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.

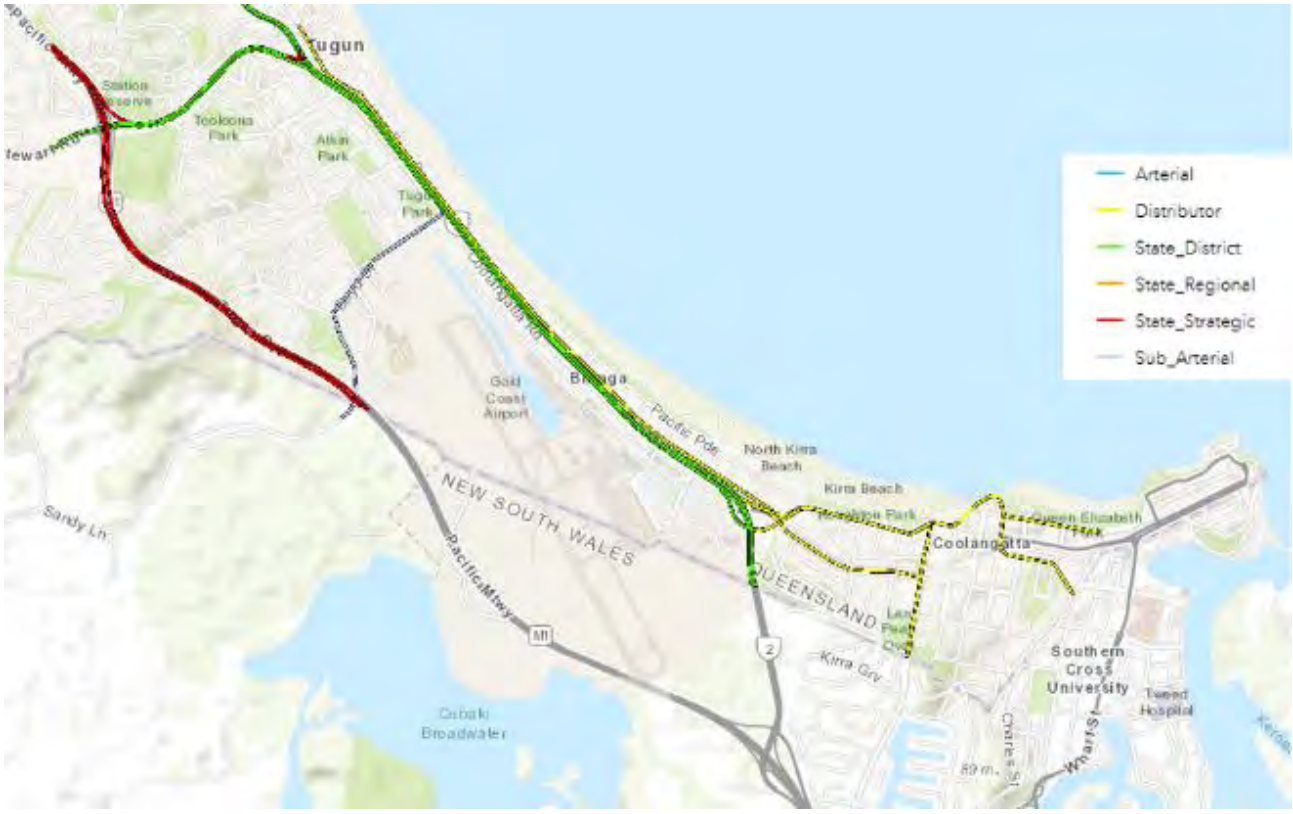


Figure 3-1 Functional road hierarchy (Source City of Gold Coast, 2022)

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

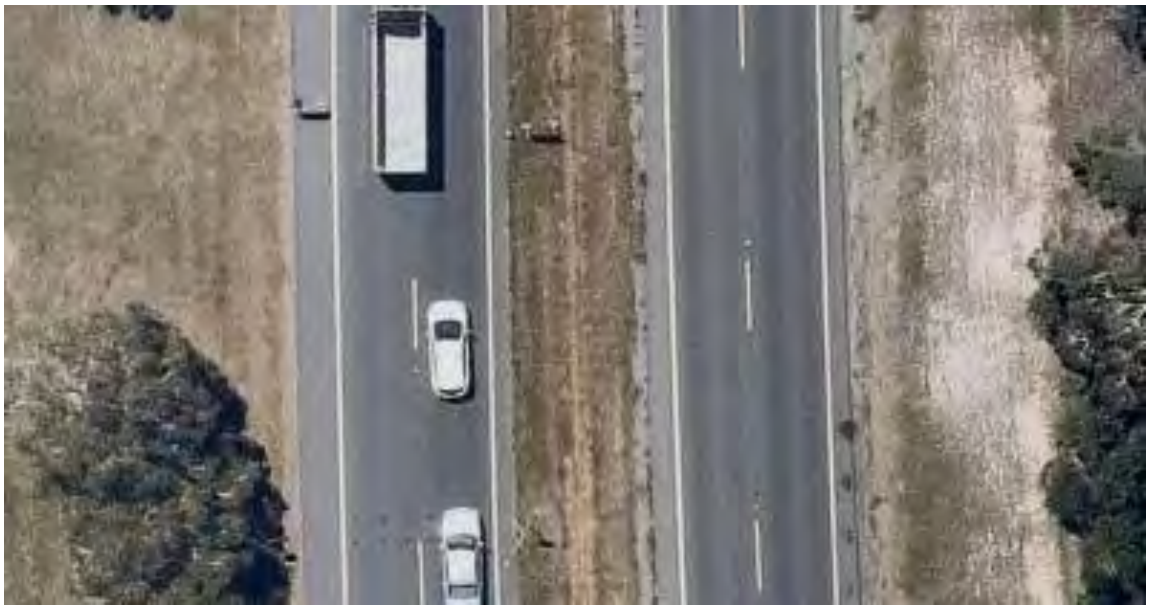


Figure 3-4 Gold Coast Highway (Kirra) typical carriageway (Image source: Metromap 2020)

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:

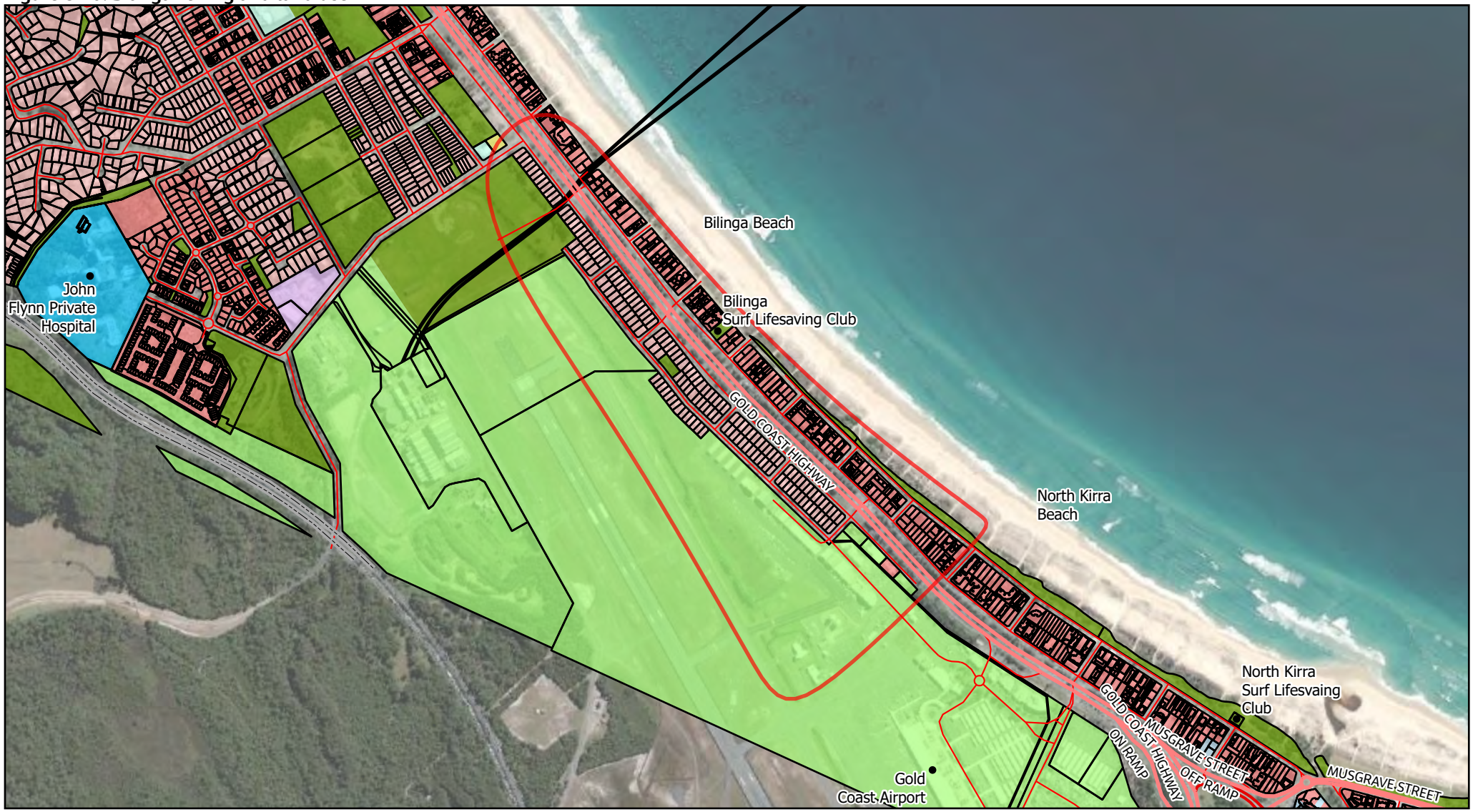
- the Gold Coast Airport
- Bilinga Beach
- the Bilinga Surf Lifesaving Club
- John Flynn Private Hospital.

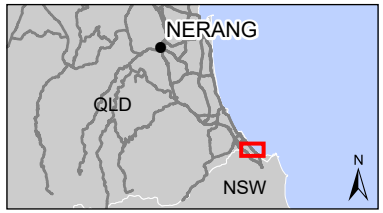
Planning Scheme zoning for the Bilinga section of the study area is identified in Figure 3-10, and generally provides for low density residential and special industry land uses to the south of the Gold Coast Highway and medium density residential land uses to the north of the highway. The Planning Scheme 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)

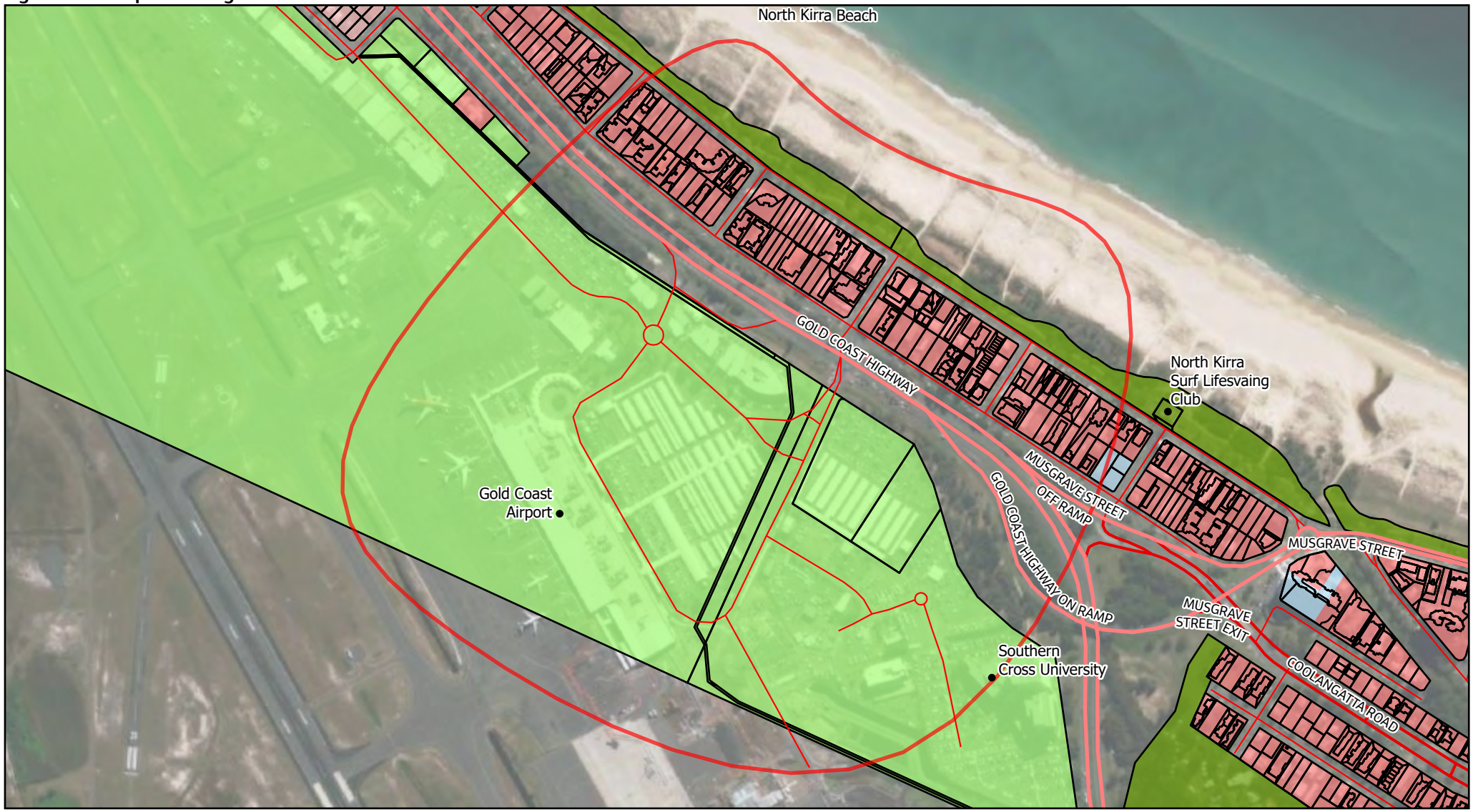
Land use within the Airport section of the study area is currently characterised by a mix of low and medium density residential development to the north of the Gold Coast Highway, with a number of short-term accommodation activities scattered along Pacific Parade and Golden Four Drive. Land uses to the 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.

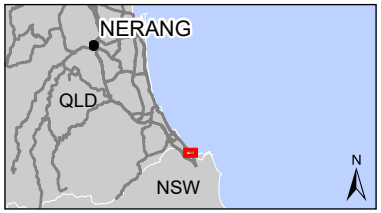
Planning Scheme zoning for the Airport section of the study area is identified in Figure 3-11. The Planning Scheme provides for medium density residential land uses to the north-east of the Gold Coast Highway, with land to the south-west of the highway zoned Special Purpose. The Planning Scheme envisages 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:

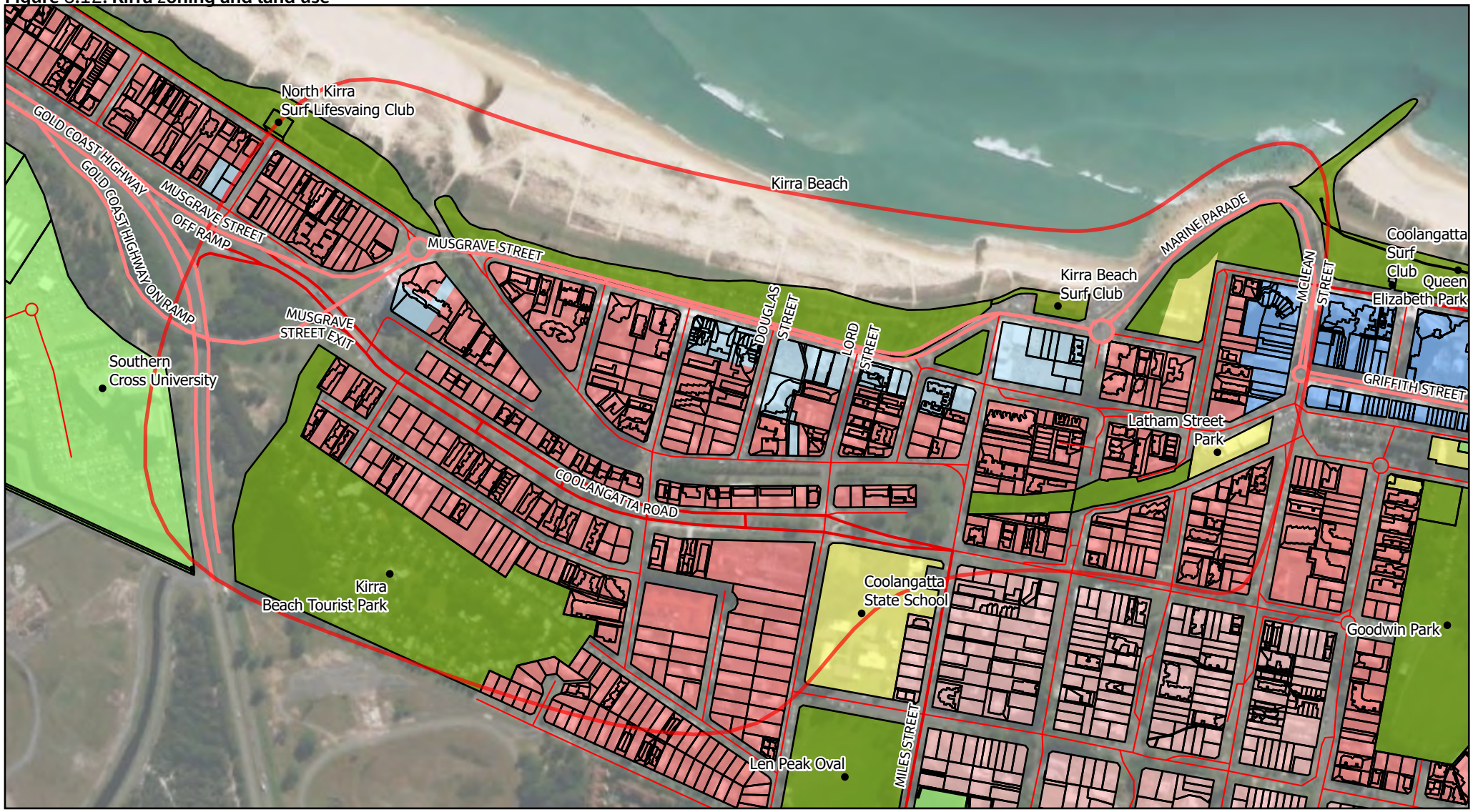
- between 9 m and 15 m (2 – 4 storeys) to the south of Coolangatta Road
- between 15 m and 29 m (4 – 8 storeys) to the north of Coolangatta Road
- 39 m along McLean Street.

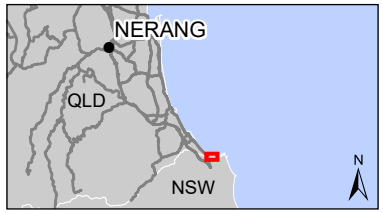
A desktop analysis of the study area has identified that the intended pattern of land use within the Kirra section of the study area, as expressed through the Planning Scheme zoning, is currently largely unrealised. Significant tracts of land within Kirra are either vacant or underutilised, particularly 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.

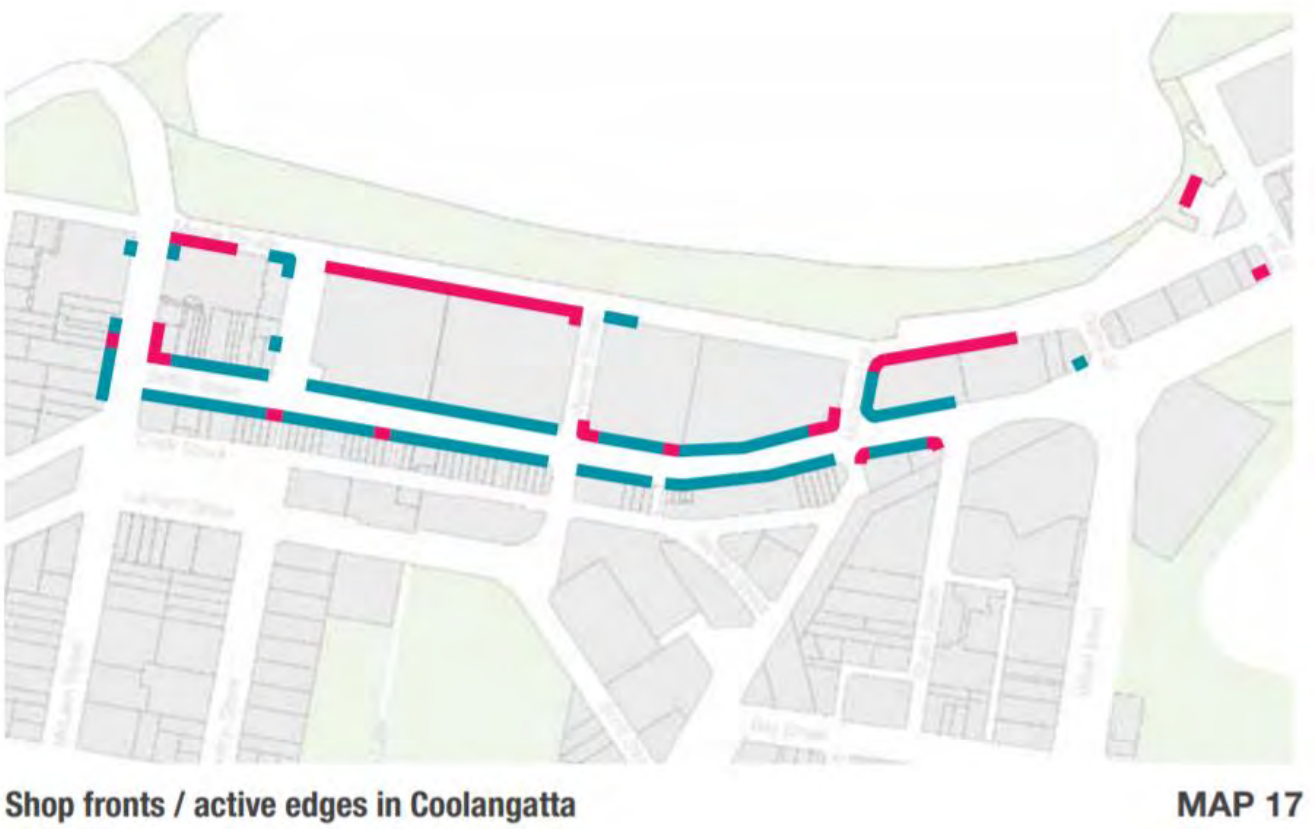
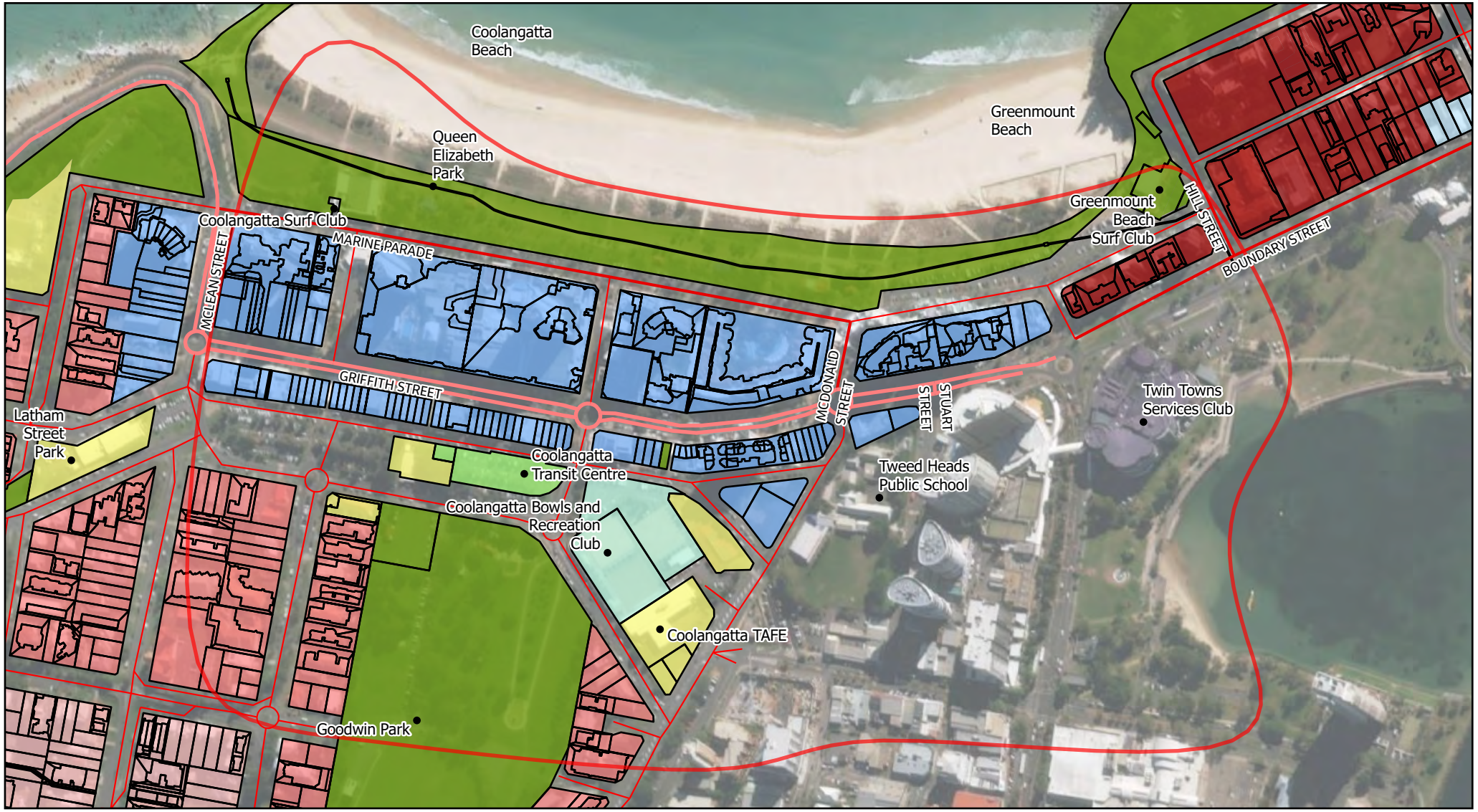


Figure 3-13: Shop fronts / active edges in Coolangatta (Coolangatta and Kirra Business Centre Master Plan CoGC,2020)

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.

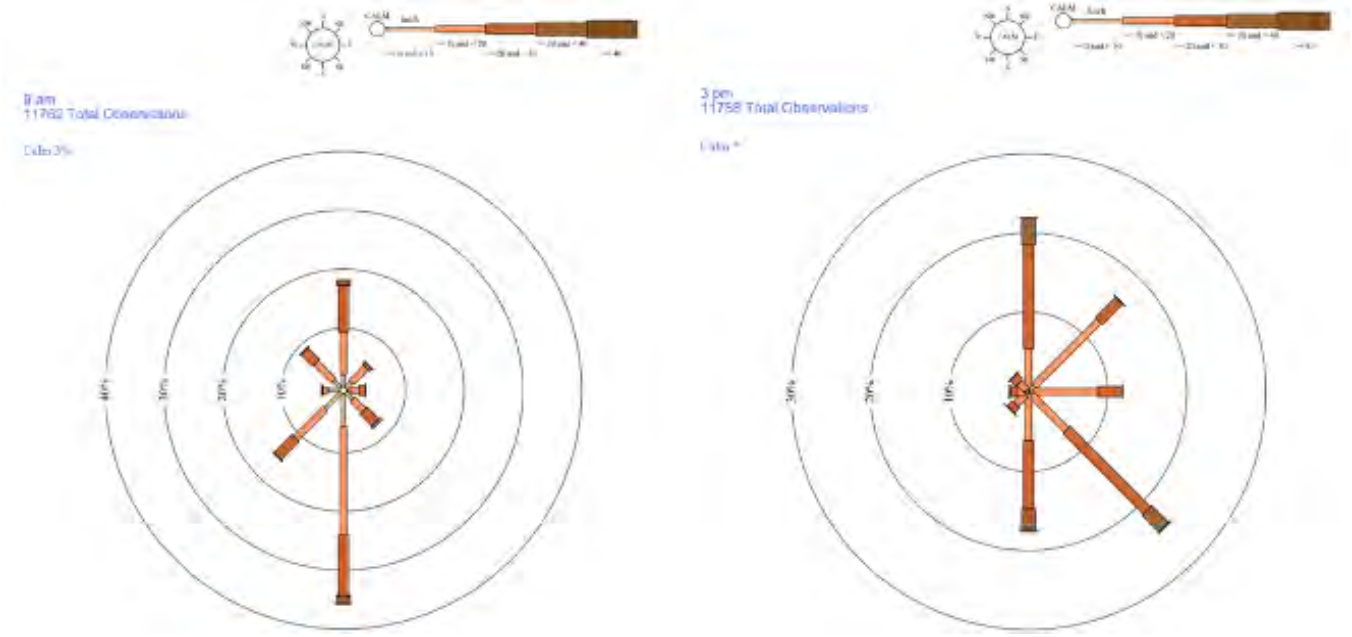


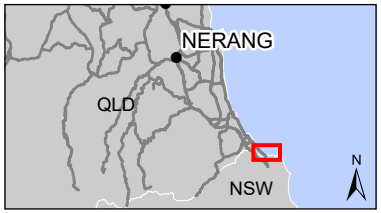
Figure 3-15: Rose of wind direction versus wind speed (km/h) between1982 and 2021 (BoM, 2021).

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

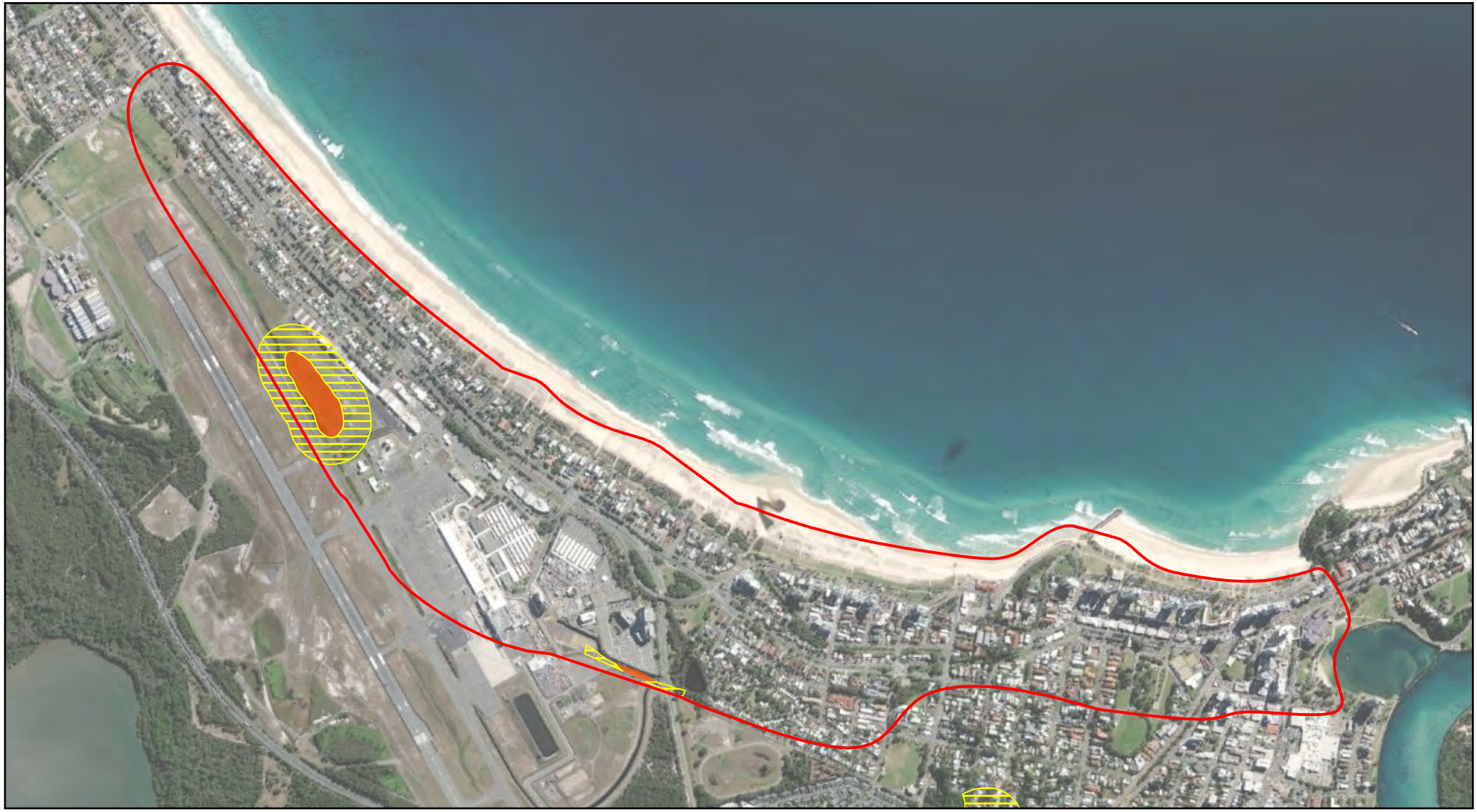
GDA 1994 MGA Zone 56 A4 1:20,000

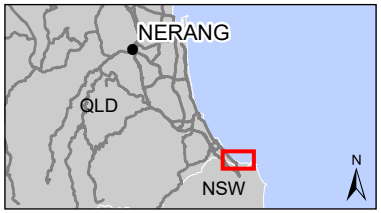
Jacobs

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

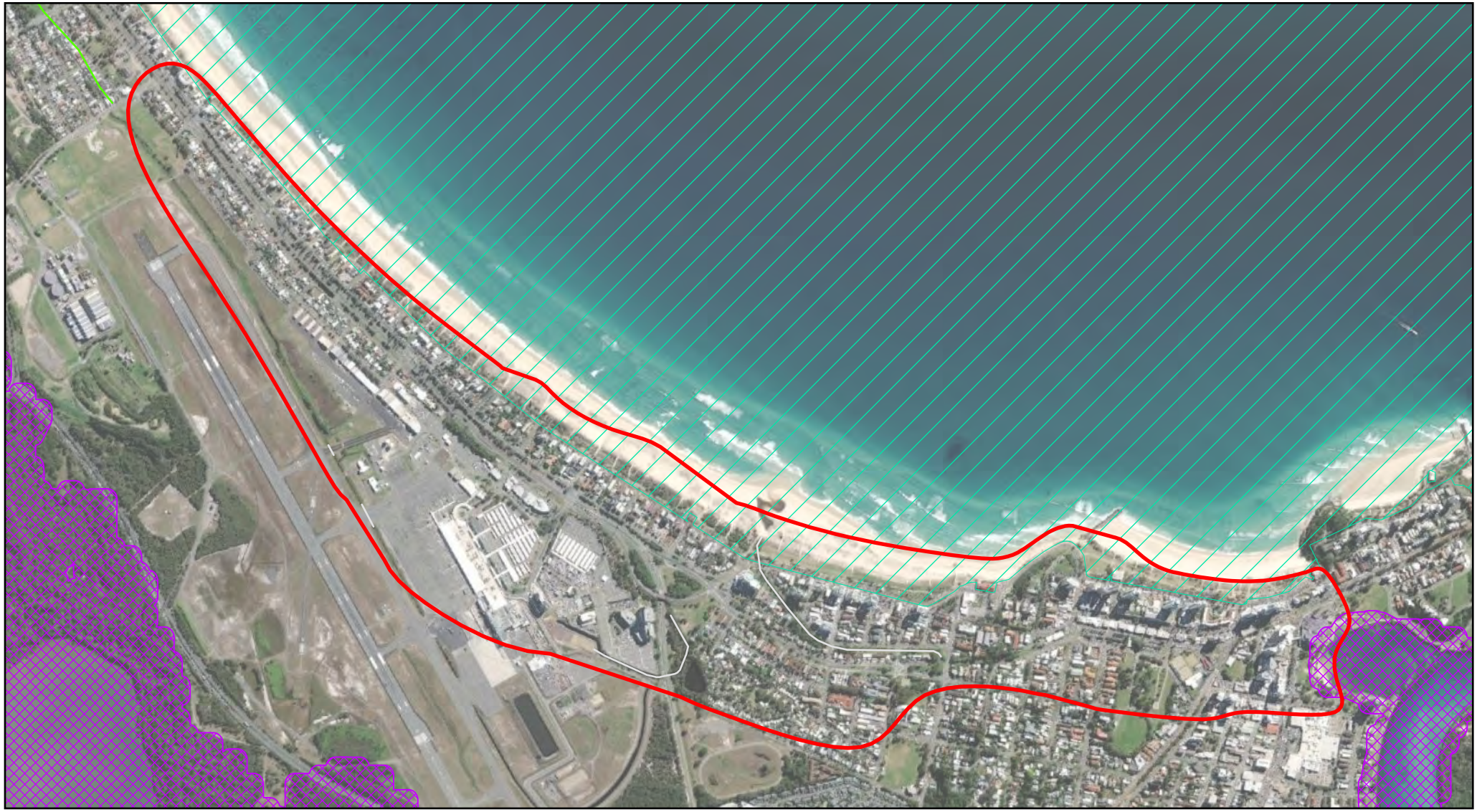
A review of the DSDILGP SPP IMS has identified the presence of several high ecological significant wetlands that are Matters of State Environmental Significance (MSES) within and adjoining the study area. These wetlands are identified on Figure 3-18 and are located within the Gold Coast Airport site 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).

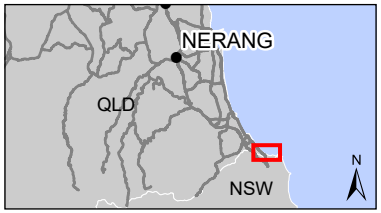
Given the location of these MSES and MLES wetlands it is considered unlikely that the project will result in direct impacts to these features, however indirect impacts to these wetlands should be considered as development of the project progresses.

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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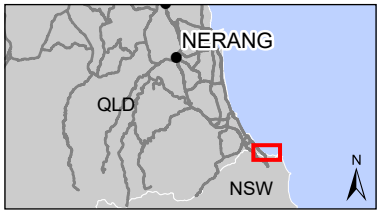
Figure 3.19: Matters of Local Environmental Significance - Water Features



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.

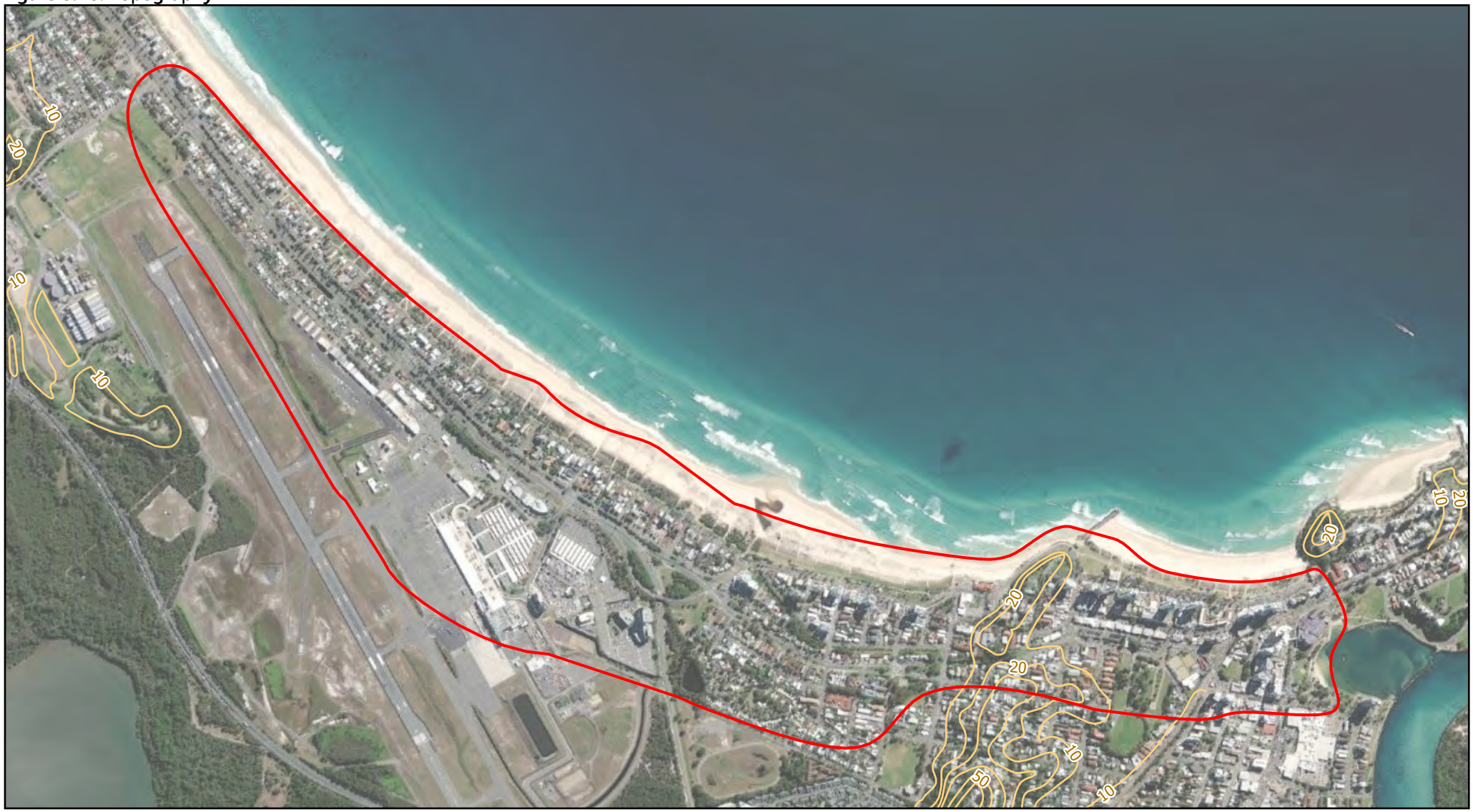
Acid Sulfate Soils

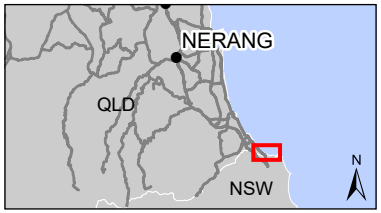
A more detailed discussion on Acid Sulfate Soils can be found in Section 3.2.5

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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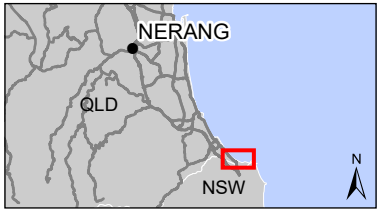
Figure 3.21: Soils



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.

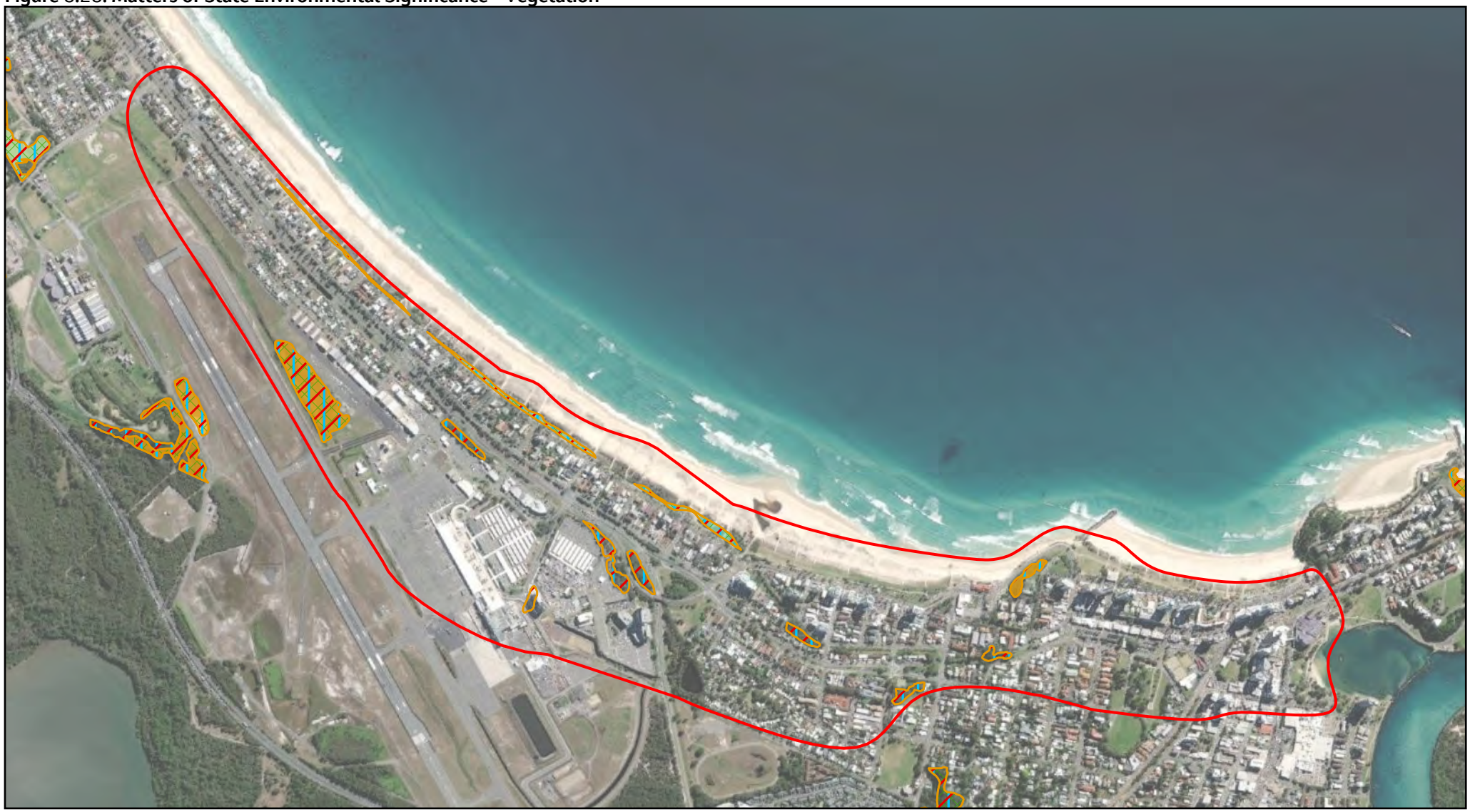
Protected fauna

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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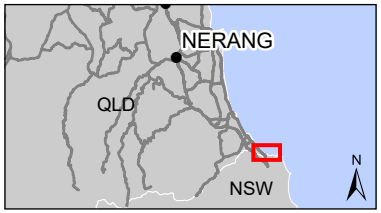
Figure 3.24: Matters of Local Environmental Significance - Vegetation



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

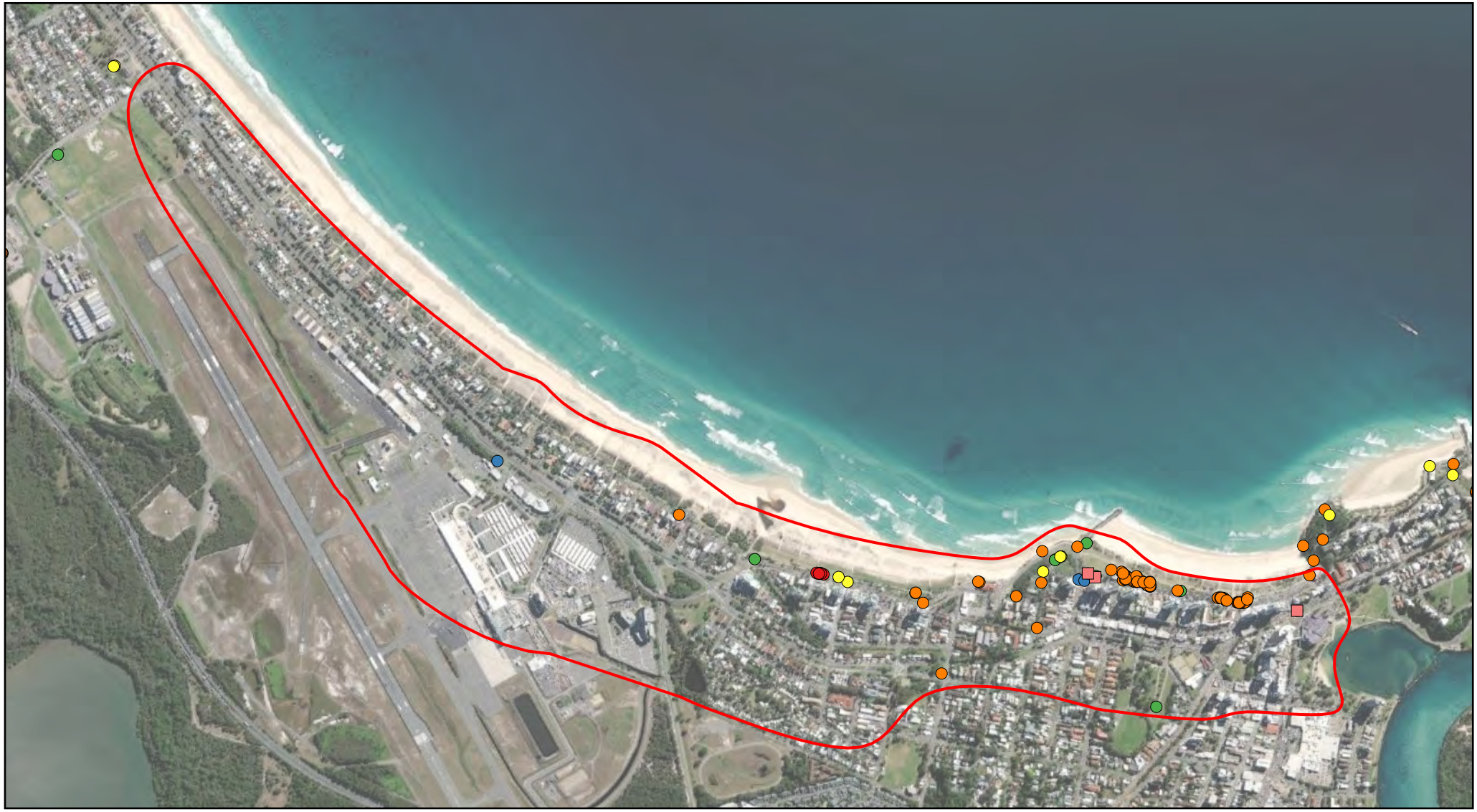
The Aboriginal Cultural Heritage Act 2003 and the Torres Strait Islander Cultural Heritage Act 2003 contain Duty of Care provisions that require those conducting activities in areas of significance to take all reasonable and practicable measures to avoid harming cultural heritage.

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.

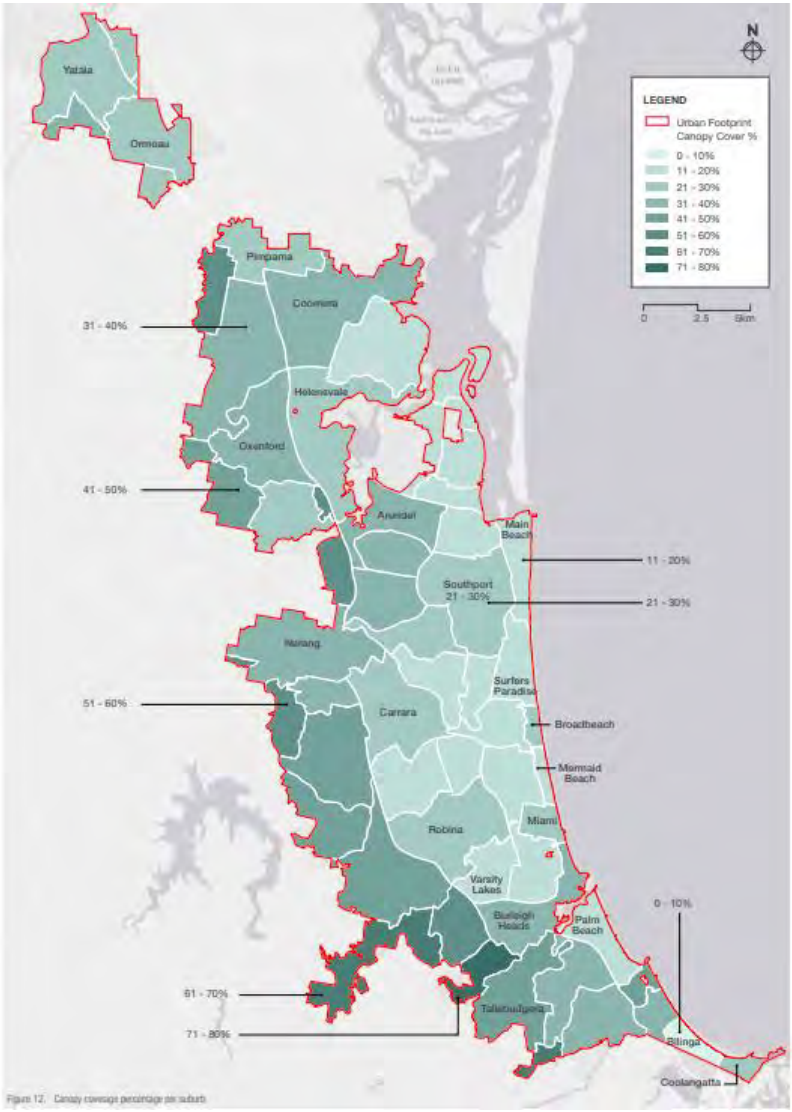

Figure 3-26: Canopy coverage percentage per suburb (Source: Urban Tree Canopy Study,2020)

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.

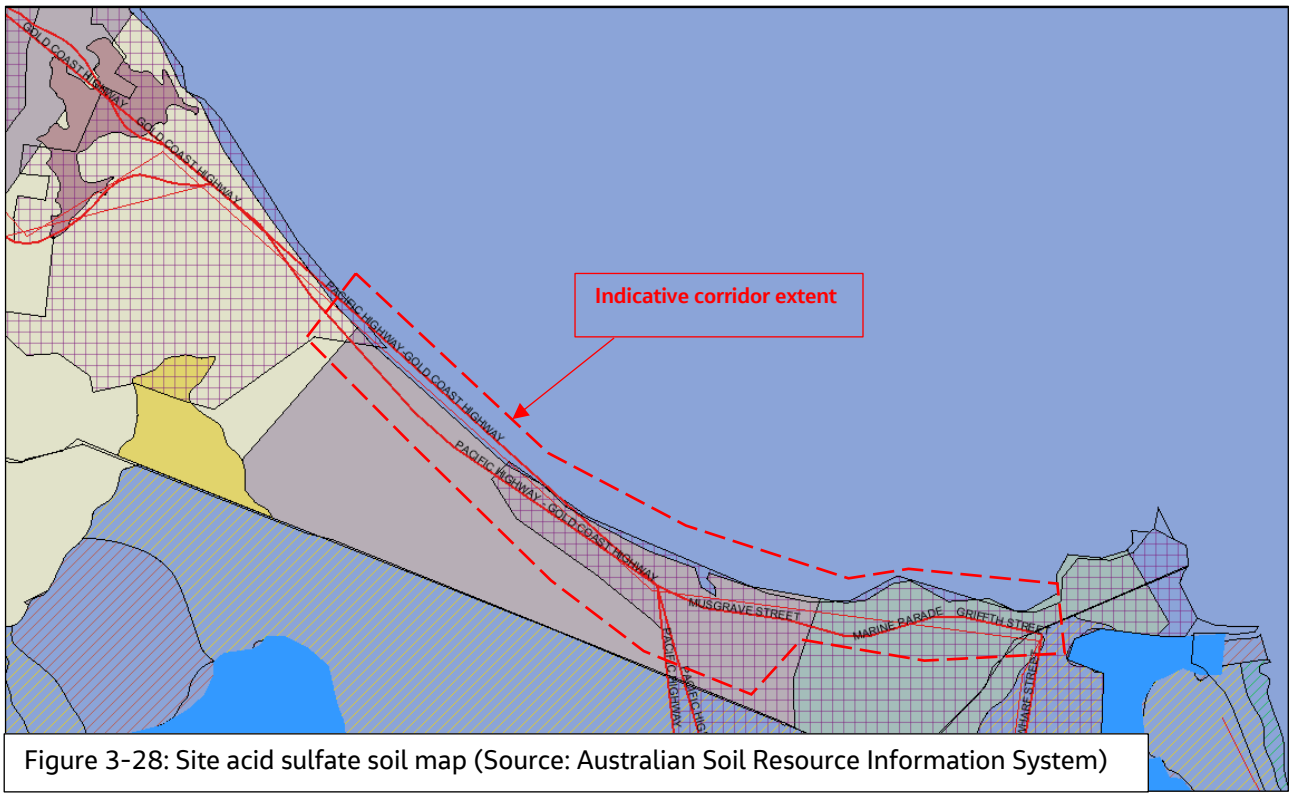

Figure 3-28: Site acid sulfate soil map (Source: Australian Soil Resource Information System)

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.

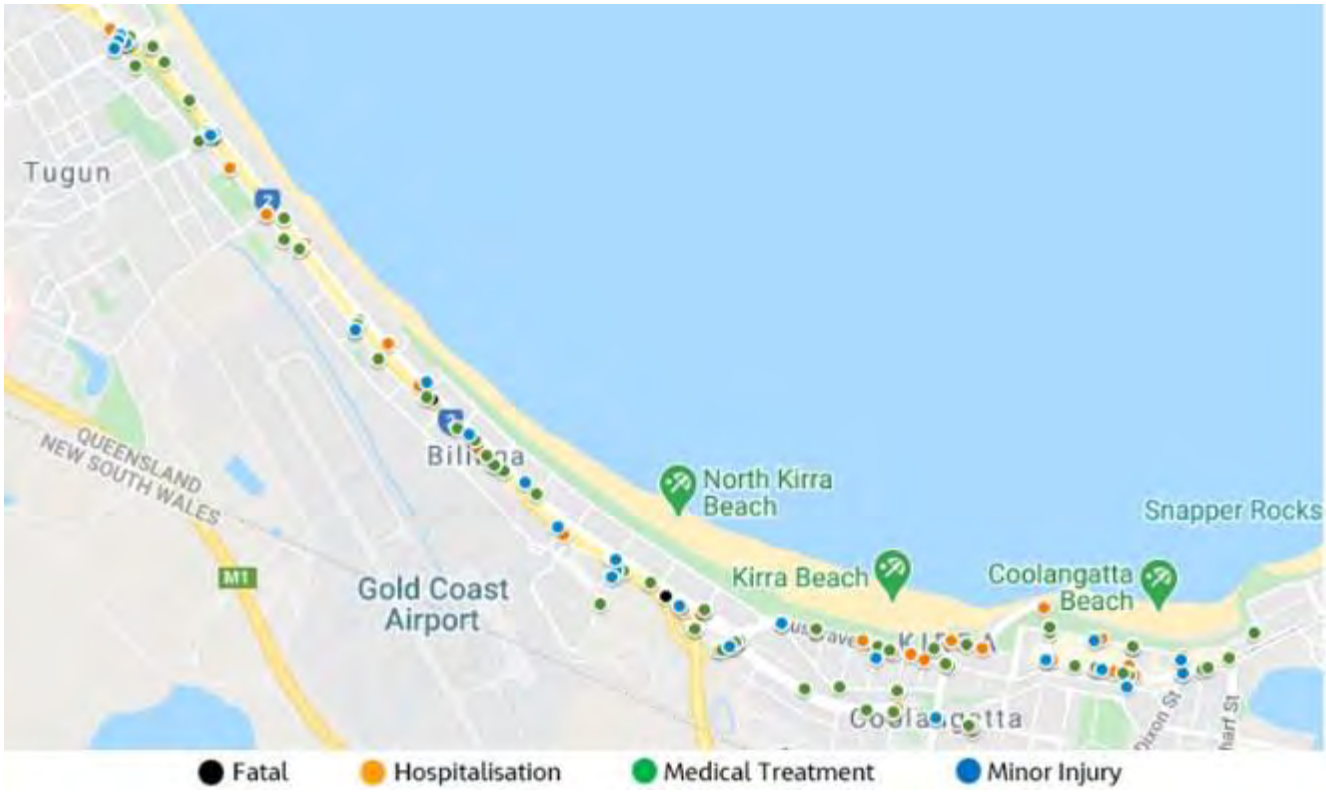

Figure 3-34 Crash Analysis 2014 to 2019[2]

[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).

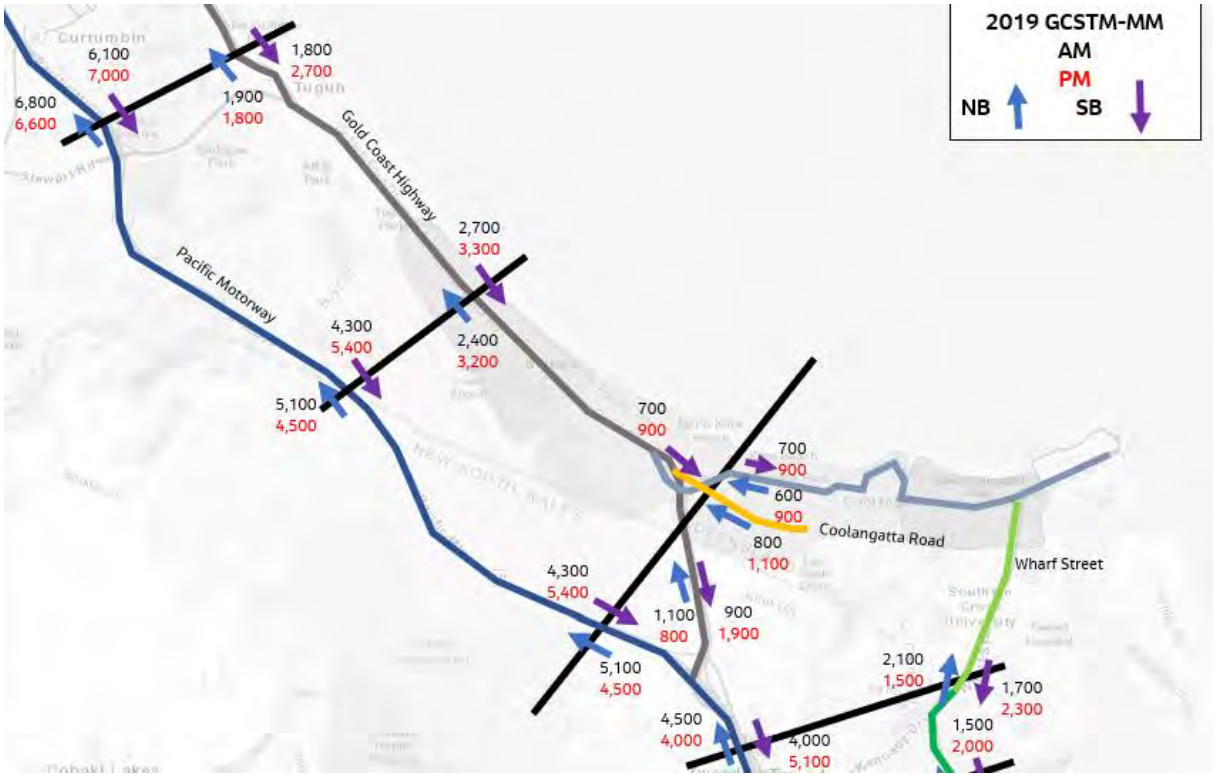

Figure 3-36: 2019 traffic volumes (Source: GCSTM-MMv2.2 Model Run: GC_2019_N013d_TW03)

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)

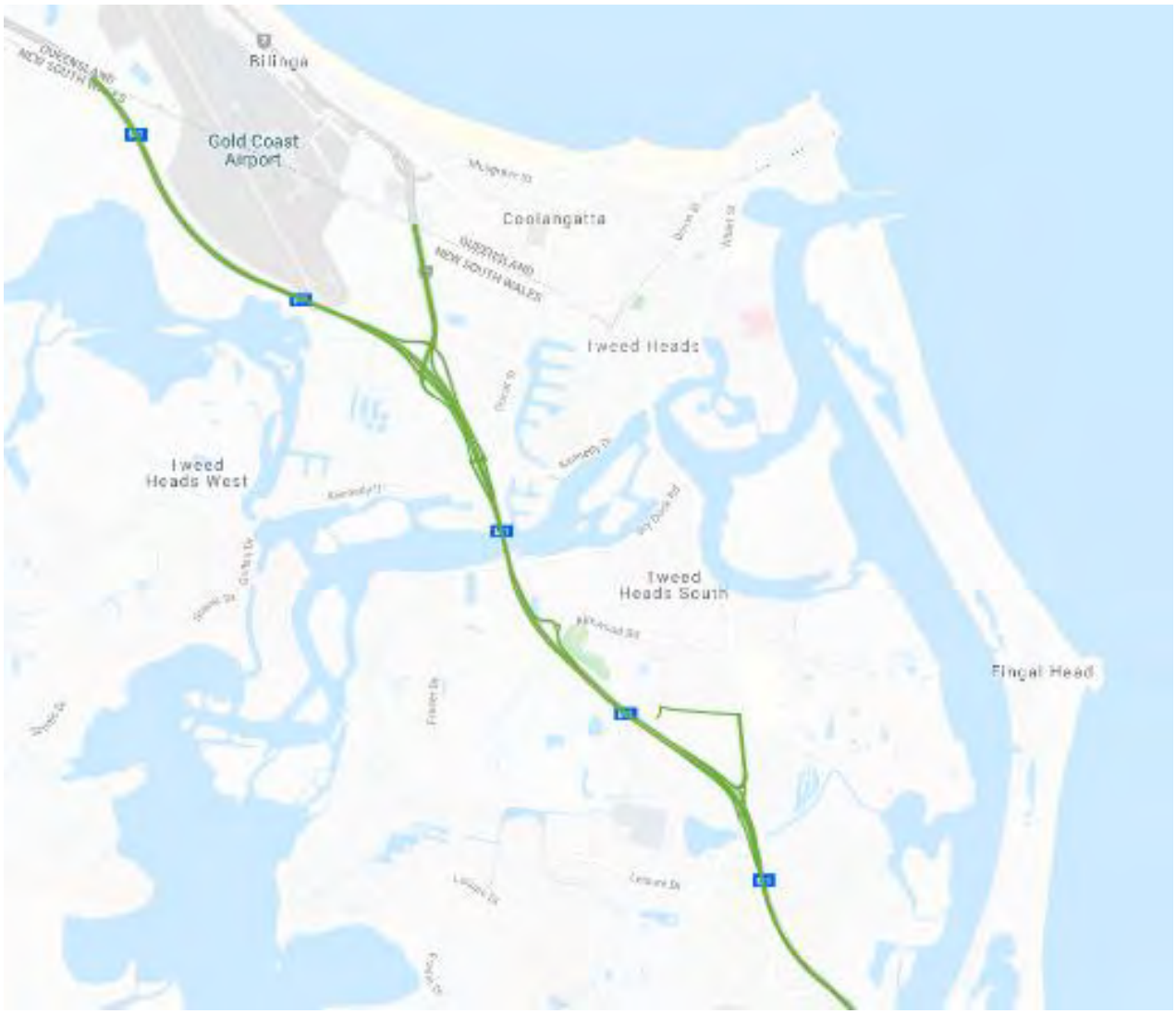

Figure 3-38: NSW heavy vehicle route map – 25/26m B-double Routes (Source: NSW Combined Higher Mass and Restricted Access Vehicle Map)

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

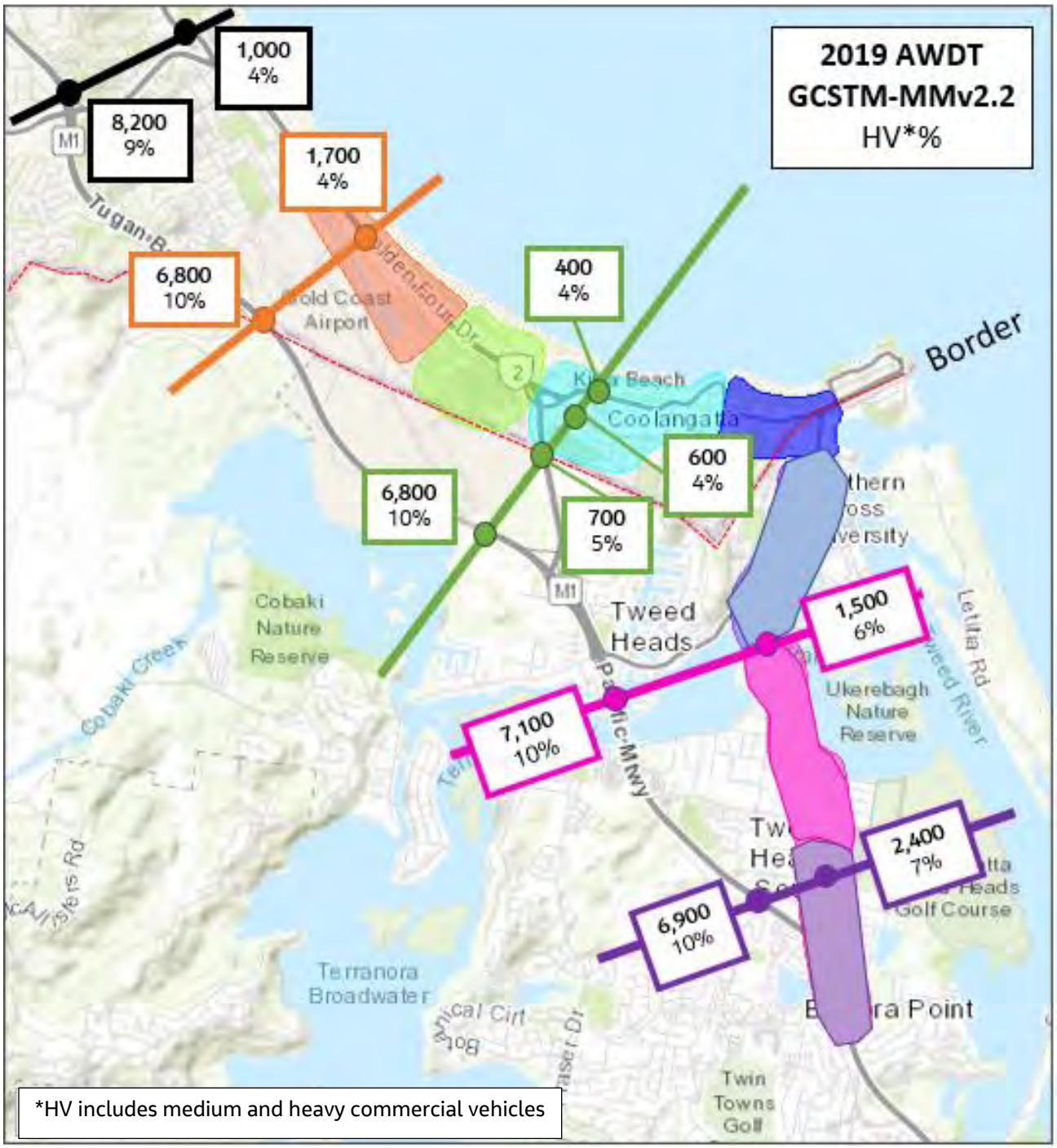

Figure 3-39: 2019 AWDT heavy vehicle volumes (Source: GCSTM-MMv2.2 , Model Run: GC_2019_N011_B003)

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.

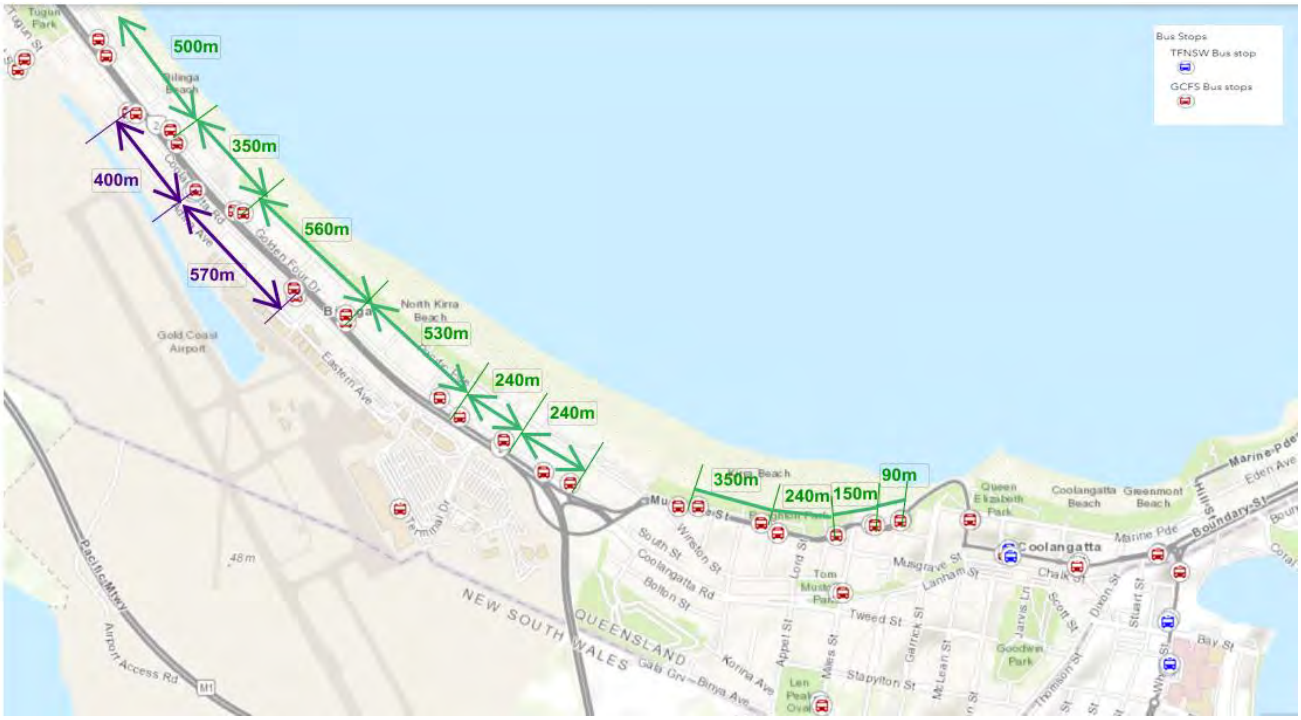

Figure 3-40: Bus stop locations and distances between stops along Golden Four Drive and Coolangatta Road (Source: Jacobs GIS webmap, 2022)

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.

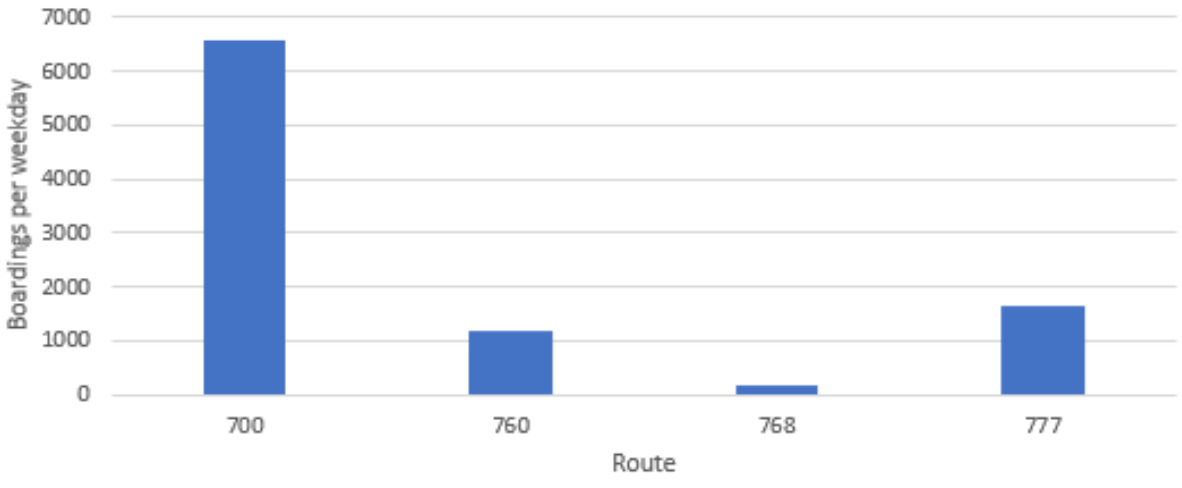

Figure 3-42: Boardings by route for the public transport services which travel through the study area

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.

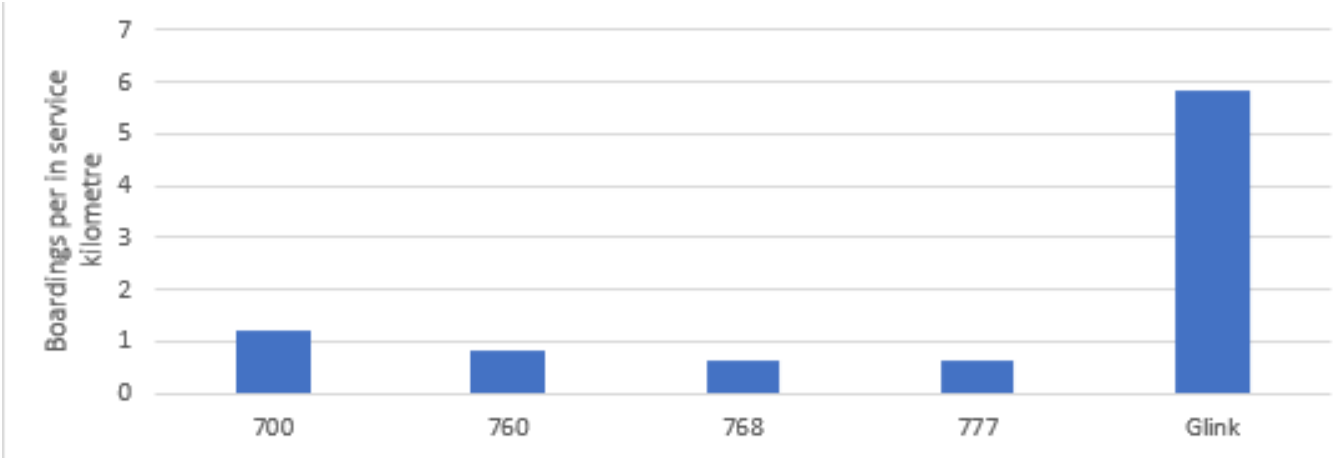

Figure 3-43: Boardings by route per kilometre

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.

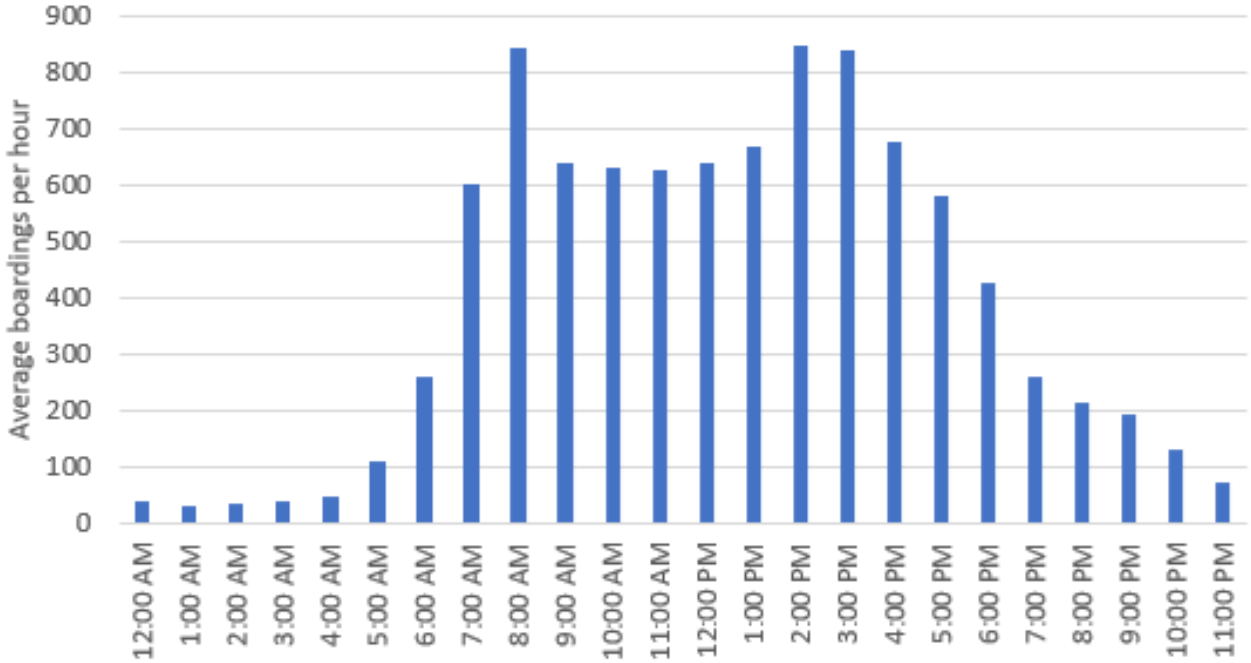

Figure 3-44: Boardings by time of day for routes 700, 760, 768 and 777

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

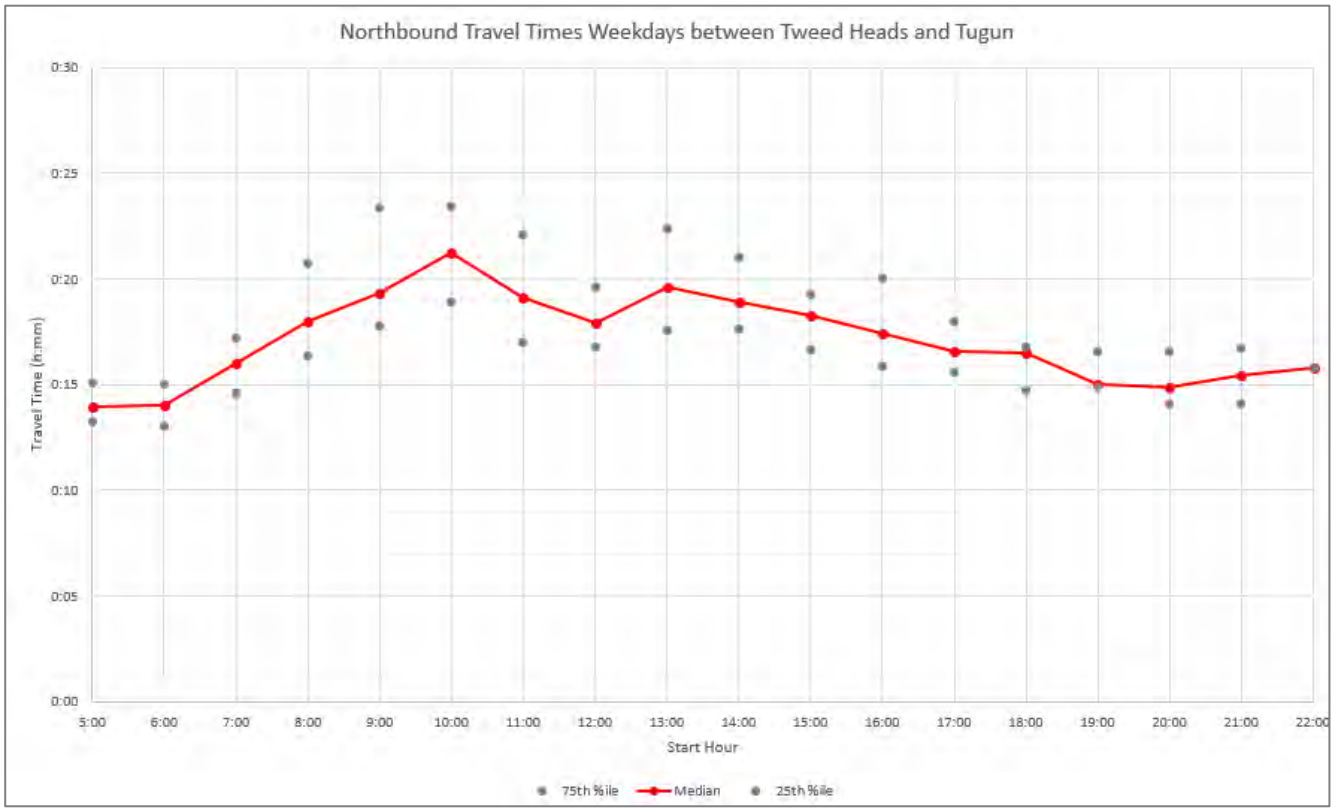

Figure 3-46: Travel time between Tweed Heads and Tugun northbound

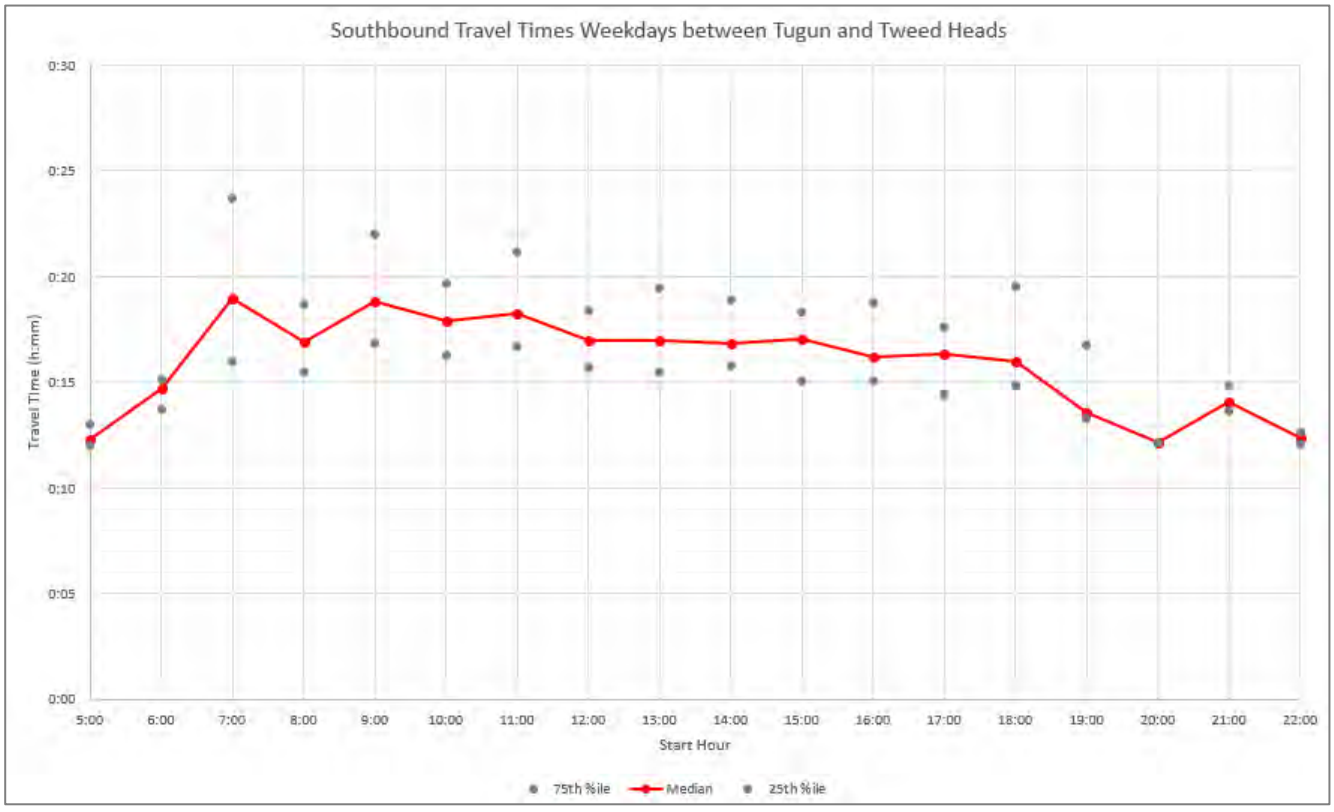

Figure 3-47: Travel time between Tugun and Tweed Heads southbound

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)

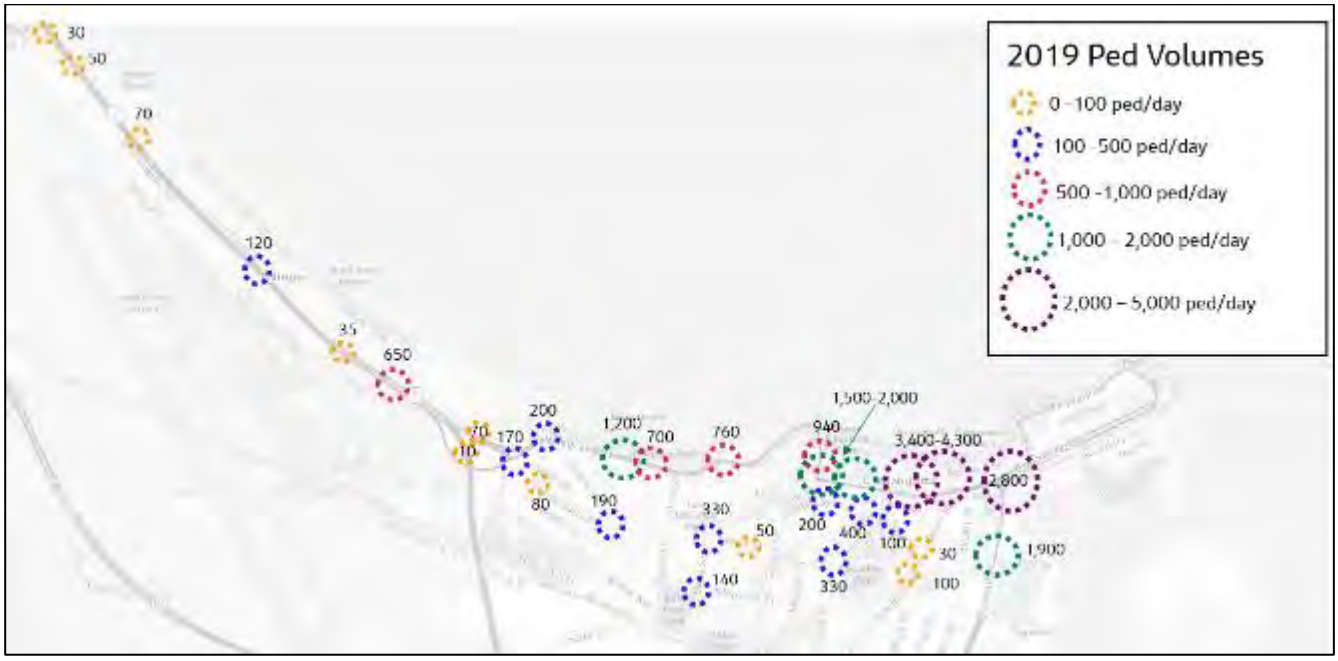

Figure 3-49: Daily pedestrian volumes (10-hour totals)

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