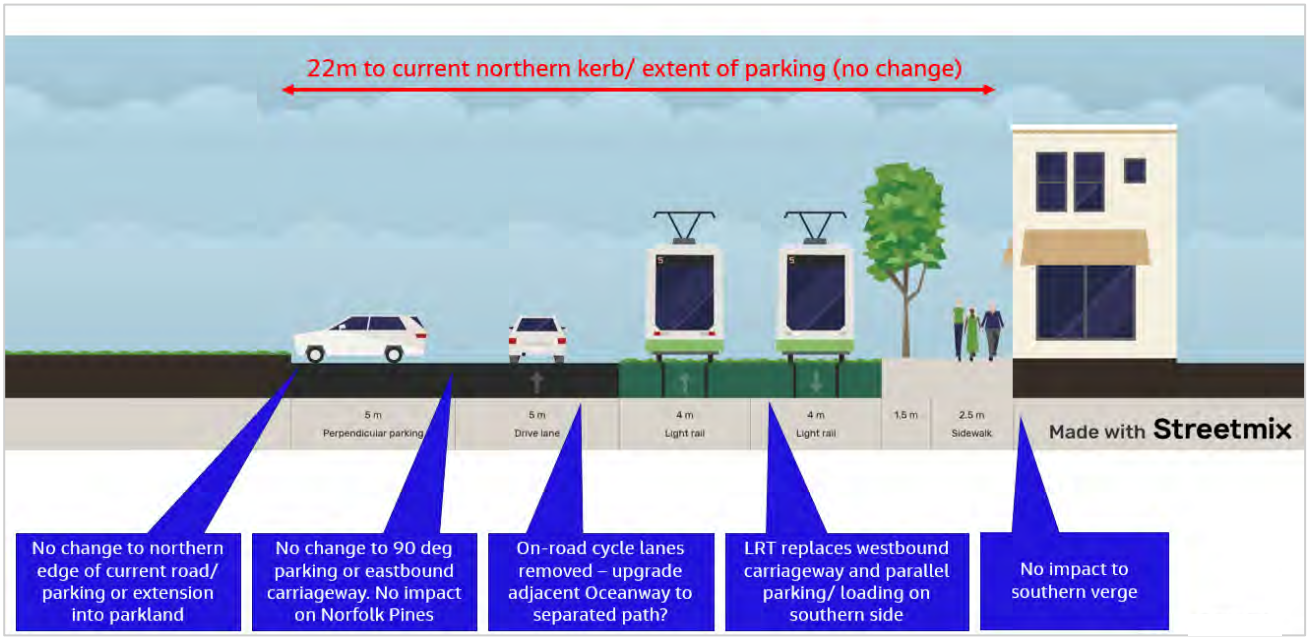


Figure 6-19: C1 – Marine Parade indicative cross section

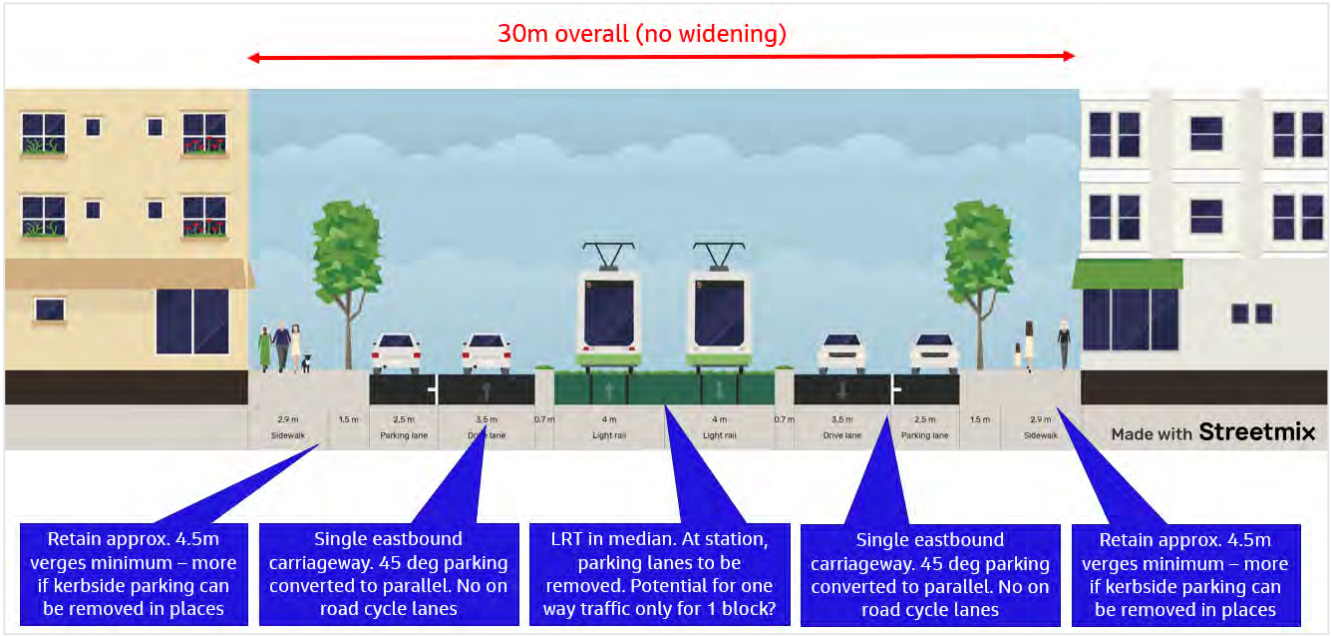


Figure 6-20: C2 - Griffith Street indicative cross section

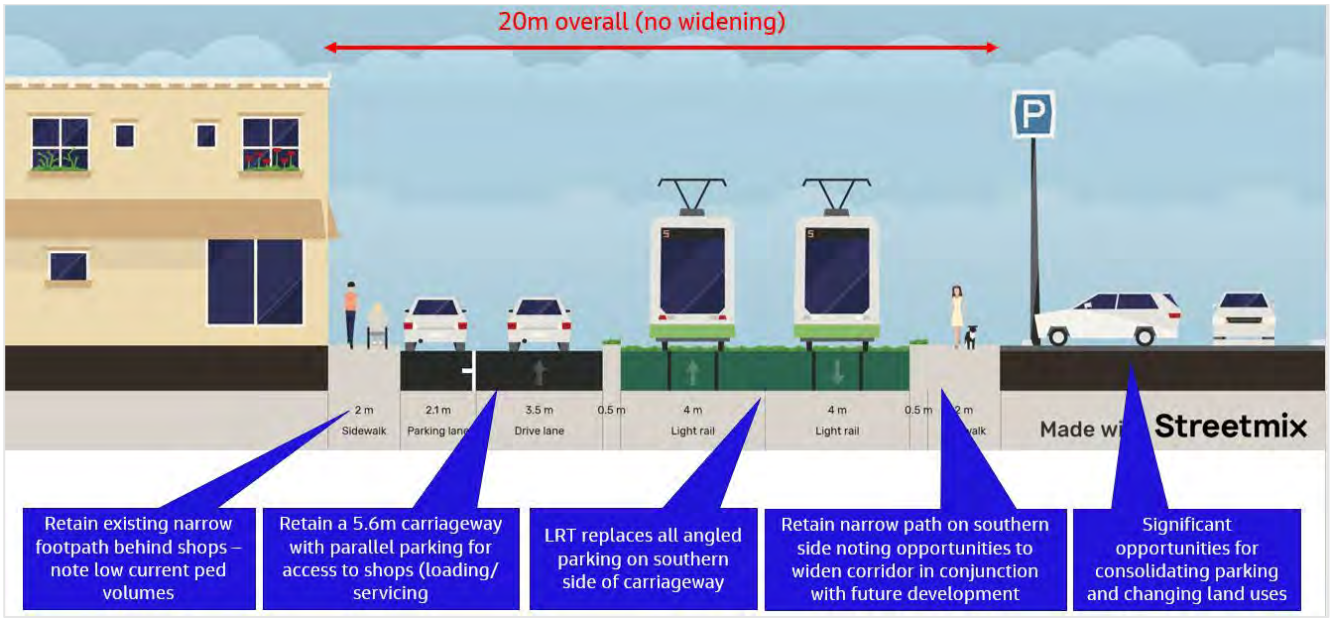


Figure 6-21: C3 - Chalk Street indicative cross section

6.4 Longlist assessment framework

A framework was developed to help 'filter' the long list corridor options down to a short list, using the same higher order categories proposed for the multi criteria analysis (MCA) which in turn was developed to be consistent with TMR Smarter Solutions MCA tool. The detailed MCA is described further in Section 7.2. The specific issues that were considered in the longlist assessment filter are summarised in Table 6-12.

Table 6-12: Long list of options filtering assessment

Category (using Smarter Solutions MCA tool, TMR)	**Long list measurement of performance**	**Score Guide (outer limits + base)**
Cost	High level discussion of likely scale of implementation costs identifying any differentiators in terms of operating costs	Scoring of each option is relative to the other options: **Very Positive** - lowest cost, specifically capital cost (in comparison to other options) - involving the shortest Light Rail distance *Shortest route = lower capital cost and operating cost* **Negative** - mid level cost (in comparison to other options) includes capital and operating cost. **Very Negative** - higher cost (in comparison to other options) includes capital and operating cost. *Longer route = higher capital cost and operating cost.*
Land use	Maximise opportunities for stimulating and encouraging land use growth in a way that is consistent with regional and local planning	**Very Positive** - aligns with regional planning and local planning objectives with encouraging land use growth and creates opportunity for local precinct enhancements **Neutral** - does not create opportunities for simulating and encouraging land use growth consistent with planning.
Transport outcomes	Public transport (PT) accessibility and connectivity (for current and future	**Very Positive –** PT travel time reduced and accessibility improved (from existing PT travel times and accessibility) that will drive better PT mode share.

Category (using Smarter Solutions MCA tool, TMR)	**Long list measurement of performance**	**Score Guide (outer limits + base)**
	customers) – qualitative assessment of likely benefit	**Neutral** - no changes to existing PT mode share **Very Negative** - PT travel time increased significantly from existing, less accessible that will impede PT mode share.
	Active transport safety, comfort and access – qualitative discussion	**Very Positive** - creates additional active transport links (from existing) and improves safety for both pedestrians and bike riders (e.g., more signalised intersections mean more safer/ controlled crossing opportunities) **Neutral** - no changes to active transport infrastructure and safety - pedestrian and cycle (as existing) **Very Negative** - net loss in active transport infrastructure (pedestrian and cycle)
	Provides adequate/ appropriate/ safe traffic capacity – qualitative discussion on likely extent of impact/ redistribution of traffic	**Very Positive** - capacity significantly improved, road safety/speed significantly improved and no net loss change to parking (compared to existing). **Neutral** - no changes to traffic capacity, road safety **Very Negative** - significant reduction in road capacity and/or road safety negatively impacted and net loss in car parking (compared to existing).
Construction and contractability	Qualitative discussion of likely construction risks and issues including traffic management, community disruption or technical risks	**Negative** - creates traffic management risks/issues during construction **Very Negative** - creates traffic management, community disruption and technical risk during construction **Fatal flaw** - construction not feasible.
Environmental impact	Qualitative discussion on the potential extent of environmental impacts focussing on noise and air quality but noting any impact on flora and fauna where relevant	**Negative** - creates manageable noise or air quality implications during operation. **Very Negative** - creates significant noise or air quality implications during operation and/or significant impacts to flora and fauna. **Fatal flaw** - extent of environmental impacts significant and option not feasible.
Social factors	Minimising impacts to adjacent land owners and the wider community.	**Neutral** - does not impact visual amenity/ urban quality, with minimal impact to local land uses, property and businesses during operation. **Very Negative** - causes significant impact on visual amenity/ urban quality and/or creates significant impact to local land uses, property and businesses during operation. **Fatal flaw** - Adjacent land owners and relevant stakeholders would reject idea completely.

6.5 Longlist assessment findings

6.5.1 Bilinga

Table 6-13 and Table 6-13 summarises the results of the assessment of the long list alignment options in Bilinga. Alignment Option B1 and B2 were taken forward as the shortlisted alignment options for further refinement and MCA. Refer to Appendix D for the detailed commentary associated with the scoring.

Table 6-13: Bilinga – long list assessment scoring

Category	B1 - East of GCH	B2 - Centre of GCH	B3 - West of GCH
Cost	Neutral	Neutral	Neutral
Land use planning	Positive	Positive	Neutral
Public transport outcomes	Very Positive	Positive	Negative
Active transport outcomes	Very Positive	Positive	Negative
General traffic outcomes	Positive	Positive	Positive
Construction and contractability	Negative	Negative	Negative
Environmental impact	Negative	Negative	Negative
Social factors	Neutral	Neutral	Neutral
RECOMMENDATIONS	PROCEED	PROCEED	DO NOT PROCEED

Table 6-14: Bilinga - long list assessment results

Option	Decision	Rationale
B1	PROCEED	This option was taken forward for the following reasons: ▪ improved PT accessibility for major land uses, replicating Route 700 but with faster travel times and less stops (all catchment still within 800m of LRT stops). ▪ road safety is potentially improved with increase in number of signalised crossings of Golden Four Drive at stations ▪ aligns with local planning with positioning Light Rail and associated with stations adjacent to land uses with the most significant uplift potential.
B2	PROCEED	This option was taken forward for the following reasons: ▪ improved PT accessibility for major land uses, replicating Route 700 but with faster travel times and less stops (all still within 800m of stops). ▪ aligns with local planning with positioning Light Rail and associated with stations adjacent to land uses with the most significant uplift potential.
B3	DO NOT PROCEED	This option was not taken forward due to the following reasons: ▪ reduced PT accessibility and access to land uses where Gold Coast Highway is a major barrier from LRT to the major land uses (medium density residential) located to the east of Gold Coast Highway. This impairs PT accessibility to/from its catchment in comparison to existing.

6.5.2 Airport

Table 6-15 to Table 6-18 summarise the results of the assessment of the long list alignment options in the airport. The assessment identified two LRT alignment options, AS2+R1+AN1 and AS3+R2+AN1, to be progressed as the shortlisted alignment options for further refinement to undertake comparative assessments for the MCA. Refer to Appendix D for the detailed commentary associated with the scoring.

Table 6-15: Heavy rail alignment option 1 – closer to Gold Coast Highway - long list assessment scoring

Category	AS1+R1+AN1	AS1+R1+AN2	AS2+R1+AN1	AS3+R1+AN1	AS4+R1+AN1
Cost	Very Positive	Negative	Positive	Negative	Very Negative
Public transport outcomes	Very Negative	Positive	Very Positive	Positive	Very Negative
Active transport outcomes	Positive	Positive	Positive	Positive	Positive
General traffic outcomes	Very Positive	Very Negative	Very Positive	Positive	Positive
Construction and contractability	Very Negative	Very Negative	Negative	Very Negative	Negative
Environmental impact	Very Negative	Very Negative	Very Negative	Negative	Negative
Social factors	Neutral	Neutral	Neutral	Neutral	Neutral
RECOMMENDATIONS	DO NOT PROCEED	DO NOT PROCEED	PROCEED	DO NOT PROCEED	DO NOT PROCEED

Table 6-16: Heavy rail alignment option 2 – closer to airport - long list assessment scoring

Category	AS1+R2+AN3	AS2+R2+AN3	AS3+R2+AN1	AS4+R2+AN1
Cost	Negative	Negative	Very Positive	Very Negative
Public transport outcomes	Neutral	Neutral	Very Positive	Negative
Active transport outcomes	Positive	Positive	Positive	Positive
General traffic outcomes	Very Negative	Very Positive	Positive	Positive
Construction and contractability	Very Negative	Negative	Very Negative	Negative
Environmental impact	Very Negative	Very Negative	Negative	Negative
Social factors	Fatal Flaw	Fatal Flaw	Neutral	Neutral
RECOMMENDATIONS	DO NOT PROCEED	DO NOT PROCEED	PROCEED	DO NOT PROCEED

Table 6-17: Airport long list assessment results – heavy rail alignment option 1 – closer to Gold Coast Highway

Option	Decision	Rationale
AS1+R1+AN1	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ due to lack of PT accessibility from airport to station (longest walking distance out of all alignment options) ▪ due to proximity to residences on the east of Gold Coast Highway and with LRT located along Gold Coast Highway, traffic management and community disruption would create significant impacts.
AS1+R1+AN2	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ LRT crosses Gold Coast Highway twice which would significantly impact highway capacity and travel time along Gold Coast Highway in both directions.

Option	Decision	Rationale
AS2+R1+AN1 (now known as A2)	PROCEED	This option was taken forward for the following reasons: ▪ Option on the outer extents of airport land with less impact (compared to other AS options) to internal airport roads. Light Rail distance is 1.53km so more direct and faster for through trips with lower operating and capital cost than other options. ▪ LRT crosses Gold Coast Highway at Terminal Drive which will run at the same time as the dominant southbound right turn into the airport, so capacity is retained, and safety improved. LRT then runs along the outer extent of the airport, avoiding impact to the internal roads.
AS3+R1+AN1	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ crosses Gold Coast Highway once at Terminal Drive but requires significant construction of existing airport land. To be taken into consideration during Airport Master Plan to manage construction risks.
AS4+R1+AN1	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ Longest Light Rail distance of 2.27km, and longest route through the airport owned land, therefore highest operating and capital cost.

Table 6-18: Airport long list assessment results – heavy rail alignment option 2 – closer to airport terminal

Option	Decision	Rationale
AS1+R2+AN3	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ Due to security, traffic and pedestrian safety concerns associated with a Light Rail in close proximity to airport terminal that will not be accepted by Gold Coast Airport. This is considered a fatal flaw based on feedback from Queensland Airports Limited.
AS2+R2+AN3	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ Due to security, traffic and pedestrian safety concerns associated with a Light Rail in close proximity to airport terminal that will not be accepted by Gold Coast Airport. This is considered a fatal flaw based on feedback from Queensland Airports Limited.
AS3+R2+AN1 (now known as A1)	PROCEED	This option was taken forward for the following reasons: ▪ LRT distance is approximately 1.72km, shortest distance so lowest operating and capital cost. ▪ LRT crosses Gold Coast Highway at Terminal Drive which will run at the same time as the dominant southbound right turn into airport, so capacity is retained, and safety improved. LRT then runs along the outer extent of the airport, avoiding impact to the internal roads. ▪ Proximity to airport terminal for convenient customer access compared to highway alignment
AS4+R2+AN1	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ Longest Light Rail distance of 2.28km, and longest route through the airport owned land, therefore highest operating and capital cost.

6.5.3 Kirra

Table 6-19 and Table 6-22 summarises the results of the assessment of the alignment options in Kirra. Alignment options K2 and K3 were taken forward as the shortlisted alignment options for further refinement and MCA. Refer to Appendix D for the detailed commentary associated with the scoring.

Table 6-19: Kirra – long list alignment option assessment scoring

Category	K1 - Musgrave St / Marine Pde	K2 - Musgrave St / tunnel	K3 - Coolangatta Rd / cutting	K4 - Coolangatta Rd / Tweed St (tunnel)	K5 - Winston Street
Cost	Very Negative	Very Negative	Negative	Very Negative	Very Negative
Land use planning	Positive	Positive	Very Positive	Very Positive	Very Positive
Public transport outcomes	Neutral	Neutral	Very Positive	Positive	Neutral
Active transport outcomes	Negative	Negative	Very Positive	Positive	Neutral
General traffic outcomes	Fatal Flaw	Positive	Positive	Positive	Negative
Construction and contractability	Very Negative	Very Negative	Neutral	Very Negative	Very Negative
Environmental impact	Very Negative	Negative	Negative	Very Negative	Very Negative
Social factors	Fatal Flaw	Negative	Neutral	Neutral	Neutral
RECOMMENDATIONS	DO NOT PROCEED	PROCEED	PROCEED	DO NOT PROCEED	DO NOT PROCEED

Table 6-20: Kirra long list alignment options assessment results

Option	Decision	Rationale
K1 - Musgrave St / Marine Pde	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ requires complete removal of traffic lanes along Marine Parade and if lanes were retained, addition of structures over water or retaining the hill is likely to be a fatal flaw in terms of cost and/or visual impact.
K2 - Musgrave St / tunnel	PROCEED	This option was taken forward for the following reasons: ▪ aligns with the underlying current land use and density mix which is orientated towards the foreshore, and opportunity to generate significant precinct enhancements (urban realm upgrades) ▪ close proximity to beach ▪ improved PT accessibility with reduced travel times to/from Coolangatta.
K3 - Coolangatta Rd / cutting	PROCEED	This option was taken forward for the following reasons: ▪ alignment with the local planning by introducing opportunities for activating and stimulating land use growth away from the foreshore ▪ better catchment (i.e., larger number of people within 800m catchment of frequent PT) ▪ minimal impacts to retail and commercial land uses during construction and operation (due to distance from the main activity centres). ▪ Catchment is located on both sides of alignment, compared to K1/K2 that limits catchment to one side given proximity to beach.
K4 - Coolangatta Rd / Tweed St (tunnel)	DO NOT PROCEED	This option was not taken forward due to significant cost associated with a tunnel and construction risks/ impacts (in terms of amenity impacts, PUP risks and geotechnical risks)
K5 – Winston Street	DO NOT PROCEED	This option was not taken forward due to significant cost associated with construction of drainage infrastructure needed for the corridor and associated construction risks/ impacts. This option also significantly impacts on local residences along corridor creating disruption to the community. It is also a slower and more circuitous route.

6.5.4 Coolangatta

Table 6-21 and Table 6-22 summarises the results of the assessment of the alignment options in Coolangatta. Option C2 and C3 are taken forward as the shortlisted alignment options for further refinement and MCA. Refer to Appendix D for the detailed commentary associated with the scoring.

Table 6-21: Coolangatta – long list alignment options assessment scoring

Category	C1 - Marine Parade	C2 - Griffith Street	C3 - Chalk Street	C4 - Tweed St / Goodwin Park / Chalk St
Cost	Very Negative	Very Negative	Negative	Fatal Flaw
Land use planning	Very Positive	Very Positive	Very Positive	Neutral
Public transport outcomes	Very Negative	Neutral	Very Positive	Negative
Active transport outcomes	Negative	Negative	Neutral	Neutral
General traffic outcomes	Very Negative	Negative	Neutral	Very Negative
Construction and contractability	Very Negative	Very Negative	Negative	Fatal Flaw
Environmental impact	Very Negative	Very Negative	Negative	Very Negative
Social factors	Very Negative	Very Negative	Neutral	Very Negative
RECOMMENDATIONS	DO NOT PROCEED	PROCEED	PROCEED	DO NOT PROCEED

Table 6-22: Coolangatta long list alignment option assessment results

Option	Decision	Rationale
C1 - Marine Parade	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ reduction in road capacity (from two lanes to one lane) shifting traffic to Griffith Street or Lanham Street. ▪ implications for events which currently rely on the temporary closure of Marine Parade for festivals etc ▪ Light Rail track impacting the visual amenity of the beach location, changing the beach character of Marine Parade. ▪ reduced number of people within walk up catchment, compared to existing buses on Griffith Street
C2 - Griffith Street	PROCEED	This option was taken forward for the following reasons: ▪ alignment with local planning aspirations by introducing opportunities for precinct enhancements. ▪ close proximity to beach ▪ consistent with current high frequency bus route and bus stop location ▪ road safety is improved with speeds reduced to 40km/hr complementing the pedestrian activity of the road.
C3 - Chalk Street	PROCEED	This option was taken forward for the following reasons: ▪ alignment with local planning aspirations by introducing opportunities for precinct enhancements. ▪ minimal impacts to retail and commercial land uses during construction and operation (due to locations just behind the main retail high street). ▪ increases PT catchment (including a greater number of land uses to the south). PT travel time reduces from existing with shorter LRT travel distance and better geometry (higher operating speeds) compared to existing bus routes.

Option	Decision	Rationale
C4 - Tweed St / Goodwin Park / Chalk St	DO NOT PROCEED	This option was not taken forward for the following reasons: ▪ fatal flaw of Tweed Street gradients likely unsuitable for LRT especially at eastern end connecting to Goodwin Park. This would require extensive structures (cuttings/ tunnels) to overcome which is likely to cause unacceptable noise and access impacts during construction as well as being very high capital cost.

7. Shortlist option development and assessment

7.1 Shortlist option development

For those corridor options that passed through the longlist filter, they were then subject to further testing and refinement including:

- Different traffic access/ intersection configuration options
- Different LRT alignment options (within the selected corridor)
- Different station location options (within the applicable investigation areas)

Through this refinement stage, the team were able to identify technical risks/issues associated with certain designs which led to the development of sub options (further explained in the following chapters). The lane configurations and layouts at major intersections located in Bilinga, Kirra and the Airport were designed based on inputs from the Jacobs traffic team.

As the Bilinga and Kirra options involved changes to the Gold Coast Highway including modifications to side road access and rationalisation of certain movements, microsimulation modelling was undertaken to assess and refine options. The Aimsun mesoscopic model developed for the previous Burleigh Heads to Tugun Multi Modal Corridor Study (GCSAM_2041_20_400dz) was used to develop a high level 2041 microsimulation model. Refer to *IH140900-TP21-CT-RPT-0001* (Jacobs, 2020) for the original mesoscopic model assumptions. A detailed overview of the microsimulation modelling is located within the relevant corridor segment chapters throughout this report.

7.1.1 Bilinga shortlist option development

Alignment options within this section were refined based on a design/geometrical review of the Bilinga corridor and subsequent traffic modelling to undertake comparative assessments for the MCA. These refinements are described in the following sections of this report.

7.1.1.1 Route option development – geometric review

This process involved developing options regarding the connectivity between Gold Coast Highway and the parallel service roads of Golden Four Drive and Coolangatta Road noting that in either option B1 or B2, all currently uncontrolled movements across the Gold Coast Highway would need to be signal controlled.

High-level line diagrams were first developed to test different options for how sides roads could be connected to the Gold Coast Highway in order to balance intersection spacing, complexity, local access and circulation. It is noted that the designs include the shortlisted concept for LRT at Terminal Drive (as per the Airport section). The sub options developed within the Bilinga section included:

Parallel Lane Option (relevant to B1 only)

- Three unsignalised T-intersections between Boyd Street and Kirribin Street. Includes three access point from Golden Four Drive and two access points from Coolangatta Road.
- Two signalised T-intersections at Loongana Avenue. Proposed separated parallel lane from Golden Four Drive that at intersection allows traffic to u-turn or to merge with Gold Coast Highway.

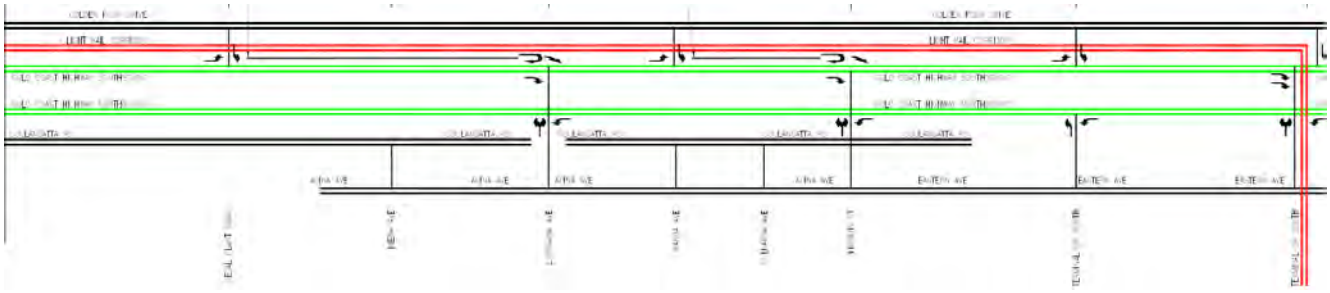


Figure 7-1: Parallel Lane option

Consolidated intersection option (refer Figure 7-2)

- Full signalised intersection at Loongana Avenue – with all movement access from Loongana Avenue and Golden Four Drive.
- Limited access to Coolangatta Road to/from Loongana Avenue due to geometric constraints created by signalised intersection and allowing for left turn from Gold Coast Highway to Loongana Avenue.
- Emergency access only at Kirribin Street.
- Addition of left turn only from Golden Four Drive to Gold Coast Highway at Terminal Drive South.
- Removal of access from remaining side roads connected to Gold Coast Highway.

Staggered T intersections option (Figure 7-3):

- Alternative option designed to avoid a complex signalised intersection with five phases and to retain full movement access along Coolangatta Road.
- Staggered T- intersections at the at Gold Coast Highway with Golden Four Drive (requiring removal of access from Loongana Avenue) and a T-intersection at Kirribin Street with Coolangatta Road (requiring the removal of access from Golden Four Drive although emergency access would be allowed).
- Addition of left turn only from Golden Four Drive to Gold Coast Highway at Terminal Drive South.
- Removal of access from remaining side roads connected to Gold Coast Highway.

The high-level line diagrams of these options were presented to TMR at Progress Meeting #12 - *IW251600-0000-ZM-MIN-0017* and of these the second and third sub options were selected to be taken forward for traffic modelling. The basis of this decision was to avoid significant delays on the Gold Coast Highway, by rationalising side road access to the main road and to minimise traffic re-routing through the local road network.

7.1.1.2 Traffic modelling - side road

The Consolidated Intersection option and the Staggered T-intersection option were modelled in a microsimulation model using the most recent version of the GCSAM 2041 model. The aim of this analysis was to understand, at a high level, the transport performance of the alternative side road designs and how they compare to each other. It was assumed for the purposes of this comparative analysis that the performance for the B1 alignment (eastern corridor) would be comparable as the B2 alignment (centre corridor) and therefore only B1 was modelled. It is noted that as part of this work, an indicative airport alignment option was adopted.

Figure 7-2 and Figure 7-3 illustrate the Aimsun interpretation of the options and detail any additional operational assumptions.

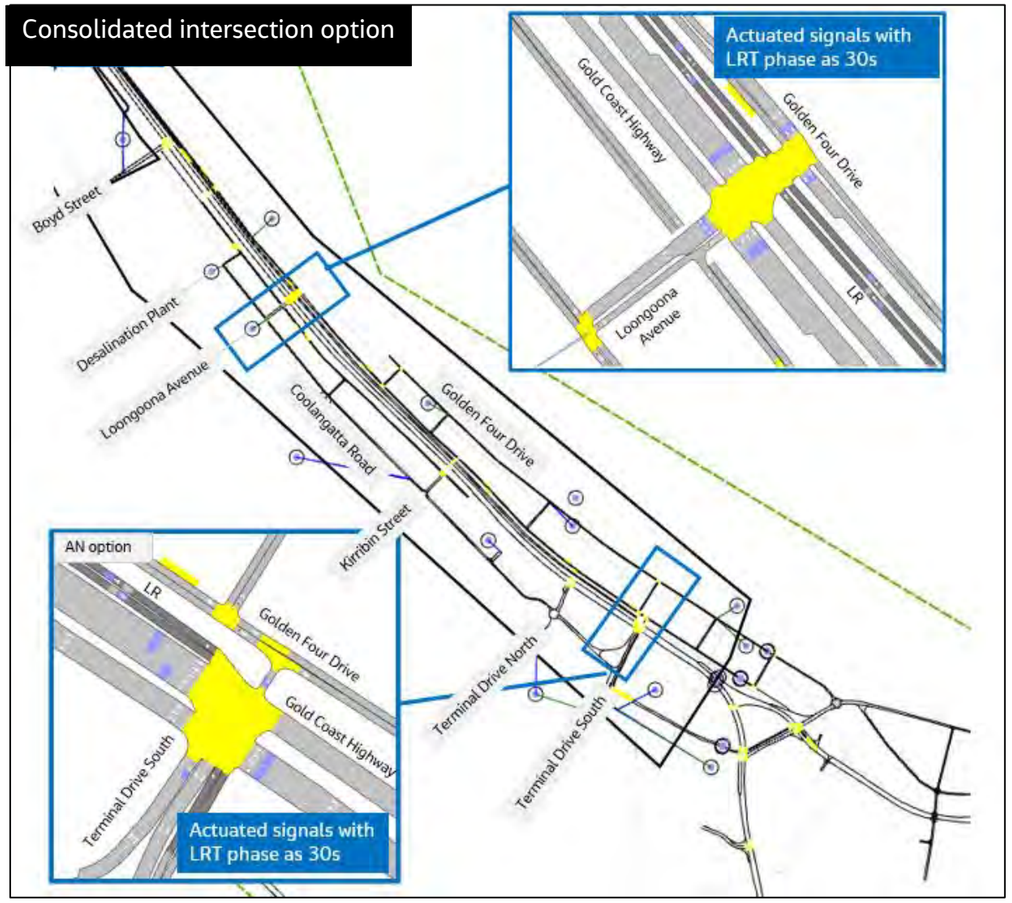


Figure 7-2: Modelled layout for consolidated intersection option (Source model - GCSAM,2019)

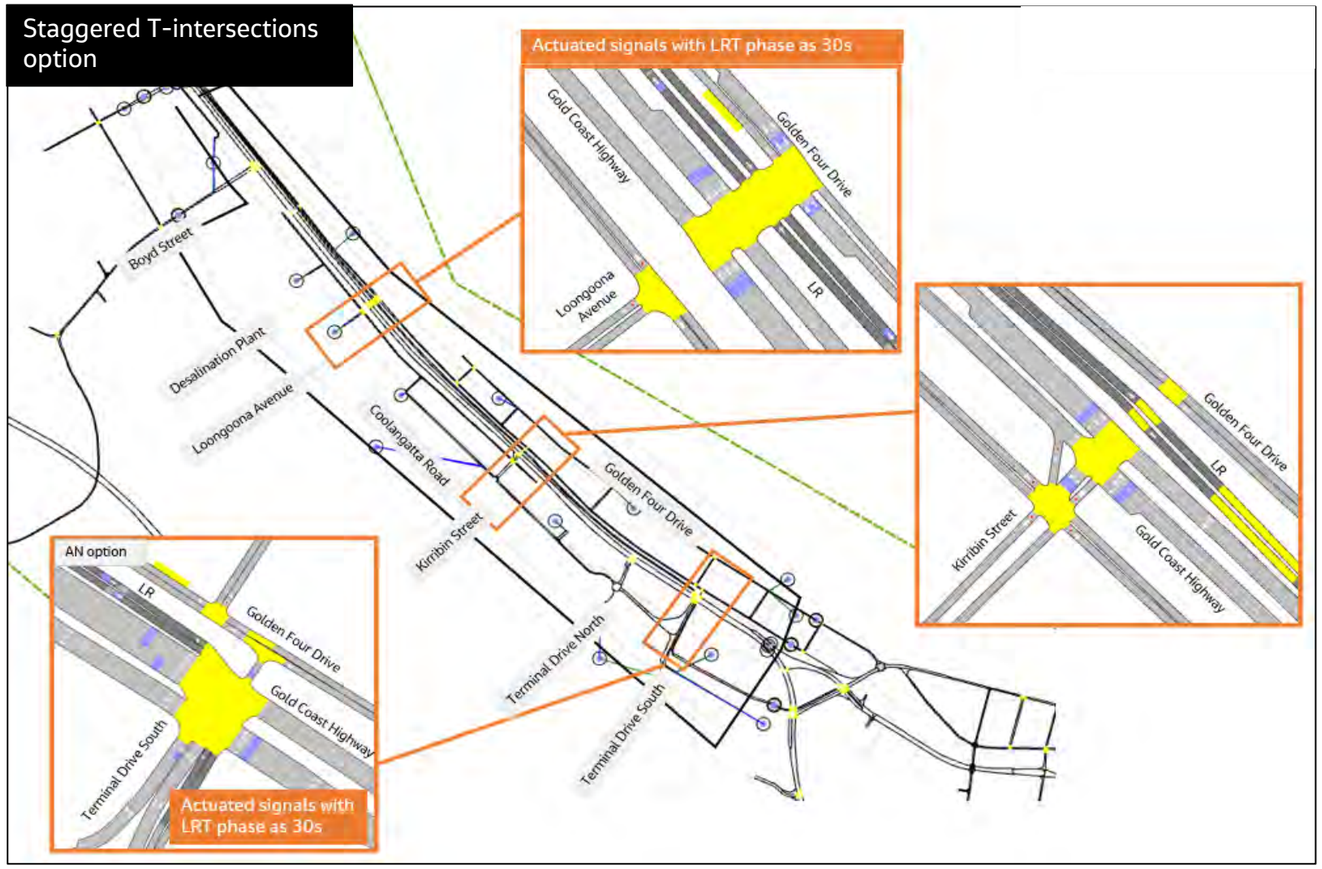


Figure 7-3: Modelled layout for Staggered T intersections options (Source model - GCSAM, 2019)

In determining the preferred sub-option, three transport metrics were analysed from the models and compared:

- Subnetwork density in both peak periods: In both peaks, the densities between the two options are comparable. There is approximately a maximum difference of 0.5veh/km between the options in both peak periods.
- Subnetwork speed: In the AM peak, average speeds range between 40km/hr to 48km/hr, with a maximum speed difference between options of approximately 2km/hr. In the PM peak, the Staggered T Intersections Option records a faster average speed for the majority of the peak period where speeds range between 25km/h to 47km/h.
- Gold Coast Highway mainline travel times (between Boyd Street to Terminal Drive South): In both peak periods, travel times along Gold Coast Highway is comparable between options with maximum travel time difference of approximately 1.5 minutes (with the Consolidated Intersection option performing better).

The travel time and speed results are expected given that with the Consolidated Intersection Option, the Gold Coast Highway traffic would only be stopped once at the Loongana Avenue intersection, compared to having to stop twice at both Loongana Avenue and Kirribin Street intersection with the alternate option. This however impedes the travel times for vehicles travelling to/from side roads and hence why, in the PM peak, the Staggered T Intersections Option performs better in terms of overall network speed. Therefore, as the results are comparable and Staggered T Intersections Option provides a better transport solution for both the mainline and side roads, and was chosen as the preferred side road access concept for both the B1 and B2 alignments. The refined shortlisted Bilinga alignment options (as B1-3 and B2-3), inclusive of the above access arrangements, were then taken forward to MCA.

7.1.1.3 Shortlisted alignment options

The figures on the following pages illustrate the shortlisted alignment options B1 and B2 used for this comparative MCA assessment.

7.1.1.4 Alignment Option B1-3 – east of Gold Coast Highway.

Figure 7-4 and Figure 7.4 illustrate the concept designs of B1-3.

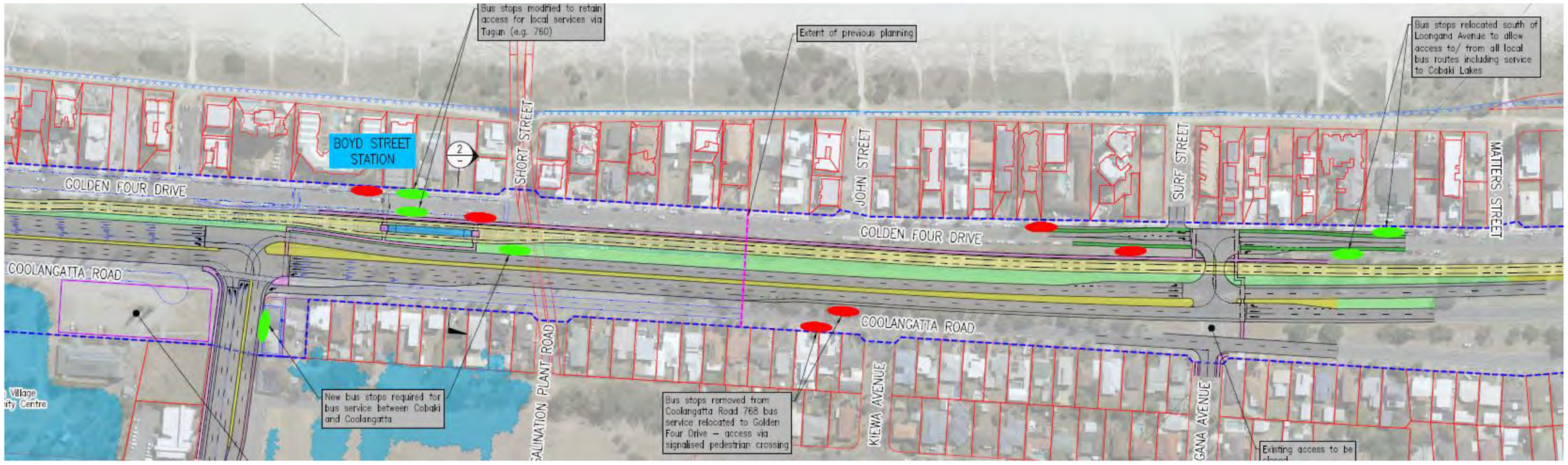


Figure 7-4: Alignment Option B1-3 design (between and including Boyd Street and Loongana Avenue)

Figure 7-5: Alignment Option B1-3 design (between Loongana Avenue and Terminal Drive)

7.1.1.5 Alignment Option B2-3 - centre of Gold Coast Highway

Figure 7-6 and Figure 7.6 illustrate the design of B2-3.

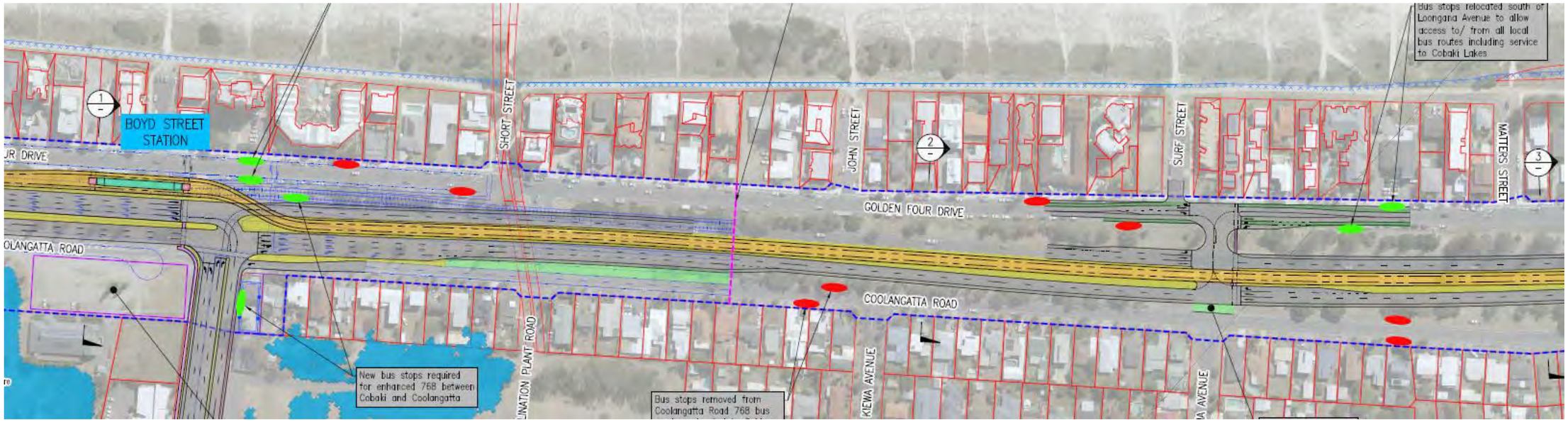


Figure 7-6: Alignment Option B2-3 design (between and including Boyd Street and Loongana Avenue)

Figure 7-7: Alignment Option B2-3 design (between and including Loongana Avenue and Terminal Drive)

7.1.2 Airport shortlisted options development

The intersection design proposed for Alignment Option AN1 was developed and tested in a microsimulation model as part of the traffic analysis undertaken for the Bilinga sub-options. Therefore, for the purposes of developing the shortlist alignment designs, the boundary between Bilinga and Airport zones was moved so that the airport alignment options now sit fully within the Gold Coast Airport land only. In addition, the boundary between Airport and Kirra was also moved so that the airport alignment options remain on airport land which means the alignment options for the Gold Coast Highway/ Coolangatta Highway/Musgrave Street are included in the Kirra section (see Section 7.1.3.1).

Therefore, only the LRT alignments within the airport, i.e., including Airport South (AS) along with the corresponding heavy rail alignment (R1/R2) were included in the design of the shortlisted airport alignment options. A high-level concept sketch of the shortlisted alignment options is illustrated in Figure 7-8. Please note that during this shortlist refinement, the airport alignment options were renamed, for simplicity, to the following:

- AS3+R2 became A1
- AS2+R1 became A2

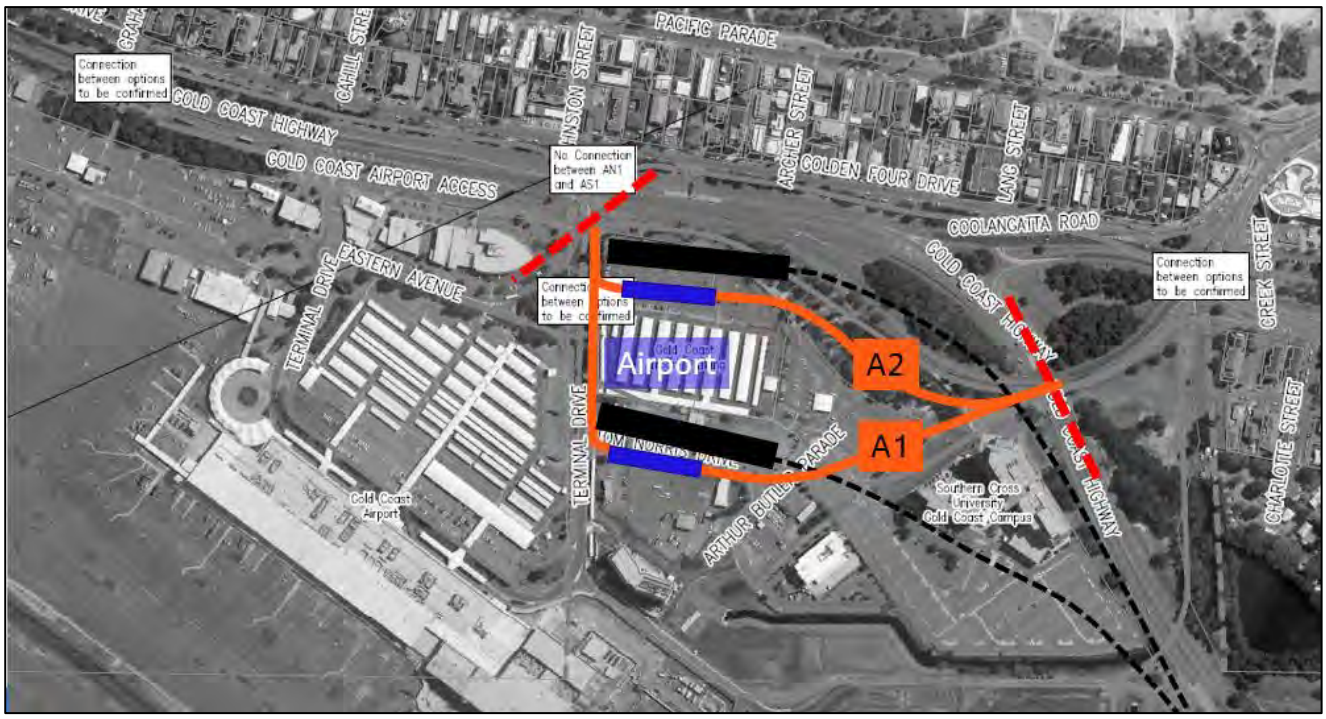


Figure 7-8: Airport short list alignment and station options – high level design (Aerial image: Metromap, 2020)

The following figures, Figure 7-9 and Figure 7-10 show the shortlisted alignment options A1 and A2 used for the comparative MCA assessment.

7.1.2.1 Alignment Option A1 (closer to Airport)

Figure 7-9 illustrates the concept design of A1-3.

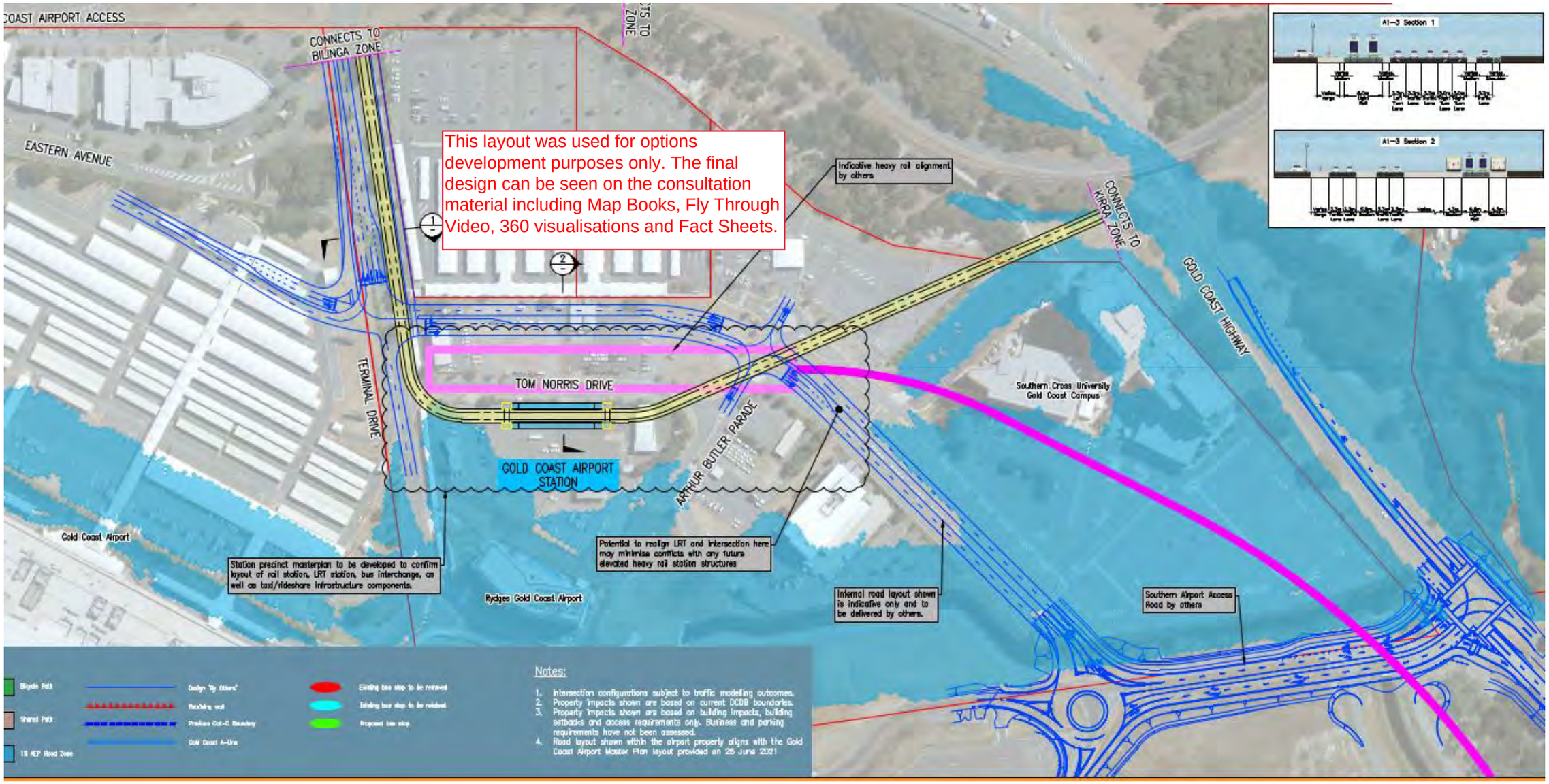


Figure 7-9: Alignment Option A1-3 design

7.1.2.2 Alignment Option A2 (closer to Gold Coast Highway)

Figure 7-10 illustrates the concept design of A2-3.

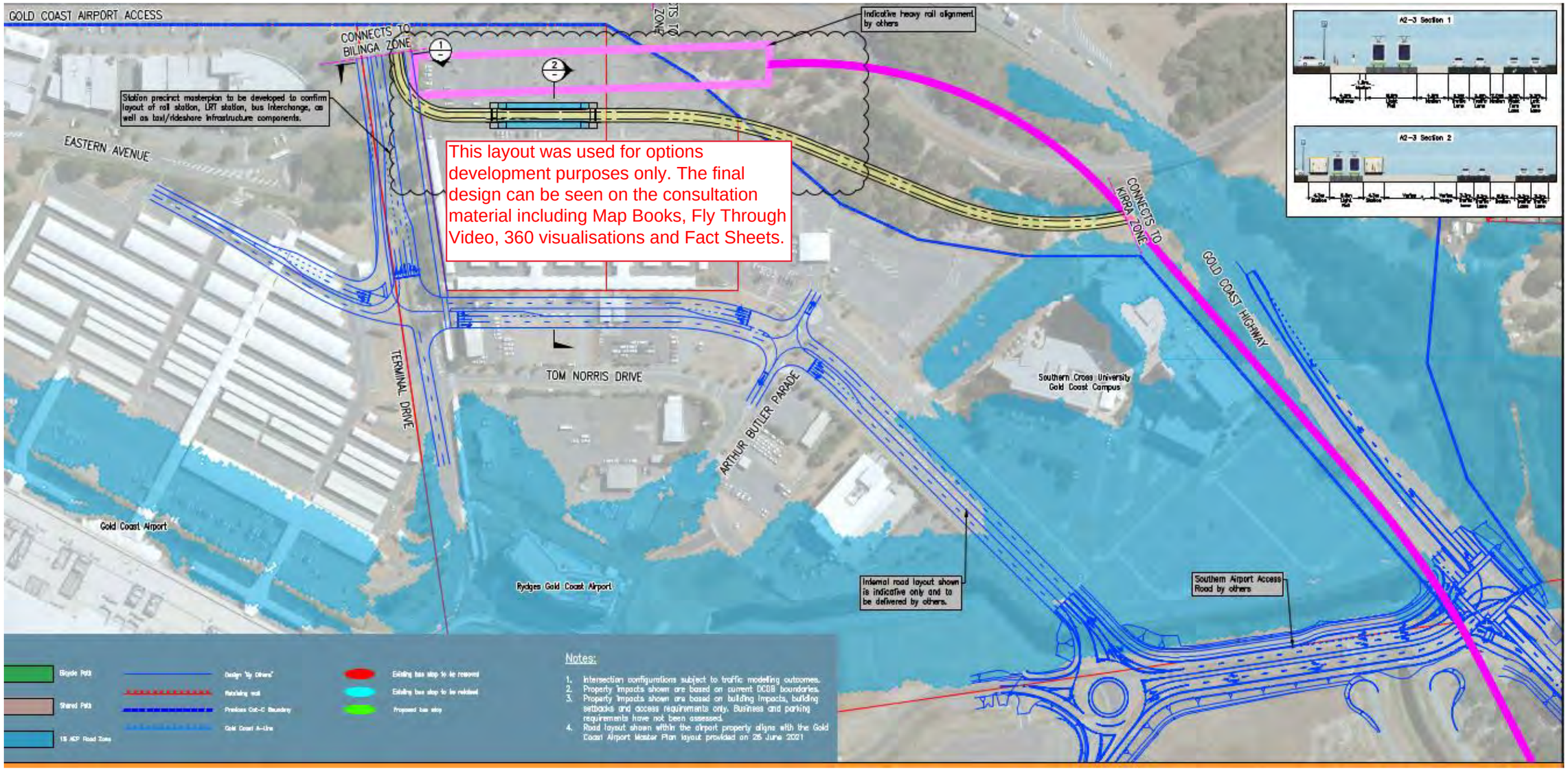


Figure 7-10: Alignment Option A2-3 design

7.1.3 Kirra shortlisted option development

As detailed above, the Kirra section was extended to include the intersections of Gold Coast Highway/ Musgrave Street / Coolangatta Road.

Options within this section were refined based on traffic modelling and a geotechnical structural review. These refinements are described in the following sections of this report.

7.1.3.1 Traffic modelling

Based on a high-level review a range of potential intersection configuration options for Gold Coast Highway / Musgrave Street / Coolangatta Road were identified with the primary aim to reduce delays, minimise footprint and improve safety. From this process, two intersection options were taken forward for a more detailed traffic analysis:

- Intersection Option 1 – Two T- intersections with the Gold Coast Highway with LRT located at the northern most intersection
- Intersection Option 2 - Single consolidated T-intersection with Gold Coast Highway enabling Coolangatta Road to connect directly with Golden Four Drive

These two options were modelled in a microsimulation model using the most recent version of the Gold Coast Southern Aimsun Model (GCSAM) 2041 model. The aim of this analysis was to understand, at a high level, the transport performance of potential options and how they compare to each other. The Aimsun layouts for the options are illustrated from Figure 7-11 to Figure 7-12. The same assumptions as the Bilinga analysis were adopted regarding Light Rail phasing and timing. For the purpose of this analysis, the GCSAM design of Light Rail connecting to Coolangatta Road was retained to create a like-for-like comparison.

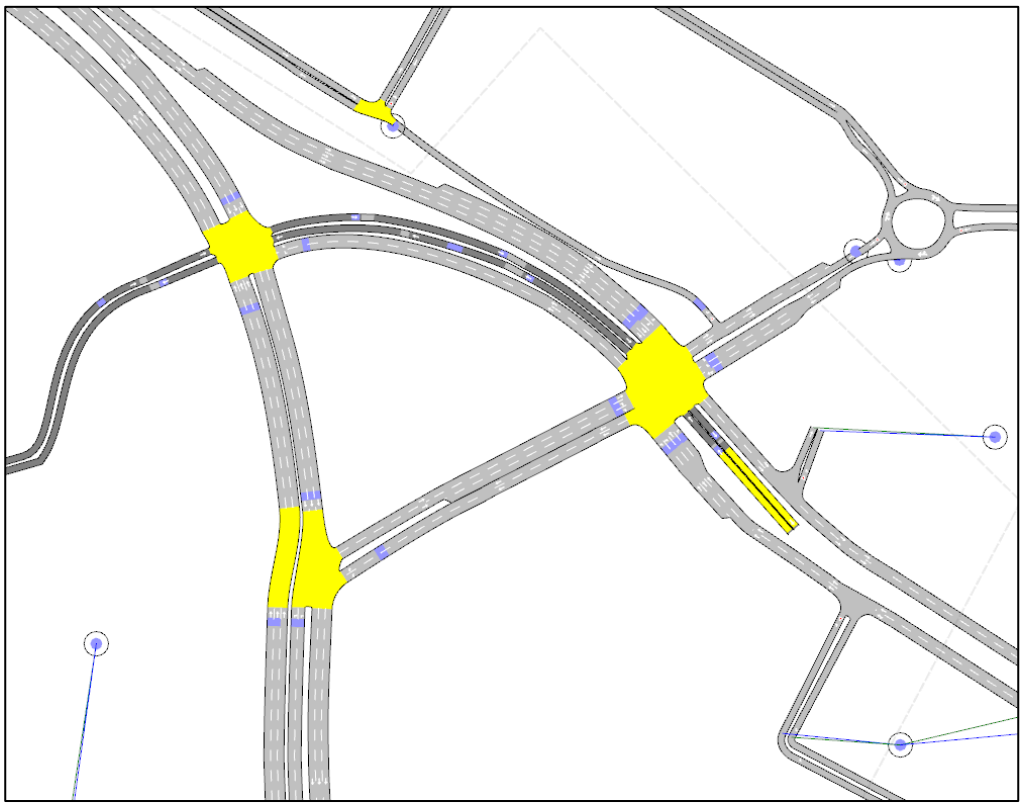


Figure 7-11: Intersection design option 1 - Aimsun layout

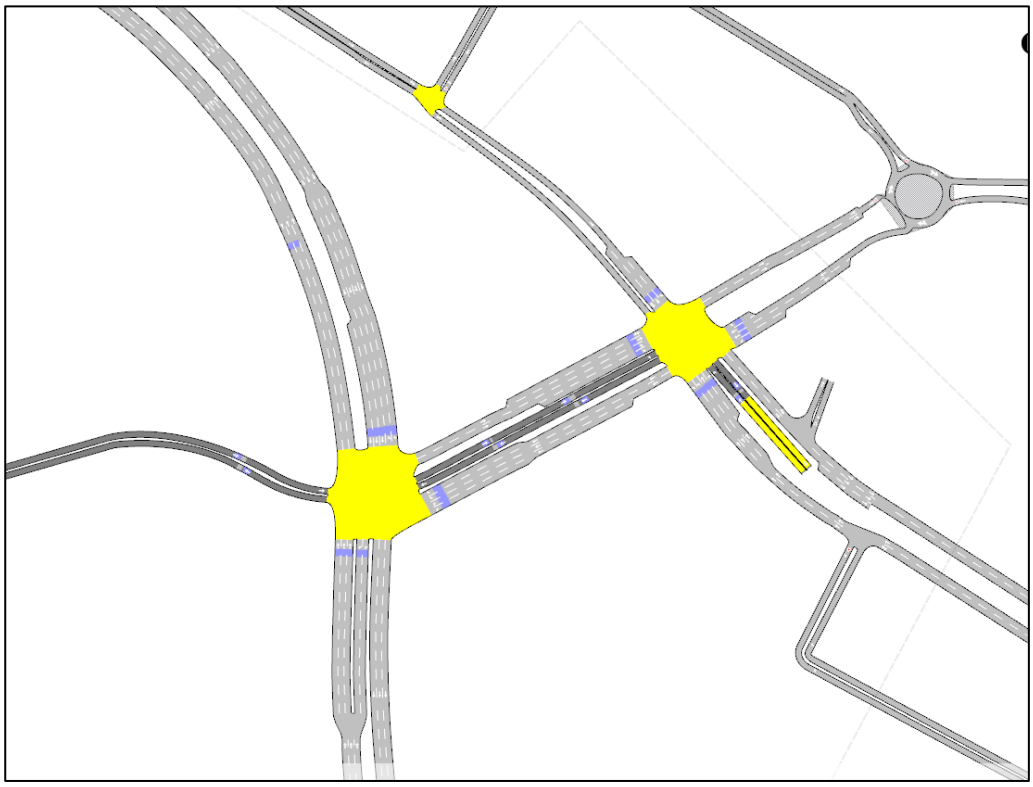


Figure 7-12: Intersection design option 2 - Aimsun layout

In determining the preferred intersection design, two transport metrics were analysed from the models and compared:

- Subnetwork density. In both peaks, the densities between intersection design option 1 and intersection design option 2 are comparable. There is approximately a maximum difference of 3 veh/km between sub options 1 and 2 in both peak periods.
- Subnetwork speed. In both peak periods, intersection design option 1 speeds are marginally faster than intersection design option 2, with a greater difference observed in the AM peak (maximum of a 7 veh/hr difference). Speeds range between 35km/hr to 45km/hr. This is due to the significant movement from Gold Coast Highway southbound turning left to Musgrave Street having to only pass one intersection in intersection design option 1 compared to two intersections in intersection design option 2. It was identified that there are opportunities to improve intersection design option 2 performance through signal coordination.

It was determined that the two intersection design options do not significantly differ in terms of traffic performance (with opportunities to improve intersection design option 2 performance even further). As such, a wider range of factors were considered including geometric design, local access, constructability, safety, cost and active transport provision. Overall, intersection design option 2 was identified as preferred as it provided better cycle lane and local traffic connectivity, created more residual space for potential Light Rail stabling and was likely to have lower cost due to smaller construction footprint. This design was then applied to both Kirra options (K2 and K3).

7.1.3.2 Geotechnical and structural review

The tunnel proposed as part of K2 was reviewed from a geotechnical and constructability perspective. The section of the route along Musgrave Street between Churchill Street in Kirra to McLean Street in Coolangatta traverses a steep highland area of coastline that includes unsuitable grades (exceeds max grade of 5%) for Light Rail on surface, therefore mined tunnel, cut-and-cover tunnel and retained cut sub-options were investigated.

Refer to Figure 7-13 for an overview of the alignment. The assessment of the corridor was undertaken through visual assessment of existing cuttings in the area and available background information.

Figure 7-13: Aerial plan layout of K2 (Aerial image: Metromap, 2020)

Key assumptions made and issues identified in this review are summarised below:

- The depth below existing road level to meet a desirable maximum 4.5 % grade (adopted based on slow approach from station stopped status noting that absolute maximum grades of 6% to 8% can be achieved for short lengths when entered at speed). To meet the requirement, Light Rail would require a depth of cut or tunnel alignment up to 14m below ground level
- The Light Rail is dual track and would require a base dimension of in the order of 8m wide excluding provision for emergency egress of between 2 to 4m
- Construction options must take into consideration how to maintain access to the existing residential properties which includes some multistorey apartment blocks that directly access Musgrave Street
- Access to associated intersecting roads (e.g., Garrick Street) should be maintained
- Any construction is to limit impacts to existing infrastructure (street furniture, above or below ground utilities, buildings, retaining walls) and impacts to the existing road formation should be minimised to ensure no major adverse effects in consideration of their present state
- Any construction impacts are to be offset through appropriate temporary or permanent measures
- Adverse community aspects of the construction (apart from access) should be minimised as far as practically possible (e.g., noise, dust, fumes etc.)

Important information that needs to be considered in assessing construction options include:

- Musgrave Street corridor is relatively narrow (typically 15-20m between property boundaries) so there are a number of difficulties with available space to cater for all the assumptions above.
- Musgrave Street traverses a steep hill (19% grade), and no subsurface information is currently available however a steep hill suggests that competent rock may be relatively close to the existing ground surface
- A review of Street View of Google Maps suggests some of the lot boundary boulder retaining walls have significant signs of instability, plus there are some notable cracks in the existing road surface.

As a result of the above high level site analysis, two clear option themes have emerged, namely a driven/ bored tunnel option and a retained cut (with optional 'cover') option.

7.1.3.2.1 Construction option 1: tunnel

The tunnel option involves development of a tunnel portal, tunnel entrance, and subsequently driving a tunnel under the surface using a tunnel boring machine (TBM) or road header type. By comparison, cut and cover construction (refer Option 2) involves using excavation equipment to dig a large trench in the ground that is then covered by a deck and in this situation road access.

Tunnelling options under this option theme include:

- Driven and Boring: The tunnel drive is short at approximately 300m long and would have significant construction costs. Construction would require a large tunnel envelope that is not viable for a tunnel boring machine (TBM) due to the lack of drive length and available space.
- Drill and blast: this technique is not viable based on the medium to high probability of risk of damage to nearby properties, utilities, street furniture and public perception of noise and vibration impacts.
- Roadheader: may be restricted to using a roadheader, but uncertainty exists on availability of good rock cover to tunnel crown. i.e., if insufficient competent rock exists then stability of tunnel is a potential issue and may result in crown hole or trough development at the surface (possibly instantaneously with the result that the road drops into the tunnel &/or the buildings are badly damaged creating a risk to life etc.). If the rock cover is sufficient, then the rock could be too strong for excavation. If the rock strength is >100 MPa, the rock becomes uneconomic to mine at an acceptable rate of progress.

Spoil management

Tunnel spoil management would be extremely problematic with traffic management at either end in high activity areas or may have to be transported to landfill

Constructability requirements

Tunnel portals could be in Musgrave Street or adjacent properties with a tunnel running parallel to Musgrave Street. The width of Musgrave St will require acquisition of multiple commercial/residential properties adjacent to the tunnel to space proof for portals, storage and to maintain property access.

There is insufficient space in Musgrave Street at present to fit in tunnel portals and maintain access to residential properties

Potential advantages

The tunnel option could potentially allow minimisation of future issues for road and community access, that is, once constructed the space over the tunnel could be available for access.

7.1.3.2.2 Construction option 2: cut-and-cover or retaining wall

Cut and cover construction involves using excavation equipment to dig a large trench (approx. 12 m wide at base to allow rail, emergency/maintenance access, excluding structural side supports, soil nails/rock bolts or anchors beyond this zone) in the ground that is then covered by a deck and in this situation possibly reinstated road access. The retaining wall option is included as it is a similar excavation but has no deck or roof and remains open.

Construction options include:

Cut-and-cover: A 10-12 m wide base dimension cut with up to a 14m deep cut is a substantial hole in the ground with high safety risk to constructors and the public. Width of excavation even with a vertical retaining structure system could be extremely difficult to achieve without detrimental effects to adjacent roads, residential properties and utilities. Potentially a red flag, i.e. as for the tunnelling option this could require acquisition of residential properties on one side of the road for space requirements

Retaining wall: would be extremely expensive to install a retaining structure that would guarantee no adverse impacts during construction and operation of the Light Rail to the directly adjacent properties and utilities. A

likely option would be bored pile wall (contiguous, soldier pile with panel or secant, diaphragm walls would be more expensive) and high noise and limited space issues for construction would be difficult to manage.

Spoil management

Retaining structure and associated excavations to form the rail corridor will have greater spoil volumes than tunnelling, so spoil management handling, transfer and disposal would be worse than the tunnel option.

Constructability requirements

Even though the excavation could be staged (by chainage) with perhaps the use of temporary soldier piles with a steel deck to provide access onto Musgrave Street from the residential properties, it would be extremely expensive and have severe impacts on construction productivity and in terms of construction progress (i.e. would take a long time to construct and accordingly would be expensive).

Potential advantages

It is considered that a cut and cover approach as identified above would be technically simpler and therefore more desirable than a tunnel, based on the short 600m section and at this level, the lack of detailed geotechnical or construction methodology information.

7.1.3.2.3 Assessment findings

Overall, this review found that both options for delivering a suitably graded LRT alignment on the Musgrave Street corridor between Churchill Street, Kirra and McLean Street, Coolangatta would result in significant physical and social impacts. Due to the spatial requirements for construction, there would be significant property acquisition and issues around impacts to existing infrastructure, being utilities and retaining walls, and maintaining property access. The section of Musgrave Street includes multiple multi-storey apartment dwellings and mid-block access to Rutledge Street and Robinson Lane.

Without further detailed investigations, the exact impacts cannot be known. However, this assessment has identified prohibitively high costs, significant disruptions to the local area and access impacts to a large number of properties.

It is recommended that alternative route be considered. Based on this assessment, and in agreement with TMR, K2 was amended east of Miles Street to follow the same alignment as K3 (i.e., with both options travelling via the former heavy rail alignment through the cutting between Miles Street, Kirra and McLean Street, Coolangatta).

7.1.3.3 Shortlisted alignment options

A high-level concept sketch of the Kirra shortlisted alignment options is illustrated in Figure 7-14. Existing bus stops on Musgrave Street/ Marine Parade are assumed to be used by tram replacement bus services under all Kirra options.

Figure 7-14: Kirra short list alignment and station options – high level design (Aerial image: Metromap, 2020)

The following figures, Figure 7-15 and Figure 7-16 show the shortlisted alignment options K2 and K3 used for the comparative MCA assessment.

7.1.3.3.1 Alignment Option K2 – Musgrave Street / cutting

Figure 7-15 illustrates the concept design of K2-2.

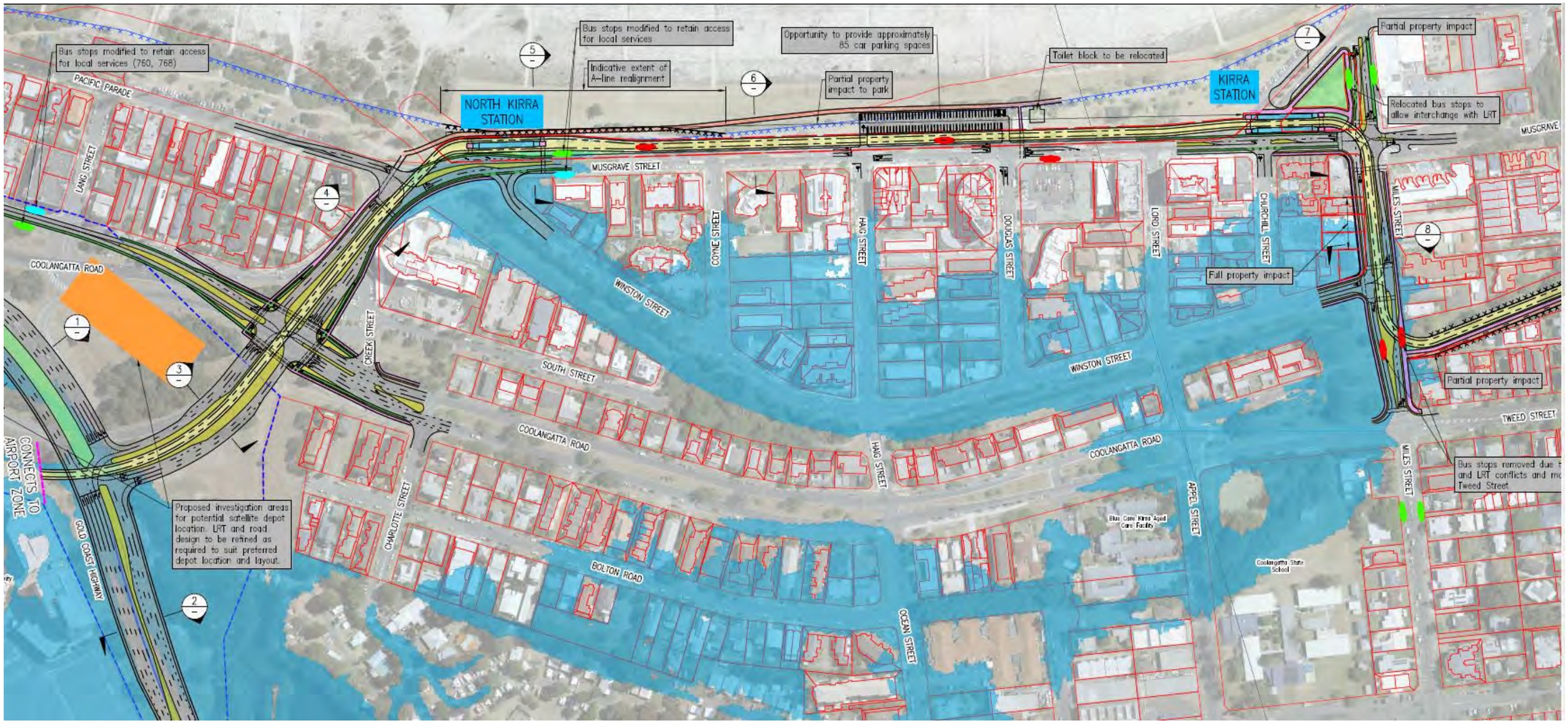


Figure 7-15: Alignment Option K2-2 design

7.1.3.3.2 Alignment Option K3 – Coolangatta Road / cutting

Figure 7-16 illustrates the concept design of K3-2.

Figure 7-16: Alignment Option K3-2 design

7.1.4 Coolangatta shortlist option development

McLean Street / Lanham Street/ Chalk Street / Griffith Street intersections were refined based on a review of existing count data and 2041 volumes from the Gold Coast Highway (Burleigh to Tugun) MMCS Aimsun 2041 Model. These volumes were used to understand the magnitude of intersection volumes and dominant movements. This initial traffic and geometric analysis informed the following major changes to the existing situation that is consistent with both shortlisted alignment options, however, it is intended to be reviewed once the preferred alignment option is identified:

With both Light Rail options travelling through the rail cutting to McLean Street, the signalisation of McLean Street and the LRT crossing was required. Due to the number of intersections in close proximity to the Light Rail, the following design changes were undertaken:

- C2 - to reduce intersection complexity and improve capacity was to convert Lanham Street (west) to a cul-de-sac. Access from McLean Street (south), Lanham Street (east), Musgrave Street and McLean Street north were retained.
- C3 – with LRT travelling along Chalk Street, the left turn from McLean Street to Chalk Street was signalised, and McLean Street (south) and Lanham Street (east) access was removed from the signalised intersection.
- Signalisation of the Griffith Street / McLean Street roundabout. This was adopted due to the close proximity of the Light Rail intersection and the potential risk of vehicles queueing at the roundabout, extending back to the Light Rail intersection, creating significant safety concerns.

A high-level concept sketch of the Coolangatta shortlisted alignment options is illustrated in Figure 7-17.

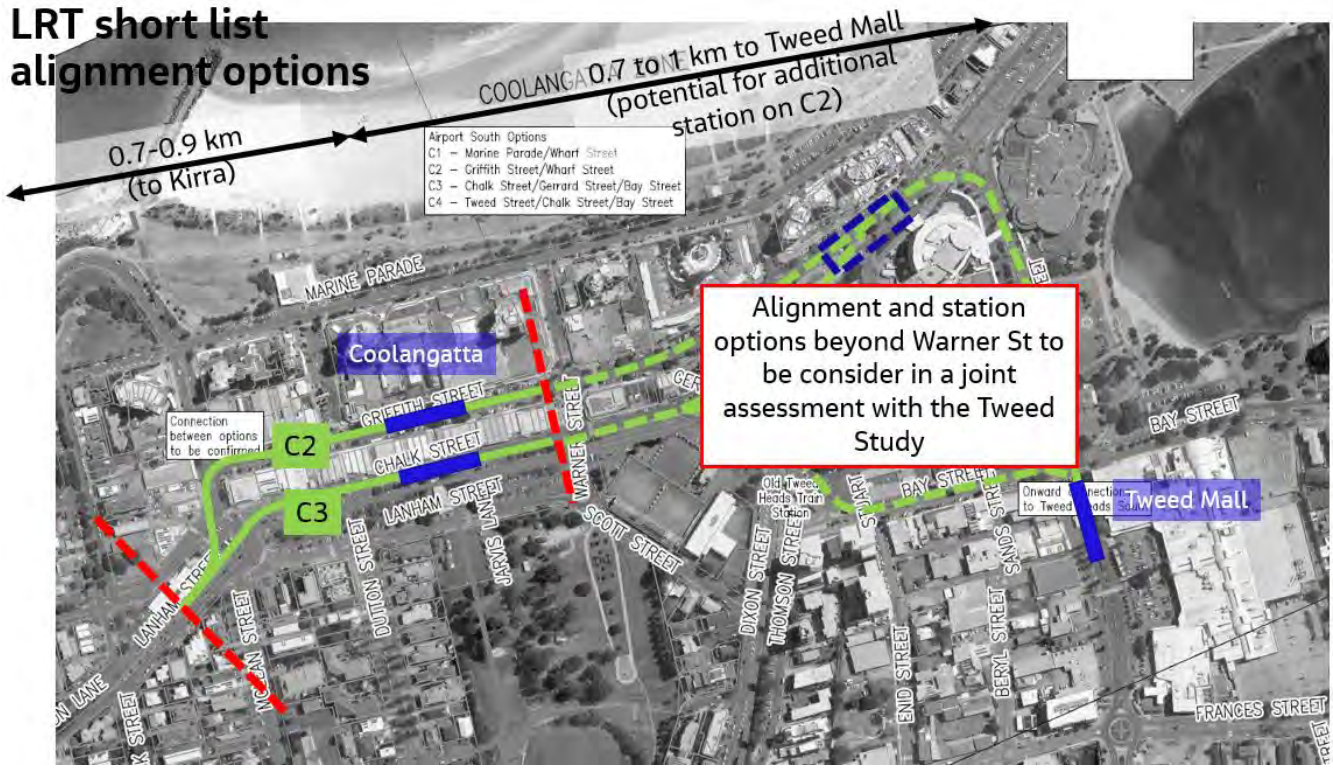


Figure 7-17: Coolangatta short list alignment and station options – high level design (Aerial image: Metromap, 2020)

The following figures, Figure 7-18 and Figure 7-19 show the shortlisted alignment options K2 and K3 used for the comparative MCA assessment.

7.1.4.1 Alignment Option C2 – Griffith Street

Figure 7-18 illustrates the concept design of C2-2.

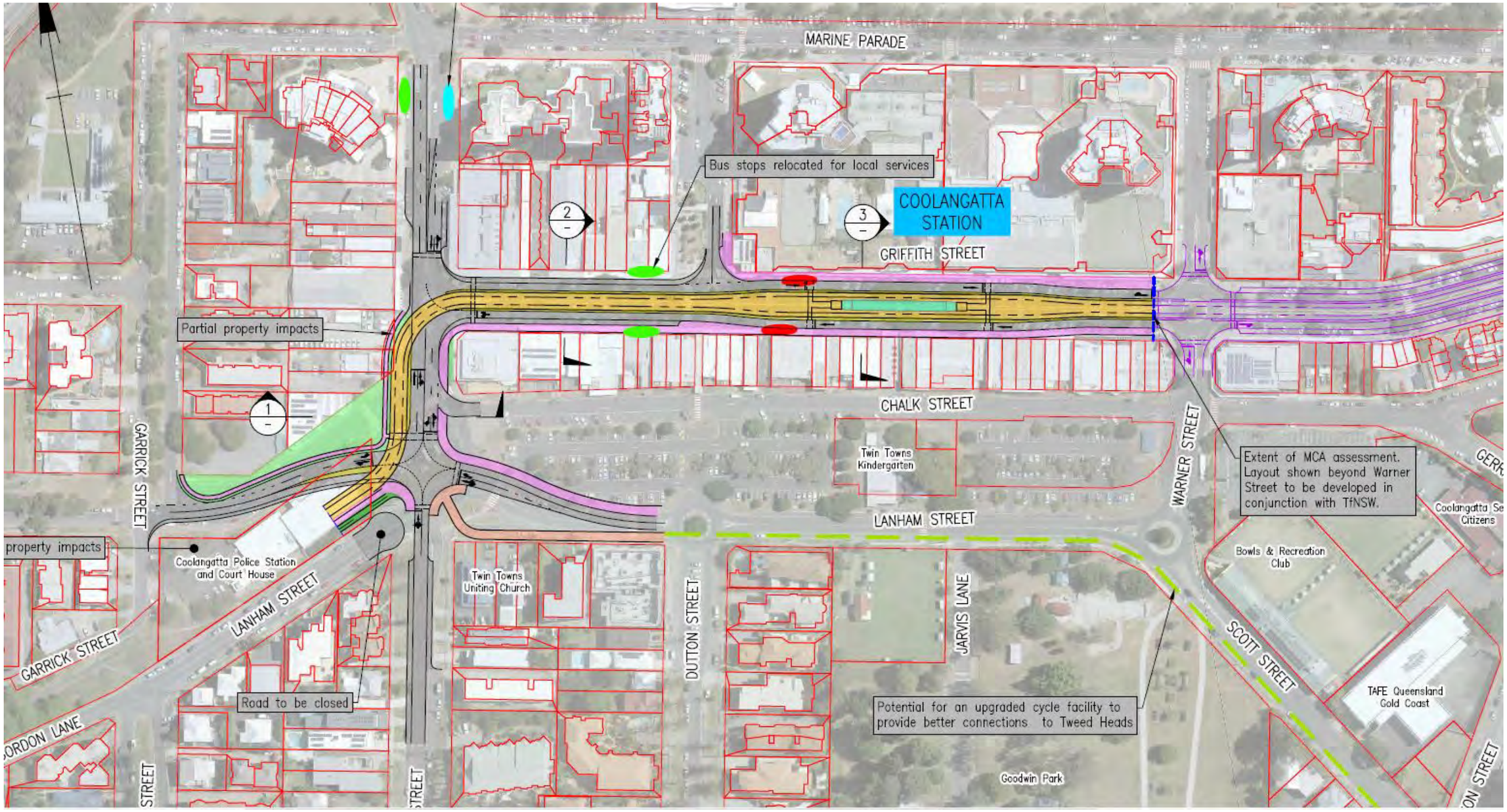


Figure 7-18: Alignment Option C2-2 design

7.1.4.2 Alignment Option C3 – Chalk Street

Figure 7-19 illustrates the concept design of C3-1.

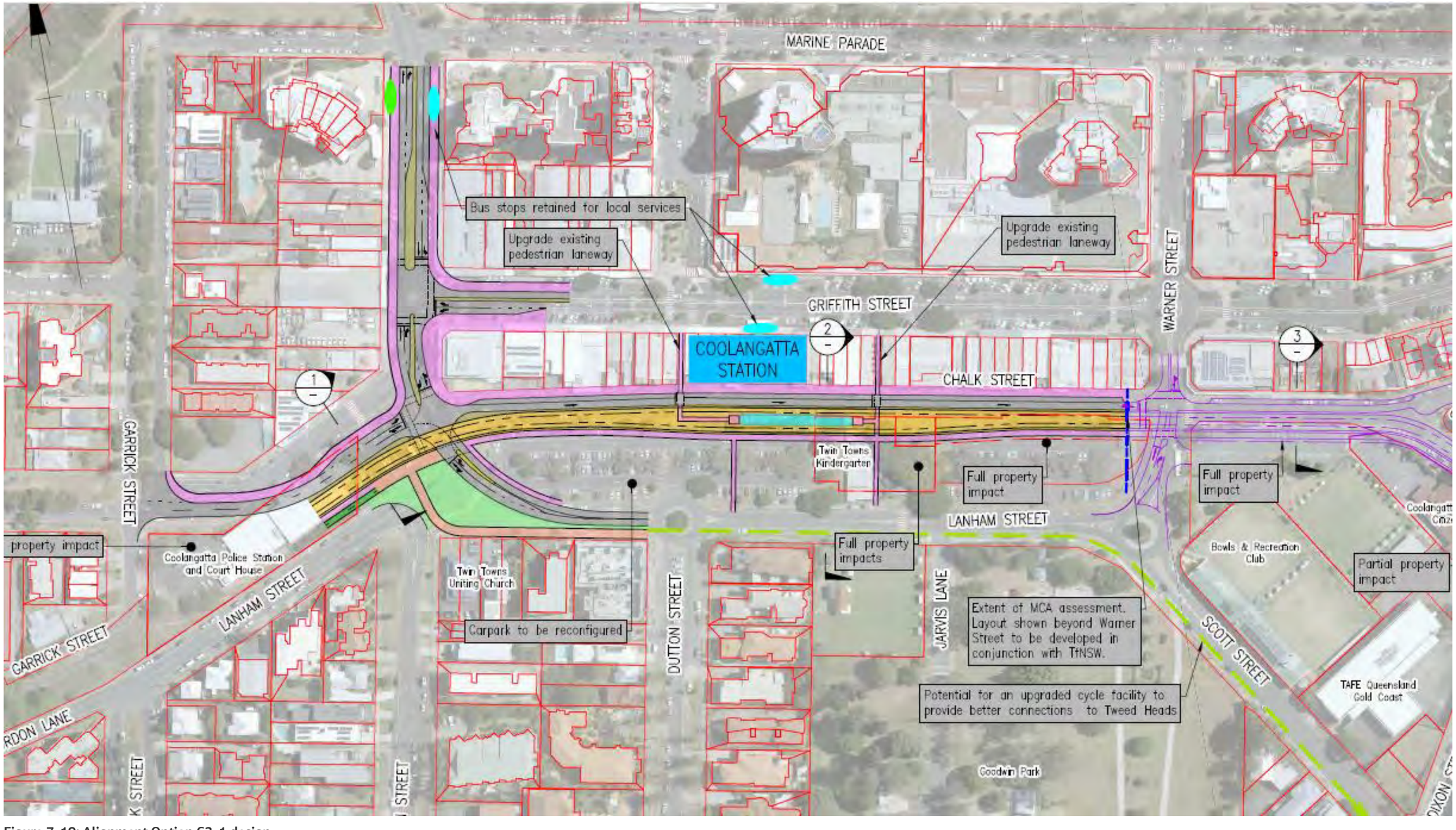


Figure 7-19: Alignment Option C3-1 design

7.2 Assessment framework

To determine the preferred corridor alignment for further investigation and refinement, comparable assessments of the short-listed alignment options using a multi-criteria analysis (MCA) was undertaken. The concept alignment options represent indicative options only and are subject to change with further analysis and feedback from key stakeholders.

Each alignment option provides a reasonable level of confidence to make comparative assessment between each option to determine their likely performance and outcomes with some flexibility. Station locations are also indicative only. All options assessed are flexible, however the concept option intent will remain.

The MCA framework has been developed in conjunction with TMR and City of Gold Coast and included the following inputs:

- TMR smarter solutions MCA guide that includes the following categories:
    1. Economic Data
    2. Transport Performance and Logistics
    3. Construction and Constructability
    4. Environmental Impact
    5. Social factors
- Infrastructure Australia (IA) MCA guide
- Project corridor vision

7.2.1 TMR smarter solutions MCA guide

The following table identifies all of the potential criteria suggested in the TMR Smarter Solutions MCA Guide, noting why certain criteria were adopted and why others are not considered suitable for this particular assessment and were therefore excluded from the MCA.

Criterion	Indicator	Rational for inclusion/ rejection in this MCA
Economic Data		
Implementation Costs	Estimated cost of construction and procurement (outturn estimate)	Construction costs to be assessed.
Whole-of-life operation and maintenance	Estimated cost of whole of-life asset operation and maintenance	At this stage of the project (alignment options) – would not produce any quantifiable differences in scores as too early to measure – not adopted.
End-to-end cost	Impact on direct end-to - end cost or price of travel (incl. amenity)	At this stage of the project (alignment options) – would not produce any quantifiable differences in scores as too early to measure – not adopted.
Road User vehicle operating costs	Estimated change in vehicle operating costs (Vehicle/Bus operating costs: fuel, tyre wear, lubricants, repairs, maintenance)	High level assessment of PT operating cost adopted – assessing kilometres travelled.
BCR	Rapid Benefit Cost Ratio	Not adopted – too early to measure
Traffic Performance and Integration		

Criterion	Indicator	Rational for inclusion/ rejection in this MCA
Network connectivity	Impact on the directness of links and the density of connections in the network	Adopted. Density plots to be reviewed to understand the traffic performance of each option.
Operating conditions	Change in the efficiency of operating conditions	Initial assessment did not produce any quantifiable differences in scores
Travel time reliability	Impact on time travel reliability, measured by the percent variation in travel time	Adopted. PT accessibility and connectivity measured.
LOS	Impact on transport network performance as captured by the level of service rating	Initial assessment did not produce any quantifiable differences in scores
Intersection delay	Change in intersection delay	Initial assessment did not produce any quantifiable differences in scores
Public transport patronage	Change in user behaviour to increase public transport patronage	To be adopted. Reflected in the assessment of understanding access to frequent and reliable public transport to support population growth.
Active transport	Impact on active transport users	Adopted. Reflected in the assessment of degree of active transport implemented, safety, comfort and access.
Performance horizon	Performance of the option over time, as measured by the duration of benefits	Too early to measure.
Amenity of travel	Change in the perceived quality or amenity of travel	Adopted for amenity of travel for active transport and public transport users.
Safety		
Safety	Impact on safety incl. accidents, injuries, casualties and property damage	Adopted criteria – to use SSA scoring
Freight		
Freight volume	Impact on freight volume	Does not produce any quantifiable differences in scores – not adopted
Freight vehicle operating costs	Estimated change in freight vehicle operating costs (Vehicle operating costs: fuel, wear, lubricants, repairs, maintenance)	Does not produce any quantifiable differences in scores – not adopted
Frequency of service	Impact on the frequency of freight services	Does not produce any quantifiable differences in scores – not adopted
Construction and Constructability		
Traffic Management	Impact on traffic management during construction/implementation	Adopted
Community disruption	Impact of construction on the local community including visual amenity, safety risk, increased traffic and additional parking demand.	Adopted. Construction vibration and noise excluded from assessment unable to create differentiated scores between the two options.
Engineering/ constructability	Potential engineering or construction challenges- during construction or across lifecycle	Two criterion adopted based on review of study area: PUP risks Construction risks (geotechnical, hydrological, etc)

Criterion	Indicator	Rational for inclusion/ rejection in this MCA
Geotechnical Risk	Level of risk attributed to the geotechnical conditions at construction site	Included in construction risks criterion.
Ease of construction	Level of political and construction risk resulting in delays and disruptions during construction	Too early to measure – not adopted.
Stageability	Ability for the option to be implemented in discrete stages over time	At this stage of the project (alignment options) – would not produce any quantifiable differences in scores – not adopted.
Environmental impact		
Noise and air quality	Impact on noise and air quality	Adopted. Air quality measured with vehicle emissions & noise measured with severance.
Vehicle emissions	Impact on vehicle emissions	Adopted - change in number of private vehicles travelling through corridor (increase or decrease in vehicle emissions).
Flora and fauna	Impact on vegetation and / or sites of environmental importance	Adopted.
Social factors		
Barriers to development	Are there any significant barriers to development? E.g., existing land use or cultural significance	Heritage and iconic landscapes considered at this stage of the project.
Future land use	Degree of alignment to strategic land use and planning objectives	Adopted. Reflected in assessment of urban amenity and liveability.
Mode Shift	Impact on user behaviour and influence on mode shift	Reflected in the improved urban amenity and liveability criteria and PT accessibility and connectivity.
Impact on property owners	Impact to local land, property and businesses resulting from disruption during construction and operation	Property impact adopted
Visual amenity and urban quality	Impact on visual amenity and urban quality as a result of changes in bikeways, walking paths, noise during construction and design/aesthetic	Adopted and reflected in assessing the improved urban amenity and liveability.
Severance	Impact on community severance	Adopted
Regional development	Change in the economic and social impact of the transport system on regional development	Adopted. Reflected in the improved urban amenity and liveability criteria.

7.2.2 Infrastructure Australia (IA) MCA guide

Key themes for multi criteria assessment as identified in the Infrastructure Australia (IA) guide are shown in Figure 7-20. Table 7-1 details how the proposed MCA framework, aligns to the themes of this IA guidance.

Figure 7-20: Infrastructure Australia MCA themes (Source: Infrastructure Australia, 2021)

Table 7-1: MCA framework – mapped to Infrastructure Australia (IA) guidance

MCA Category		MCA Criteria		Alignment with IA guide
1	Cost	1.1	Construction costs (inc. property)	Aligns with the "deliverability" theme in IA guide
		1.2	Operating cost (PT network)	
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	These criteria closely relate to the overall project objectives and the corridor vision – this aligns with the "strategic fit" theme in the IA guide.
		2.2	Improved urban amenity and liveability	
3	Transport outcomes	3.1	PT accessibility and connectivity	
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	
		3.3	Traffic performance	
		3.4	Road safety	
4	Construction and constructability	4.1	Traffic management risks (during construction)	Aligns with the "deliverability" them in IA guide
		4.2	Community disruption risks (during construction)	
		4.3	PUP risks (during construction)	
		4.4	Other construction risks (geotechnical, hydrological, etc)	
5	Environmental impact	5.1	Transport emissions (air quality)	These criteria align with the "societal impact" theme in IA guide.
		5.2	Ecological and natural hazard risks	
6	Social factors	6.1	Heritage and iconic landscapes	
		6.2	Noise and severance (to local land uses, property and businesses) during operation	
		6.3	Property impacts	

7.2.3 MCA categories, criteria and scoring

This section details how each MCA category is broken down to a criterion and how it is scored. Table 7-2 details the MCA category, criterion and performance measures with the detailed of the method of assessment contained in Appendix E.

Table 7-3 details the high-level range in scoring applied to the MCA criteria where the scoring is based on an 11-point system (from -5 to +5). The range in scoring differs for each criteria dependent on whether the criteria is inherently worsening the current situation (can only score between 0 and -5) or is improving the current situation (0 to +5), this is explained in detail for each criteria in detail in Appendix E.

Table 7-2: MCA criteria and performance measures

MCA Category		MCA Criteria		MCA Performance Measure
1	Cost	1.1	Construction costs (inc. property)	High level capital cost - based on Project Cost Estimate
		1.2	Operating cost (PT network)	High level operating cost - based on total daily bus and LRT operating km.
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	Jobs served within 800m of an LRT station (2041) and Residents within 800m of an LRT station (2041)
		2.2	Improved urban amenity and liveability	Extent of opportunities for local precinct enhancements/ placemaking (micro scale)
3	Transport outcomes	3.1	PT accessibility and connectivity	Measure of accessibility: In vehicle travel time by Public Transport between Tugun and Coolangatta
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	Pedestrian Safety Score (using SSA) Cycle Safety Score (using SSA) and additional safety observations
		3.3	Traffic performance	Transport operations based on density plots and travel time / volume metric extraction from Aimsun.
		3.4	Road safety	Safe System Assessment (overall score) - lower SSA score means more alignment with SSA principles. High level safety review of components captured in the SSA.
4	Construction and constructability	4.1	Traffic management risks (during construction)	Qualitative assessment based on traffic engineering assessment of likely lane closure requirements
		4.2	Community disruption risks (during construction)	Qualitative assessment around likely impacts to businesses and residents (inc parking removal/ relocation)
		4.3	PUP risks (during construction)	Qualitative assessment around number of potential high-risk obstacles (inc impact on any major plant)
		4.4	Other construction risks (geotechnical, hydrological, etc)	Qualitative assessment (number of geotechnical risk features e.g., Kirra hill, wetlands)
5	Environmental impact	5.1	Transport emissions (air quality)	Change in number of private vehicles travelling through corridor (increase or decrease in vehicle emissions).
		5.2	Ecological and natural hazard risks	Area of flora and fauna impacted; Inc number water bodies impacted, erosion and other natural hazard risks

MCA Category		MCA Criteria		MCA Performance Measure
6	Social factors	6.1	Heritage and iconic landscapes	Number heritage listed properties or iconic landscape features; parklands impacted
		6.2	Noise and severance (to local land uses, property and businesses) during operation	Number of properties potentially affected by noise impacts or urban separation. Include commentary on sensitive land uses, any notable increases on traffic and/or specific geometric differences (tight corners) which introduce new noise issues (wheel squeal)
		6.3	Property impacts	Number of properties impacts (full/ part) and whether residential/ business

Table 7-3: MCA general scoring

Score	
5	Substantial benefits and a high degree of confidence of benefits being realized and/or long term / permanent benefits
4	High extent of benefits and confidence of benefit being realized and/or medium - long term benefits
3	Good benefits and/or medium term
2	Low or localised benefits and/or short term
1	Very low benefits and/or very short term
0	No change in benefits, impacts or difficulties from current situation
-1	Few difficulties, very low cost or low impact on some resources/values and/or very short term
-2	Minor difficulties, low cost or minor impacts on resources/values and/or short term
-3	Some difficulties, moderate cost or some impact on resources/values and/or medium term
-4	Clear difficulties, high cost or high impact on resources/values and/or medium - long term
-5	Substantial difficulties, very high cost or substantial impact on resources/values and/or long term / permanent

7.2.4 Weightings

At the end of the MCA workshop, a link to an online form was distributed to participants asking them to rank the MCA categories from 1 to 6 for three different zones (Bilinga, Airport and Kirra/Coolangatta). Kirra and Coolangatta were combined due to similarities in transport context and as well as urban growth and catchment opportunities. 14 responses were received from TWG participants in total.

The combined ranking results were then used to identify whether there were different priorities within each section of the corridor and the relative importance of the decision criteria (against other criteria under consideration). Statistical methods were used to convert the rankings to weightings as the mixed nature (qualitative and quantitative) of the MCA criteria tends to make it difficult for participants to directly attribute percentage weights to individual criteria.

Two statistical methods were tested for deriving weightings for the MCA tool namely:

- Rank Sum
- Rank Order Centroid

Each of these proposed weighting methodologies are explained below.

7.2.4.1 Rank Sum

As detailed in the Smarter Solutions – MCA Tool user guide, "the rank sum weighting method assigns weightings by first ranking each criteria in order by preference; the most preferred option is selected as the first rank." The relative weightings are then calculated by applying the formula detailed in Figure 7-21. The rank sum methodology derives weightings that are more narrowly distributed relative to alternative ranking methodologies

$$wt_i = \frac{K - r_i + 1}{\sum_{j=1}^{K} K - r_j + 1}$$

Where:

- r_i is the rank of the *i*th objective
- K is the total number of objectives

Figure 7-21: Rank sum formula

7.2.4.2 Rank Order Centroid

As detailed in the Smarter Solutions – MCA Tool user guide, "the rank order centroid weighting method aims to minimise the maximum error of each weight by identifying the centroid of all possible weights relative to the assigned ranking of alternatives. Similar to the other rank methods, the criteria must first be ranked by preference then the relative weightings are then calculated by applying the formula detailed in Figure 7-22. The rank order centroid methodology returns weights that are more dispersed than the rank sum methodology. The result being that the first rank achieves a higher weighting compared to the Rank Sum method. For this reason, the Rank Order Centroid method was adopted for this study.

$$wt_i = \left(\frac{1}{K}\right)\sum_{j=1}^{K}\left(\frac{1}{r_j}\right)$$

$$wt_1 = \left(1 + \frac{1}{2} + \frac{1}{3} + \ldots \frac{1}{K}\right)/K$$

$$wt_K = \left(0 + 0 + 0 + \ldots \frac{1}{K}\right)/K$$

Where:

- r_j is the rank of the *j*th objective
- K is the total number of objectives

Figure 7-22: Rank order centroid formula

Refer to Figure 7-23 for a comparison of the weighting methodologies.

Criterion	Straight Rank	Rank Sum	
		Weight	Normalised Weight
A	4	2	13.3%
B	2	4	26.7%
C	5	1	6.7%
D	1	5	33.3%
E	3	3	20.0%
Total		15	100.0%

Criterion	Straight Rank	Rand Order Centroid	
		Reciprocal Weight	Normalised Weight
A	4	0.250	9.0%
B	2	0.500	25.7%
C	5	0.200	4.0%
D	1	1.000	45.6%
E	3	0.333	15.7%
Total		2.283	100.0%

Figure 7-23: Weighting methodology comparison (Appendix 1, TMR Smarter Solutions) – note only the Rank Order Centroid method was taken forward

7.3 MCA workshop and results

A Technical Working Group (TWG) workshop was held on 10 September 2021 with relevant stakeholders including City of Gold Coast (CoGC), various TMR divisions and TfNSW. Participants reviewed the draft assessment findings and proposed scores for each options in each section in accordance with the scoring guideline and methodology outlined above. Inputs from participants including changes to scores and comments have been reflected within the following sections.

7.3.1 Bilinga

This section summarises the MCA scoring and subsequent weighting of the shortlisted Bilinga alignment options with the detailed commentary contained in Appendix E. The purpose of the MCA scoring is to undertake a comparison assessment of the shortlisted alignment options to arrive at a preferred LRT alignment within the corridor for further investigation and refinement.

7.3.1.1 Bilinga MCA scores

Table 7-4 summarises the raw and unweighted scores from the workshop. These scores have been reviewed and approved by TMR and stakeholders from the TWG.

Table 7-4: Final scoring of Bilinga option (unweighted)

MCA Category		MCA Criteria		BILINGA	
				B1-3 Eastern LRT corridor	B2-3 Median LRT corridor
1	Cost	1.1	Construction costs (inc. property)	-2	-4
		1.2	Operating cost (PT network)	5	5
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	4	2
		2.2	Improved urban amenity and liveability	2	2
3	Transport outcomes	3.1	PT accessibility and connectivity	5	4
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	3	2
		3.3	Traffic performance	5	4
		3.4	Road safety	3	4
4	Construction and constructability	4.1	Traffic management risks (during construction)	-3	-5
		4.2	Community disruption risks (during construction)	-4	-2
		4.3	PUP risks (during construction)	-4	-2
		4.4	Other (geotechnical, hydrological, etc) during construction	0	0
5	Environmental impact	5.1	Transport emissions (air quality)	4	4
		5.2	Ecological and natural hazard risks	0	0
6	Social factors	6.1	Minimise impacts on heritage and iconic landscapes	-3	-1
		6.2	Noise and severance impact to local land uses, property and businesses during operation	-2	-1
		6.3	Property impacts	0	0

7.3.1.2 Bilinga weightings and sensitivity tests

As part of the TWG Workshop 3 held on 10 September 2021, stakeholders were asked to rank the MCA categories for Bilinga (1 = highest priority and 6 = lowest priority) to inform on the weightings of the MCA category. Using the survey results as an input, three weighting scenarios were developed:

- Scenario 1: reflects the exact order of first preferences from the survey (with Transport Performance ranked 1)

- Scenario 2: Elevated the second ranked category (Land Use) to number 1 to test if this would alter the results
- Scenario 3: Same as Scenario 1 but with 'Cost" removed noting that the two options were only 11% apart, to see if this would alter the result

After applying the different rankings and their corresponding weightings (refer Appendix E for more detail), B1-3 was identified as the preferred option, even prior to any mitigation for tree loss (refer to Table 7-5).

Table 7-5: MCA results with rank order weightings applied.

Scenario	B1-3 Eastern LRT corridor	B2-3 Median LRT corridor
Scenario 1	2.33	1.85
Scenario 2	2.16	1.60
Scenario 3	2.19	1.90

7.3.1.3 Emerging preferred Bilinga recommendation

The findings from the MCA indicate that:

- **B1-3** performs better in terms of cost, catchment/ serving growth as well as slightly better LRT travel times and general traffic performance. B1 is also consistent with the proposed east-side LRT running for the section north to Tugun Village
- **B2-3** performs slightly better in terms of impacts on landscape/ trees and impacts to residents and businesses
- **B1-3** is marked down due to the LRT requiring removal of mature trees and vegetated buffer between Golden Four Drive and GCH. Therefore, a revised version of B1-3 is proposed to be re-designed to include a wider buffer where possible which would likely outperform B2-3 overall and could offer:
  - Enhanced opportunities for placemaking and legibility with retention of more of the current avenue of trees as part of an arrival gateway
  - Enhanced opportunities for active transport
  - Reduced visual amenity and noise impacts
  - Reduced impacts on PUP and road drainage on Golden Four Drive but a higher cost (assumed to be comparable with B2-3)

Nevertheless, even prior to mitigation, B1-3 achieves the highest weighted score under all 3 ranking scenarios and as such was the recommended emerging preferred option for Bilinga.

7.3.2 Airport

This section summarises the MCA scoring and subsequent weighting of the shortlisted Airport alignment options with the detailed commentary contained in Appendix E. The purpose of the MCA scoring is to undertake a comparison assessment of the shortlisted alignment options to arrive at a preferred LRT alignment within the corridor for further investigation and refinement.

7.3.2.1 Airport MCA scores

Table 7-6 summarises the raw and unweighted scores. These scores have been reviewed and approved by TMR and relevant stakeholders.

Table 7-6: Final scoring of Airport option (unweighted)

MCA Category		MCA Criteria		AIRPORT	
				A1-3 Closer to Airport Terminal	A2-3 Closer to Gold Coast Highway
1	Cost	1.1	Construction costs (inc. property)	-5	-2
		1.2	Operating cost (PT network)	-5	-4
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	4	1
		2.2	Improved urban amenity and liveability	4	2
3	Transport outcomes	3.1	PT accessibility and connectivity	4	5
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	2	-1
		3.3	Traffic performance	0	2
		3.4	Road safety	-1	0
4	Construction and constructability	4.1	Traffic management risks (during construction)	-2	-1
		4.2	Community disruption risks (during construction)	-2	-1
		4.3	PUP risks (during construction)	-1	-1
		4.4	Other (geotechnical, hydrological, etc) during construction	-2	-1
5	Environmental impact	5.1	Transport emissions (air quality)	4	4
		5.2	Ecological and natural hazard risks	0	-1
6	Social factors	6.1	Minimise impacts on heritage and iconic landscapes	-1	-1
		6.2	Noise and severance impact to local land uses, property and businesses during operation	0	0
		6.3	Property impacts	-3	-1

7.3.2.2 Airport weightings and sensitivity tests

As part of the TWG Workshop 3 held on 10 September, stakeholders were asked to rank the MCA categories for Airport (1 = highest priority and 6 = lowest priority) to inform on the weightings of the MCA category. Using the survey results as an input, three weighting scenarios were developed:

- Scenario 1: reflects the exact order of first preferences from the survey (with Transport Performance ranked 1)

- Scenario 2: Elevated the second ranked category (Land Use) to number 1 to test if this would alter the results
- Scenario 3: Same as Scenario 1 but with 'Cost" removed to see if this would alter the result

After applying the different rankings and their corresponding weightings (refer Appendix E), A1-3 was identified as the preferred option (refer to Table 7-7).

Table 7-7: MCA results with rank order weightings applied.

Scenario	A1-3 Closer to Airport Terminal	A2-3 Closer to Gold Coast Highway
Scenario 1	0.47	0.40
Scenario 2	0.93	0.40
Scenario 3	1.27	0.91

7.3.2.3 Emerging preferred Airport recommendation

The findings from the MCA indicate that:

- **A1 (terminal)** performances significantly better in terms of supporting growth and enhancing access to frequent and reliable public transport for key regional destinations (airport university). It also delivers better urban amenity and placemaking outcomes.
- **A2 (Gold Coast Highway)** is slightly shorter and therefore cheaper with marginally faster travel times for through passengers. A2 also scores better from road safety and traffic performance perspective although these are marginal.

A1-3 achieves the highest weighted score under all 3 ranking scenarios and as such is the recommended emerging preferred option for the Airport.

7.3.3 Kirra

This section summarises the MCA scoring and subsequent weighting of the shortlisted Kirra alignment options with the detailed commentary contained in Appendix E. The purpose of the MCA scoring is to undertake a comparison assessment of the shortlisted alignment options to arrive at a preferred LRT alignment within the corridor for further investigation and refinement.

7.3.3.1 Kirra MCA scores

Table 7-8 summarises the raw and unweighted scores. These scores have been reviewed and approved by TMR and relevant stakeholders.

Table 7-8: Final scoring of Kirra option (unweighted)

MCA Category		MCA Criteria		KIRRA	
				K2-2 Musgrave Street & Miles Street	K3-2 Coolangatta Road
1	Cost	1.1	Construction costs (inc. property)	-4	-3
		1.2	Operating cost (PT network)	2	4
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	-2	4
		2.2	Improved urban amenity and liveability	3	4
3	Transport outcomes	3.1	PT accessibility and connectivity	3	5
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	-1	3
		3.3	Traffic performance	-2	3
		3.4	Road safety	-1	3
4	Construction and constructability	4.1	Traffic management risks (during construction)	-3	-3
		4.2	Community disruption risks (during construction)	-4	-2
		4.3	PUP risks (during construction)	-3	-4
		4.4	Other (geotechnical, hydrological, etc) during construction	-3	-2
5	Environmental impact	5.1	Transport emissions (air quality)	2	4
		5.2	Ecological and natural hazard risks	-3	-1
6	Social factors	6.1	Minimise impacts on heritage and iconic landscapes	-5	-2
		6.2	Noise and severance impact to local land uses, property and businesses during operation	-5	-3
		6.3	Property impacts	-3	-1

7.3.3.2 Kirra weightings and sensitivity tests

As part of the TWG Workshop 3 held on 10 September, stakeholders were asked to rank the MCA categories for Kirra and Coolangatta (1 = highest priority and 6 = lowest priority) to inform on the weightings of the MCA category. Using the survey results as an input, three weighting scenarios were developed:

- Scenario 1: reflects the exact order of first preferences from the survey (with Transport Performance ranked 1)

- Scenario 2: Elevated the second ranked category (Land Use) to number 1 to test if this would alter the results
- Scenario 3: Same as Scenario 1 but with 'Cost" removed to see if this would alter the result

After applying the different rankings and their corresponding weightings (refer Appendix E for more details), K3-2 was identified as the preferred option (refer to Table 7-9).

Table 7-9: MCA results with weightings applied.

Scenario	K2-2 Musgrave Street & Miles Street	K3-2 Coolangatta Road
Scenario 1	-0.74	2.25
Scenario 2	-0.87	2.16
Scenario 3	-0.67	2.45

7.3.3.3 Emerging preferred Kirra recommendation

The findings from the MCA indicate that:

- **K2 (Musgrave Road and Miles Street)** would provide a unique beachside transport experience for passengers serving the current highest trip generating uses within this part of the study area. But K2 comes at an increased cost, longer journey time, and with major impacts to parkland/ visual amenity
- **K3 (Coolangatta Rd)** offers a shorter, faster, cheaper route. It is more centrally located to the wider catchment and may help support population growth more equitably. While it has construction challenges due to lots of frontage stakeholders, the corridor is wide and could become a green boulevard
- Overall, K3 significantly outperforms K2. Due to the scale of scoring differences, K3 is likely to be the emerging preferred option regardless of the application of weightings

K3-2 achieves the highest weighted score under all 3 ranking scenarios and as such is the recommended emerging preferred option for Kirra.

7.3.4 Coolangatta

This section summarises the MCA scoring and subsequent weighting of the shortlisted Coolangatta alignment options with the detailed commentary contained in Appendix E. The purpose of the MCA scoring is to undertake a comparison assessment of the shortlisted alignment options to arrive at a preferred LRT alignment within the corridor for further investigation and refinement.

7.3.4.1 Coolangatta MCA scores

Table 7-10 summarises the raw and unweighted scores. These scores have been reviewed and approved by TMR and relevant stakeholders.

Table 7-10: Final scoring of Coolangatta option (unweighted)

MCA Category		MCA Criteria		COOLANGATTA	
				C2-2 Griffith Street	C3-1 Chalk Street
1	Cost	1.1	Construction costs (inc. property)	-4	-3
		1.2	Operating cost (PT network)	2	4
2	Land use planning	2.1	Enhanced access to frequent and reliable public transport to support population growth	3	3
		2.2	Improved urban amenity and liveability	2	4
3	Transport outcomes	3.1	PT accessibility and connectivity	3	4
		3.2	Degree of active transport infrastructure implemented - safety, comfort and access.	1	2
		3.3	Traffic performance	-1	4
		3.4	Road safety	-2	-1
4	Construction and constructability	4.1	Traffic management risks (during construction)	-5	-1
		4.2	Community disruption risks (during construction)	-5	-1
		4.3	PUP risks (during construction)	-3	-3
		4.4	Other (geotechnical, hydrological, etc) during construction	0	0
5	Environmental impact	5.1	Transport emissions (air quality)	5	5
		5.2	Ecological and natural hazard risks	0	0
6	Social factors	6.1	Minimise impacts on heritage and iconic landscapes	-2	-1
		6.2	Noise and severance impact to local land uses, property and businesses during operation	-3	-2
		6.3	Property impacts	-2	-3

7.3.4.2 Weightings and sensitivity tests

As part of the TWG Workshop 3 held on 10 September 2021, stakeholders were asked to rank the MCA categories for Kirra and Coolangatta (1 = highest priority and 6 = lowest priority) to inform on the weightings of the MCA category. Using the survey results as an input, three weighting scenarios were developed:

- Scenario 1: reflects the exact order of first preferences from the survey (with Transport Performance ranked 1)

- Scenario 2: Elevated the second ranked category (Land Use) to number 1 to test if this would alter the results
- Scenario 3: Same as Scenario 1 but with 'Cost" removed to see if this would alter the result

After applying the different rankings and their corresponding weightings (refer Appendix E for more details), C3-1 was identified as the preferred option (refer to Table 7-11).

Table 7-11: MCA results with weightings applied.

Scenario	C2-2 Griffith Street	C3-1 Chalk Street
Scenario 1	0.68	1.81
Scenario 2	0.30	1.60
Scenario 3	0.94	2.02

7.3.4.3 Emerging preferred Coolangatta recommendation

The findings from the MCA include:

- **C2 (Griffith Street)** reflects the existing road and transport hierarchy with public transport serving the original 'high street' but comes with higher costs and significant construction impacts to business due to major construction including utilities diversions within a constrained road corridor. It will also result in the permanent loss of most on-street car parking, is more disruptive to local vehicle access and circulation and significantly reduces pedestrian oriented public realm.
- **C3 (Chalk Street)** offers a more transformative opportunity for Coolangatta and could help shape a more balanced town centre anchored by LRT and a new civic precinct to the south (if enabled/ encouraged through redevelopment opportunities). It also offers a more direct/ shorter/ cheaper/ easier to construct route towards Kirra and good onward extension options towards Tweed Heads.

C3-1 achieves the highest weighted score under all 3 ranking scenarios and as such is the recommended emerging preferred option for Coolangatta.

7.4 Conclusions from shortlist assessment (MCA)

Following a detailed, multi-faceted and multi-stage option development and assessment process, the following emerging preferred alignment options were recommended to proceed to Stage 4 (Option refinement). Key elements to be further resolved are noted under each section heading.

7.4.1 Bilinga:

Option B1-3 was the recommended preferred alignment however is subject to re-design to provide a wider buffer between the LRT corridor and Golden Four Drive to create greater visual separation, retain mature trees wherever possible and to deliver a road corridor that creates an entry/gateway statement to the Gold Coast from the Airport.

- Investigate modifications to the cross section of the option to provide a wider buffer between the LRT tracks and Golden Four Drive for greater visual separation to retain mature trees (Norfolk Pines) and to deliver a road corridor that helps make an entry/ gateway statement to the Gold Coast from the airport
- Identify opportunities for enhanced cycle facilities on Golden Four Drive as noted in the SSA

- Identify opportunities for traffic and urban realm treatments in the vicinity of the two stations fronting Golden Four Drive (including options for formalised pedestrian crossing facilities of Golden Four Drive at both ends of station platforms)
- Investigate bus stop and/or bus priority facility options at both the Boyd Street intersection and the Terminal Drive intersection to cater for existing (retained) and new local bus routes
- Include enhanced pedestrian crossing facilities at all signalised intersections in line with QLD road safety policy

7.4.2 Airport:

Option A1-3 was the recommended preferred concept for a consolidated multi-modal (LRT, heavy rail and bus) public transport facility located between the airport terminal and the proposed new internal airport distributor road (approx. 150-180m from the airport terminal building). However heavy rail alignment constraints need to be investigated further to confirm viability of this location.

- Critically, this option relies on the feasibility of a future heavy rail station in this (or a substantially similar) location. A key early task in further option development is the reconfirmation of the feasibility (and risks/ impacts) of such a heavy rail station arrangement and related main line alignment. Should this not be deemed feasible, alternative heavy rail alignment and station arrangements which deliver heavy rail as close as possible to the terminal building, in line with the intent of A1-3, should be explored as a fallback.
- Identify the functional requirements for scheduled urban bus services that may serve the future multi modal airport station including local TransLink services and possible future TfNSW (Tweed) services in order to determine an appropriate bus station footprint (and access/ egress strategy)
- Confirm requirements for and incorporate infrastructure provision for other motorised access modes including taxi and kiss n ride
- Confirm the preferred pedestrian and cycle access strategy, which may depend on the exact station location and extent of roads/ barriers between the PT hub and the airport terminal. Pedestrian access options may include a combination of at grade and grade separated facilities.
- Identify opportunities for the airport multi modal passenger facility to be integrated into a public space creating a benefit to the airport precinct including adjacent hotel and university precincts
- Identify options and a preferred approach to satellite depot and stabling facilities in or immediately adjacent to the airport precinct.

7.4.3 Kirra:

Option K3-2B was the recommended preferred concept to take forward, with LRT located within the Coolangatta Road corridor

- Reconfirm the number and optimal location of station(s) in this corridor segment, in conjunction with the final station location in the airport precinct relative to the North Kirra catchment. If a two-station solution remains preferred, investigate moving Kirra station closer to Miles Street (a clear north-south axis and potential 'feeder' route for both active transport and bus users)
- Confirm requirements for active transport both on/ adjacent to Coolangatta Rd and on Miles Street – both in terms of principal level cycle facilities and cross corridor pedestrian connections, particularly those also used by students at the adjacent Coolangatta State School.
- Review the required number and configuration of traffic lanes on Coolangatta Road as well as on street parking requirements and opportunities
- Undertake sufficient hydraulic analysis to determine a suitable infrastructure or operational solution for the current flood immunity deficiencies identified on Coolangatta Rd and Miles Street
- Undertake sufficient structural analysis to confirm the preferred approach to retaining walls within the 'cutting', between Miles Street and McLean Street

7.4.4 Coolangatta:

Option C3-2B was the recommended preferred concept to be taken forward, with LRT located immediately south of Chalk Street

- Early consultation and coordination with key affected stakeholders are recommended, including Queensland Police, Magistrates Court and Twin Towns Kindergarten.
- Inter-related to the above required consultation and coordination is the need to undertake sufficient 'precinct planning' to confirm key option components (including exact station location and pedestrian connection strategy). This planning would be intended to identify the key changes required to support the implementation of LRT, mitigate its direct impacts, or help maximise its benefits. This includes the potential reconfiguration of car park land post construction as well as the potential for new civic buildings and plazas/ public spaces, maximising as well as enhancing north south pedestrian connections from south of Lanham Street to North of Griffith Street.
- Confirm requirements for active transport enhancements on or parallel to the LRT alignment to provide a high-quality principal level connection between Tweed Heads and Coolangatta (civic and retail precinct) complementing recreational facilities along the foreshore (Oceanway)
- Continue to work collaboratively with TfNSW to determine feasible onward extension options into Tweed Shire
- In parallel with the above, confirm requirements for bus stop and interchange facilities in and around the Coolangatta LRT station in particular to serve Tweed Shire bus services.

Figure 7-24: Emerging preferred Light Rail alignment and station locations post MCA

8. Preferred option refinement

8.1 Option refinement process

The refinement of the emerging preferred option post MCA included the following steps and process, which are elaborated on under each of the four corridor section sub-headings further below:

- Review stakeholder feedback on emerging preferred options post MCA and confirm the key design philosophy and design parameters guiding the option refinement
- Undertake additional investigations as required including traffic, land use, geometric
- Update design including and changes to station location/ configuration and intersection layouts

A more detailed description of the option refinement process can be found in the Design Report, in Appendix I.

8.2 Bilinga option refinement

8.2.1 Refined design philosophy

Having reviewed stakeholder feedback, the reconfirmed design philosophy for the Bilinga section included to:

- Maintain, as far as possible, the median between the existing Gold Coast Highway southbound carriageway and Golden Four Drive to provide visual separation, retain mature trees and deliver a road corridor that helps make an entry / gateway statement to the Gold Coast from the airport.
- Maintain Gold Coast Highway posted speed at 80km/h (with a design speed of 90 km/h)
- Provide appropriate cycle infrastructure on parallel roads to the Gold Coast Highway
- Maximise catchment and activation opportunities through the placement of LRT stations between Boyd Street and Airport
- Provide efficient and safe pedestrian access across the corridor and at the LRT stations
- Provide appropriate local access arrangements
- Ensure efficient access to and from the emergency services facilities near Kirribin Street
- Provide flexibility for local bus routes on Golden Four Drive, including opportunities for passengers to transfer between us and Light Rail

8.2.2 Design changes and refinements made

Key elements of the design that were amended or refined in response to the design philosophy above are captured in the following tables.

Table 8-1: Design changes and refinement Bilinga

Design element	Description of change/ final option
Station location and land uses	Existing and potential land uses around the two proposed stations (one at Boyd Street, one at Kirribin Street) were analysed to confirm that the previously proposed station locations are well suited and could result in modest changes to land use, to create greater opportunities for activation. Broader changes to land uses on the western side of the Gold Coast Highway were identified as possible but subject to a detailed assessment by City of Gold Coast
Landscaping/ trees	A tree survey was conducted to assess the general quality of existing Norfolk Island Pines along both sides of the Gold Coast Highway from Tugun to the Gold Coast Airport. This was used to help refine the horizontal alignment, to preserve as many higher value species as possible.
Horizontal alignment	The revised horizontal alignment for the Light Rail now generally runs along the current Gold Coast Highway southbound carriageway with localised track widening at the station locations. This alignment minimises impacts on the existing Norfolk Pine trees in the eastern median. The positioning of the Light Rail alignment has resulted in the relocation of the Gold Coast Highway northbound and southbound alignments to the west, causing impacts to the median on the

Design element	Description of change/ final option
	western side. The alignments for Golden Four Drive and Coolangatta Road are generally as per existing. However, the Coolangatta Road alignment has been amended south of Kirribin Street to provide full movements access to Gold Coast Highway.
Vertical alignment	With the introduction of Light Rail to the corridor, there is no longer sufficient width to provide table drains, with kerb and channel now proposed along the Gold Coast Highway carriageways. To provide sufficient longitudinal grade for drainage in the kerb and channel, a minimum grade of 0.5% has been used. To achieve this minimum, a rolling grade has been introduced to provide intermediate crests and sags along the length of the alignment. To avoid grade differences between the Gold Coast Highway and the Light Rail corridor, the longitudinal grade on the Light Rail alignment generally matches the Gold Coast Highway. The longitudinal grade on Golden Four Drive and Coolangatta Road remains unchanged.
Intersections and local access	The Preferred Option results in some significant changes to intersection locations, layouts and access configurations as follows: ▪ Boyd Street / Coolangatta Road – new signalised T intersection between Boyd Street and Gold Coast Highway with Coolangatta Rd limited to left only to Boyd Street. ▪ Desalination Plant Road / Coolangatta Road / Gold Coast Hwy – new signalised intersection but with movements now limited to providing access between Coolangatta Road (south) and GCH (north) ▪ Loongana Avenue / Coolangatta Road / GCH/ Surf Street/ Golden Four Drive- Closure of Loongana Avenue and Coolangatta Road to GCH, but an all movements signalised double T-intersection of Surf Street/ Golden Four Drive and GCH is provided ▪ Coolangatta Road / GCH (opposite of Gibson Street) – unsignalised left in / left out arrangement remains unchanged ▪ Kirribin Street/ Coolangatta Road/ GCH / Golden Four Drive – closure of all current traffic movement signalised on/ off Gold Coast Highway but with signalised ped crossing retained. ▪ Coolangatta Road / GCH (opposite Graham Street) – new all movements T intersection replacing movements removed at Kirribin ▪ Terminal Drive / GCH – no change to existing unsignalised left in/ left out movements ▪ Terminal Drive South / GCH Golden Four Drive – signalised intersection remains but with movement to/ from Golden Four Drive removed and diagonal LRT movement added
Barrier treatments	As the design speed of the Gold Coast Highway is to remain 90km/h and width constraints exist within the corridor, safety barriers are required in the median between the Gold Coast Highway carriageways, between the southbound carriageway and the Light Rail corridor and between the northbound carriageway and Coolangatta Road. Following project team discussions, it was determined that where there is sufficient width for safety barrier deflection semi-rigid barriers (e.g. W-Beam or Wire Rope Safety Barrier) is appropriate, but where deflection width is not available, concrete barriers are proposed.
Station configuration	Station layouts were designed to respond to specific site constraints and resulted in the following configurations: ▪ Boyd Street is a side platform arrangement which suited this particular site due to inadequate space for additional pedestrian pathways around the station. The side platform configuration also helps shield neighbouring residents to the east from noise and light spill from the station, particularly at night. Pedestrian access is provided at both ends of the platforms ▪ Bilinga (Kirribin Street) is an island platform configuration which provides space for a vegetated buffer or station plaza between the southbound LRT track and Golden Four Drive to help soften the station. Pedestrian access is provided at both ends of the platforms
Property access and impacts	▪ There are no direct property impacts (land requirements) ▪ The design philosophy along Golden Four Drive and Coolangatta Road was to maintain the existing kerb alignment and heights to minimise impacts on property accesses. There are no identified changes to property accesses along these roads. ▪ The property access arrangements for the Airport Central commercial development and the Hope Petrol Station between Terminal Drive South and Terminal Drive North have been reconfigured to suit the proposed Gold Coast Highway alignment

Design element	Description of change/ final option
Active transport	The design philosophy for provision of active transport within the Bilinga sections is based around the Safe Systems Approach, where exposure, likelihood and severity are reduced through design. This has included providing controlled pedestrian movements at a number of new pedestrian actuated crossings (PAC) across the Gold Coast Hwy and limiting cycle movements to the parallel roads of Coolangatta Road and Golden Four Drive to separate bike riders from the 80km/h traffic of Gold Coast Hwy. Through consultation with City of Gold Coast it was determined that the most appropriate all ages and abilities cycle facility (i.e., off road path) should be the existing Oceanway, with Golden Four Drive providing an alternative routes for faster and more confident bike riders. Nevertheless, the design response allows for marked cycle lanes on Golden Four at intersections that are affected by the project with space for retrofitting separators at a later date if required
Public Transport (bus)	Urban bus stops have been provided within close proximity to the LRT stations and existing locations. The overall bus network strategy post LRT implementation is to be reviewed as part of further design development. Bus stops have only been allowed for on Golden Four Drive due to the functional downgrade of Coolangatta Road to a local access connection and it no longer providing a two-way connection to Boyd Street.

8.3 Airport option refinement

8.3.1 Refined design philosophy

Having reviewed stakeholder feedback, the reconfirmed design philosophy for the Airport section included:

- Align with the Gold Coast Airport Master Plan where possible
- Leverage off a more resolved heavy rail alignment into the precinct
- Provide a central public transport hub incorporating Light Rail, buses and heavy rail
- Provide a single Light Rail station
- Provide high quality and convenient connections to the airport terminal building and surrounding land uses
- Minimise impacts on the Southern Cross University campus and the Australian Federal Police facilities
- Minimising security risks on the airport terminal building
- Provide a Light Rail satellite depot

The resolution of the design to address these above points involved a parallel study into feasible heavy rail alignments into the airport precinct, given the uncertainty that existed post MCA in this regard. A detailed technical memorandum captures these investigations and can be found in Appendix F. The key findings insofar as they relate to design changes and refinement is documented below.

8.3.2 Design changes and refinements made

Key elements of the design that were amended or refined in response to the design philosophy and subsequent heavy rail alignment and stations options analysis are captured in the following table.

Table 8-2: Design changes and refinement Airport

Design element	Description of change/ final option
Station location and land uses	Consistent with the A1 options selected through the MCA, the final Airport LRT station is located centrally within the airport precinct, in close proximity (approx. 150m) to the new terminal building southern extension as well as hotel (Rydges) and Southern Cross University. The LRT station (as part of an ultimate multi-modal passenger transport facility) is located centrally to significant amounts of land currently underutilised as at grade car parking but which could be developed into a future airport business and commercial precinct.

Design element	Description of change/ final option
Horizontal alignment	The Light Rail alignment runs along the southern side of Terminal Drive South to provide easier access to the public transport hub west of Tom Norris Drive. It was positioned to avoid impact on the airport parking facilities south of Terminal Drive South. The alignment turns through 90° to run parallel to the western boundary of the existing carpark at the airport frontage. Tom Norris Drive alignment is relocated to be positioned between the carpark and the Light Rail corridor. The bus interchange is to the west of the Light Rail corridor with a future heavy rail corridor identified between the Light Rail corridor and the bus interchange. It is assumed that the future heavy rail infrastructure would be elevated within this zone. The Light Rail alignment passes through the Tom Norris Drive/Arthur Butler Parade intersection running to the north of the Southern Cross University campus before joining Musgrave Street at the Gold Coast Highway intersection. The existing Eastern Avenue alignment has been amended to connect to Terminal Drive South at the Tom Norris Drive intersection as a four way intersection.
Vertical alignment	The vertical grading for Terminal Drive South and the Light Rail alignment generally follows the existing road grading. The alignment is generally at existing surface levels through the station area and across the Tom Norris Drive/Arthur Butler Parade intersection. The height of the Light Rail and Gold Coast Highway alignments was determined by the grading requirements of the rail alignment within the satellite depot. The alignment within the depot was positioned at or above the existing surface to avoid drainage/flooding issues. The grading within the depot led to the height for the turn-out to/from the main Light Rail corridor. The turn-out to the depot must be on a consistent grade which, in this case, was 3%, which is an extension of the superelevation on the Gold Coast Highway.
Intersections and local access	The Preferred Option results in some notable changes to the road network relative to today including intersection locations, layouts and access configurations through the Airport section. However, these changes were largely driven by early internal road layout concept sketches provided by QAL as part of their emerging masterplan refresh process. This includes: ▪ The consolidation of Tom Norris Drive/ Terminal Drive with Terminal Drive/ Eastern Avenue into a four-way signalised intersection. The change is that LRT is now proposed to pass across the southern approach to this proposed future intersection (parallel with the Terminal Drive towards airport movement. ▪ Replacement of the existing Tom Norris Drive/ Arthur Butler Parade roundabout with a relocated and upgraded four-way signalised intersection. The change is that that LRT is now proposed to pass diagonally through the intersection ▪ All current vehicular accesses to buildings and carparks would be retained even if relocated
Station configuration	The airport LRT station consists of side platforms with pedestrian access from both ends of the platforms. Side platforms provide better interaction with the other adjacent facilities provided within the public transport hub including Kiss n Ride/ taxi facilities on Tom Norris Drive to the north-east and the bus interchange/ future heavy rail station to the south-west.
Light Rail depot	The satellite Light Rail depot was positioned within the existing road reserve to the north of the Southern Cross University campus. This location and configuration were chosen to avoid impacts on Gold Coast Airport properties. This arrangement provides capacity for 8 Light Rail vehicles stored on four tracks (two per track). Vehicular access to the depot is from the northbound carriageway of the Gold Coast Highway again to minimise impacts on airport properties and operations.
Active transport	Two key pedestrian spines are provided within the design, parallel to Light Rail. ▪ A 3m shared path along the southern side of Light Rail between the Gold Coast Highway/ Musgrave Street and Tom Norris Drive provides a strong pedestrian and cycle connection between the Airport/ University precinct and Kirra to the east, including the Oceanway path. ▪ A 2m wide footpath along the south eastern side of Light Rail (parallel to Terminal Drive south between its intersection with Gold Coast Highway and the Rydges hotel caters for this

Design element	Description of change/ final option
	already strong pedestrian design line between the airport terminal and the beach, residential and tourist accommodation precinct to the east.
Public Transport (bus)	The airport LRT station is support by a bus station and layover facility design to cater for local bus movements not replaced by Light Rail. Given the uncertainty over the specific number and frequency of bus routes that will serve this facility, a nominal allowance of 80m of bus stop kerb length is currently proposed which could provide for up to 4 buses simultaneously (depending on vehicle size and type of operations). In addition, a further 80m of kerb length is provided on the right hand side of the bus access road where out of service buses can layover such as for drivers to take rest breaks.

8.4 Kirra option refinement

8.4.1 Refined design philosophy

In order to refine the design philosophy for the Kirra section stakeholder feedback on the shortlisted K3-2 option from the MCA was reviewed and a follow-up workshop with Council stakeholders was held on 24 November 2021. From this, the following refined design philosophy was developed:

- Provide an efficient and attractive Light Rail corridor in the Coolangatta Road central median and through the Lanham Street Park
- Provide an efficient and legible road connection between Gold Coast Highway, Musgrave Street, Golden Four Drive and Coolangatta Road
- Minimise property, parking and access impacts particularly on Coolangatta Road
- Focus all ages and abilities cycle facilities on Winston Street linking the Lanham Street connection to the Oceanway with secondary on road facilities along Coolangatta Road / Golden Four Drive
- Provide two Kirra stations, located at the northern and southern ends of Coolangatta Road in areas that consider existing and future land uses, activation potential and wider catchment connections
- Provide safe and attractive pedestrian access across the corridor and at the LRT stations

8.4.2 Design changes and refinements made

Key elements of the design that were amended or refined in response to the design philosophy are captured in the following table.

Table 8-3: Design changes and refinement Kirra

Design element	Description of change/ final option
Station location and land uses	A detailed land use and future catchment analysis was undertaken to identify the relative merits of a 1-station versus a 2-station solution for Kirra. These potential benefits were assessed against potential patronage and journey time implications. Overall, the analysis supported a two-station solution as it could deliver significantly more people within 5-minute walk time of LRT, resulting in solid daily boardings and with minimal impact on travel times. Based on the available evidence and considering feedback from workshop 4, a two station solution was recommended for Kirra, with the (South) Kirra station moved approximately 200m further south-east (closer to Miles Street) compared to the location shown in the earlier concept sketches.
Horizontal alignment	The existing horizontal alignment configuration in the Musgrave Street area, including the existing overpass structure and associated abutment approaches, will be removed and replaced with at-grade intersections at Gold Coast Hwy/ Musgrave Street and Musgrave Street / Golden Four Drive / Coolangatta Road. The Light Rail alignment runs in the median of Musgrave Street and then turns 90° through the Musgrave Street / Golden Four Drive / Coolangatta Road intersection to continue in the median along Coolangatta Road where the North Kirra station is located.

Design element	Description of change/ final option
	At the Kirra Station location at the eastern end of Coolangatta Road, the Light Rail alignment transitions to the northern side of Coolangatta Road, crosses Miles Street to continue through the Lanham Street Park. The alignment follows the original heavy rail corridor alignment through Lanham Street Park. The existing cul-de-sac service road servicing Nos. 1 – 11 Coolangatta Road will be reversed with access provided from Miles Street.
Vertical alignment	The height of the Light Rail alignment as it crosses the Gold Coast Highway is dictated by the grading requirements of the Light Rail satellite depot and associated turn-outs and crossovers and well as flood heights on the Gold Coast Highway. The vertical grading along Coolangatta Road between Musgrave Street and Appel St/Lord St matches the existing kerb heights to minimise impacts to existing property accesses. The area between Appel Street/Lord Street and Miles Street is subject to flooding. Due to impacts on property accesses and private property, it was not considered feasible to raise the heights of the existing intersections at Appel Street/Lord Street and Miles Street. The grading of the Light Rail alignment therefore generally matches the existing levels at the intersections but with Kirra Station raised.
Flooding	▪ Whilst the 1% AEP was a target for track level this would have required the raising of Appel Street and Miles Street by 250 to 350 mm at the location of the Light Rail crossing resulting in numerous property impacts and wider overland drainage path issues. Instead, based on agreement with TMR, the final design includes a Kirra Station located at 3.58m AHD therefore achieving 1% AEP immunity but with the road crossings of Coolangatta/ Appel and Miles Street matching existing levels (around 3.2m AHD) which are typically at the 5% AEP level.
Intersections and local access	The Preferred Option results in some changes to the road network including intersection locations, layouts and access configurations as follows: ▪ Coolangatta Road and Musgrave Street with GCH (south of Airport) – currently a complex network of separated movements and one grade separated movement to be replaced with a single all movements T intersection ▪ Lang Street / Golden Four Drive / Coolangatta Road – the Coolangatta Road section is removed leaving a simple T intersection between Lang Street and Golden Four Drive ▪ Musgrave Street / Coolangatta Road / Golden Four Drive – intersection remains a four way signalised all movements intersection but with the Coolangatta Road north approach removed and instead Golden Four Drive is connected instead providing simpler and more legible access to the North Kirra precinct from the Gold Coast Highway ▪ Charlotte Street / Coolangatta Road/ Creek Road - New signalised intersection retaining a right into Charlotte, but no right out (alternative = Ocean St). Creek St becomes left in left out but with the ability to U-turn at Charlotte Street intersection ▪ Coolangatta Road mid-block u turn facilities - Removed due to Light Rail requiring the space in the median ▪ Haig Street / Coolangatta Road – New signalised intersection retaining all movements ▪ Appel Street / Coolangatta Road / Lord Street - New signalised intersection retaining all current movements as well as new ahead and right turn movements from Appel Street Cul-de-sac of Coolangatta Road service road south of Lord Street with new access from Miles Street Miles Street / Coolangatta Road/ Tweed Street – existing intersection and movements retained
Station configuration	The North Kirra Station is configured with an island platform which was selected due to its more spatially efficient cross section within this road median. The station has pedestrian access at both ends, connected to the signalised road intersections of Musgrave/ Coolangatta/ Golden Four Drive to the north and Coolangatta/ Charlotte to the south. The (south) Kirra station is configured as side platforms, due to its location within a parkland setting whereby the platforms can be better integrated with the surrounding greenspace and adjacent path network. Pedestrian access is provided at both ends of the platforms connecting

Design element	Description of change/ final option
	to Coolangatta Road/ Miles Street to the east and Coolangatta Road/ Appel Street / Lord Street to the west.
Property access and impacts	The design philosophy along Coolangatta Road was to maintain the existing kerb alignment and heights to minimise impacts on property accesses. There are no identified changes to property accesses along Coolangatta Road between Musgrave Street and Miles Street. Due to the reconfiguration of the Musgrave Street/ Golden Four Drive/ Coolangatta Road intersection, seven existing driveways on the eastern side of Golden Four Drive between Lang Street and Musgrave Street reconfiguration to suit the proposed layout. Similarly, a further two existing driveways on the northern side of Coolangatta Road, east of Lord Street will require extension due to the reconfiguration of the service road cul-de-sac. Due to the alignment of the Light Rail corridor as it crosses Miles Street a property impact (partial land resumption) is expected at No. 20 Miles Street.
Active transport	The final design solution involves the following features from north to south: ▪ A 3m wide off road shared path) is provided along the western side of the Gold Coast Highway connecting to the existing pathway south of the border to create a continuous high-quality off-road connection to Tweed Heads West and beyond filling a missing link in the strategic cycle network ▪ Off-road one-way cycle tracks (LTS) are provided along both sides of Musgrave Street between Pacific Parade and the Coolangatta Road, then become shared paths between Coolangatta Road and the Airport – these provide a critical connection to this major jobs/ education precinct from the coastal active transport network ▪ On road cycle lanes on Coolangatta Road – forming a continuous facility connecting to the existing on road cycle lanes on Golden Four Drive. A reduced traffic speed is also proposed for the current section of Coolangatta Road that is posted at 60 km/h to create a continuous 50km/h corridor. This is likely to offer a Level of Traffic Street 3 (LTS3) which is considered adequate for confident, experienced riders who want a faster more direct route. At Miles Street on road bike riders can continue east up Tweed Street, south or north on Miles Street or access the off-road separated path through the old rail cutting. ▪ Parallel to Coolangatta Road, an all ages and abilities cycle facility (LTS1) is proposed by Council along the southern side of Winston Street. This provides the most direct connection between the Oceanway (also LTS1) to the north/west and the enhanced connection via the old rail cutting to the south/east (also LTS1). ▪ On road cycle lanes are provided on Miles Street, a key north-south connection between Tweed Heads West and Kirra which is likely to provide an LTS2/3 facility. Depending on future cycle network planning, additional lane separators could be added to make these partially protected cycle lanes; and A separated pathway through the old rail cutting, comprised of a 3m two-way cycle track and a 2m footpath which is LTS1. This provides a more direct and relatively flat connection between Coolangatta (particularly southern Coolangatta)/ Tweed Heads and destinations to the north, complementing the Oceanway which has a high recreational value but is relatively indirect
Public Transport (bus)	No changes are assumed for TfNSW route 601 which will continue to use Miles Street. However, replacement bus stops are required due to LRT construction and these will be located as close as possible to the LRT station at Miles Street to maximise interchange opportunity for the large Tweed Heads West catchment to the south. Given the low frequency of service (2 buses per hour) in lane bus stops immediately north of the LRT crossing are proposed Tram Replacement Bus services are assumed to follow the LRT route on Coolangatta Road with the need for bus stops at the north-western end of Coolangatta Road near Charlotte Street and an additional pair at the eastern end, utilising the relocated route 601 stops on Miles Street. This is because Tram Replacement Bus services are assumed to use Miles Street and Marine Parade to access Coolangatta due to the lack of any roadway running parallel to Light Rail through the old rail cutting. Given the infrequent nature of these and likely off-peak usage in lane bus stops are proposed.

8.5 Coolangatta option refinement

8.5.1 Refined design philosophy

In order to refine the design philosophy for the Coolangatta section stakeholder feedback on the shortlisted C3 option from the MCA was reviewed and a follow-up workshop with Council stakeholders was held on 24 November 2021. From this, the following refined design philosophy statements were developed:

- Reuse the existing protected rail corridor between Miles Street and Lanham Street.
- Provide a direct and efficient Light Rail corridor between Chalk Street and Lanham Street
- Enhance the amenity and public realm of Chalk Street (a key station interface and pedestrian access route)
- Maintain local street access for Garrick Street, Lanham Street, Musgrave Street and McLean Street
- Maintain access along and property access to Chalk Street from McLean Street
- Minimise impacts on McLean Street/Griffith Street roundabout
- Minimise impacts on car parking and mitigate where possible through offsets within the study area
- Provide flexibility for the Light Rail corridor to be extended further south towards Tweed Heads
- Improve the safety and attractiveness of the precinct for pedestrians and bike ride activity (such as through speed reductions)
- Minimise impacts on existing Norfolk Pine trees along the frontage of 45 McLean Street
- Provide a highly visible and legible LRT terminus station with good pedestrian access to Griffith Street

8.5.2 Design changes and refinements made

Key elements of the design that were amended or refined in response to the design philosophy are captured in the following table.

Table 8-4: Design changes and refinement Coolangatta

Design element	Description of change/ final option
Station location and land uses	Three potential station locations were investigated namely McLean St, Mid Block and Warner Street. Following stakeholder discussion on the 24 November 2021, Option 3 (Warner Street) was confirmed as the preferred station location. This location was identified as offering the best opportunity for a highly visible and legible station with direct access north to the beach and south to the surrounding catchment. It was also the best located geographically to serve the wider Coolangatta town centre including destinations further east along Griffith Street including Twin Towns.
Horizontal alignment	The Light Rail corridor exits the Lanham Street Park at the Coolangatta Police Station and Court House between Musgrave Street and Lanham Street. It then crosses McLean Street and continues on the southern side and parallel to Chalk Street before terminating at Coolangatta Station, west of Warner Street. The corridor is positioned to enable it to continue further south into Tweed Heads. The alignment suits options which continue along Chalk Street and Gerrard Street. The horizontal alignments for McLean Street, Musgrave Street and Lanham Street are generally as per existing with all existing local road connections maintained.
Vertical alignment	The Light Rail alignment exits the existing Lanham Street Park cutting and crosses McLean Street at existing heights. The vertical grading of the alignment generally matches the existing as it runs parallel to Chalk Street
Intersections and local access	The Preferred Option results in some minor changes to intersection locations, layouts and access configurations as follows: ▪ Garrick/ Lanham – no change (remains an unsignalised all movements T intersection) ▪ McLean Street South / Lanham Street west – no change (remains an unsignalised all movements T intersection)

Design element	Description of change/ final option
	▪ Lanham Street west/ McLean Street north/ Lanham Street east – existing unsignalised all movement intersection signalised with all movement retained. ▪ McLean Street north/ Musgrave Street - Remains unsignalised but the right turn movement out of Musgrave has been removed with vehicles needing to use the roundabout to head east
Station configuration	▪ Coolangatta LRT station is an island platform arrangement, 8m in width, which is consistent with Helensvale Station and wider than a typical 4.8m island platform. The LRT tracks extend approximately 20m beyond the end of the platform to accommodate a buffer stop arrangement (again, consistent with Helensvale LRT station) Pedestrian access to provided to both ends of the LRT platforms, with a signalised crossing of Chalk Street and the LRT tracks at the western end of the platforms and a raised zebra crossing (wombat) of Chalk Street at the eastern end of the platforms
Property access and impacts	Minimal impacts to property accesses in Coolangatta. Key property requirement is the Police Station/ Magistrates Court on Musgrave Street
Public carparking	In total there are approximately 382 car parking spaces on the southern side of Chalk Street, southern side of Musgrave Street and in the off-street Chalk/ Lanham carparks. The final design of the Light Rail tracks and station requires the removal of 186 of these, while the potential station plaza area would require the removal of a further 18 carparks. 130 carparks at the western end would be retained unchanged while a further 106 carparks could be provided where the Twin Towns kindergarten is currently located and by reconfiguring the eastern carpark. A net increase of 34 carparks on the southern side of Musgrave Street (west of Mclean Street) is also proposed. Overall, this would result in 270 carparks being retained/ provided relative to the existing 382, equating to 70% of the current capacity. Based on the City of Gold Coast commissioned occupancy surveys this would be more than sufficient to cater for peak demands.
Active transport	The refined design in Coolangatta includes new relocated or formalised pedestrian crossing facilities including: ▪ New signalised pedestrian crossings of McLean and Lanham Street as part of the LRT intersection with McLean Street ▪ Relocated zebra crossings on Lanham Street east aligning with new crossings of the LRT tracks and to provide access between the bus stops and the LRT station ▪ Provision of 1 addition zebra crossing and 1 additional signalised mod block crossing of Chalk Street to align with pedestrian crossings of the LRT tracks ▪ Relocated and raised (wombat) crossing of Musgrave St closer to McLean St on the pedestrian desire line The final design also includes new facilities to enhance cycle connections to and through Coolangatta, complementing the existing Oceanway, as follows: ▪ Off road, separated path through the old rail cutting as far east as the new signalised intersection of Lanham Street/ McLean Street/ LRT corridors, forming an all ages and abilities cycle facility (LTS1) (refer Item 1) East of the rail cutting a Shared Use Pathway along the southern verge of Lanham Street and Scott Street provides an all ages and abilities cycle facility (LTS1). Priority for pedestrians and bike riders crossing Dutton Street help reinforce this as an LTS1 facility
Public Transport (bus)	▪ New bus stops have been provided on each side of Lanham Street with clear line of sight to the LRT station to allow easy bus-LRT interchange and also to cater for tram replacement buses in close proximity, when required ▪ Each bus stop is 35m long capable of accommodating 2 buses simultaneously, assuming semi-independent operation. A 50m long layover bay (capable of accommodating 2 buses with independent manoeuvring) is also proposed on the southern side of Lanham, west of the north-westbound bus stop to cater for a potential extension of Tweed route 600.

8.6 Risks and issues

A risk register was developed and can be found in Appendix K. Key findings are captured under the following sections, whereby risks and issues as well as associated recommendations for mitigation are highlighted.

Some overall project wide risks and issues are listed below

- Project scope and limitation: the study scope and purpose has been designed to inform corridor planning and likely future land requirements only. It was not undertaken to a level of detail sufficient to justify any particular investment in infrastructure.
- Costs and affordability: Initial construction costs estimates used to support option selection are unlikely to be sufficiently robust for future planning and investment decisions particularly with significant price rises in material and labour across the construction industry
- Level of information including PUP and survey: This is currently relatively coarse, resulting in a risk of additional costs to address currently unforeseen issues. Undertake further investigations (survey, PUP) to inform future design to mitigate this risk
- Drainage and flooding – the level of detail and analysis undertaken in this design phase was limited and there was no modelling. Further design stages will need to resolve flooding and drainage issues.
- Transport and traffic modelling: Modelling tools used will need to be reviewed in future project stages to take into account changes in traffic volumes, population and employment. There are also identified opportunities for using a refined suite of modelling tools, in the latest software versions to provide a better, more consistent corridor level assessment from Burleigh Heads through to Coolangatta
- Road safety risks including driver confusion in areas where LRT right of way intersects with traffic lanes. Consider detail signage and line marking treatment to reduce driver mistakes
- Pedestrian safety risks particularly on or near the Gold Coast Highway where the posted speed remains 80 km/h. Investigate further measures and controls to reduce both the likelihood of a pedestrian-vehicle conflict and the consequence should it occur.

Some high-level risks identified for the four project sections are tabulated in Table 8-5:

Table 8-5: risks and opportunities

Area	Risk/Issues
Whole of corridor	Technology: investigate what provisions could be included as part of future design stages to enable wire-free Light Rail operations on all or part of the study corridor. This could include a review of latest vehicle requirements/ capabilities as well as opportunities for alternate traction power and charging infrastructure.,
Bilinga	Community/ political - Risk of community acceptance of the extent of changes to local access particularly to/ from Coolangatta Rd- potential need to amend design and add more costly access arrangements. Environmental/ community - Risk of greater vegetation loss than indicated on plans, due to either construction impacts or risks imposed by large tree close to the LRT alignment (overhead wires) Traffic/ safety - Closely spaced intersections between Desalination Plant Road / GCH and Boyd Street/Gold Coast Highway and potential for queue overspill – may require further investigation of both infrastructure and operational (signal coordination) measures Traffic/ access - Design vehicles unable to undertake all turn movements along Gold Coast Highway and Coolangatta Road due to tight geometry – may require a wider access strategy or further design development
Airport	Internal access road - Uncertainty about the future design, location and operations of the internal airport access roads including levels. Pedestrian access – the connection between Airport and transport hub may need further review including the form of crossing over the bus access road. Opportunity to improve quality of connection through wider footpaths and frequent/improved shelter.

Area	Risk/Issues
	Depot operations – The LRT access to depot is limited to a south facing connection – potential need to investigate north facing track access options if this operational flexibility is required Tenure/ legal - risk of any proposed transport infrastructure on Federally leased airport land not being fully protected from incompatible uses – requires consultation with the federal Department of Infrastructure, Transport, Regional Development and Communication (Airport branch) around legal mechanism for protection as well as consultation with Queensland Airports Limited as lessee.
Kirra	Pedestrian and cycle connections – Connection between Airport and Oceanway is beyond the scope of the project and is unresolved as it relies on decision about other Oceanway connections by CoGC – continue to work with council to resolve the wider precinct strategy Flood immunity - LRT would not have immunity to a 1% AEP flood event. Further hydraulic modelling required to understand if wider measures such as additional culverts/ pipes) can improve the immunity of the current LRT design or to investigate ways to raise the LRT corridor and accept additional property impact where the road may need to be re-graded. A related opportunity is that any flood mitigation works undertaken to support future LRT implementation may improve existing local flooding issues. Geotechnical risks associated with retaining wall design and construction methods – further site investigations required to inform these Land – the removal of the Musgrave Street flyover and the consolidation of complex traffic movements into a simpler set of intersections releases a large area of road reserve land between the Gold Coast Highway and Musgrave Street which could be investigated for alternative uses including commercial uses, active public recreational uses (such as parkland/ playgrounds) or passive uses such as vegetated buffer zone.
Coolangatta	Electrical safety – risks to human safety where residences/people located on Gordon Lane that are at/above the OLE Level. Barrier treatments such as anti- throw screen fencing on top of barrier will need to be considered Pedestrian/ cyclist safety – general risks associated with increased level of pedestrian and cyclist activity around McLean Street and Lanham Street increased the likelihood of conflicts with vehicles. Whilst partly controlled through formal crossings consider reduced speed limits such as 30-40 km/h to reduce consequence of such conflicts Amenity/ urban realm –the current design has not yet optimised the amenity, activation and passive surveillance for passengers in the vicinity of the LRT station. Significant opportunities exist through a comprehensive precinct master planning exercise to identify the preferred ultimate arrangement of car parking and other land uses (including buildings with active ground floor frontages) fronting or in close proximity to the LRT station to improve the safety and attractiveness of the urban realm in this Major Regional Activity Centre. Extension feasibility risk – whilst the current terminus is orientated to facilitate simple onward extensions towards Tweed Heads the current planning does not identify or explicitly protect for property required east of Warner Street to further extend LRT. There is a significant opportunity to continue to work with TfNSW to identify a pathway to route protection to support this potential future extension.