APPENDIX 3: TRAFFIC IMPACT ASSESSMENT

AP03

Boyne Tannum Aquatic Recreation Centre

Traffic Impact Assessment

Gladstone Regional Council

19 August 2022

→ The Power of Commitment

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GHD Australia Pty Ltd | ABN 55 120 617 021

100 Goondoon Street, Level 2

Gladstone, Queensland 4680, Australia

T 61-7-4973 1600 | **F** 4972 6236 | **E** gltmail@ghd.com | **ghd.com**

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1. Introduction

1.1 Project Background

Gladstone Regional Council (GRC) engaged GHD Pty Ltd (GHD) to prepare a Traffic Impact Assessment (TIA) as part of the concept design and proposed planning application for the Boyne Tannum Aquatic Recreation Centre (BTARC). The proposed development is to consist of a 50m FINA standard pool, waterslide, splash pad, kiosk and associated infrastructure, located within Lot 900 SP152499, Coronation Drive, Tannum Sands.

The location of the proposed development is indicated in Figure . The site fronts Coronation Drive which is a GRC road and connects to the Tannum Sands Road, which is a State Controlled Road under the control of the Department of Transport and Main Roads (TMR).

The land for the proposed development is zoned Emerging Communities as per the GRC Planning Scheme, Our Place Our Plan, Version 2 (2017).

Figure 1 Proposed development locality (GRC – Geocortex - 2022)

1.2 Purpose of this report

The purpose of this report is summarise the findings of the TIA, which assessed the potential impact of the proposed development on the adjoining roads and the suitability of the proposed car parking provision.

The TIA identifies the anticipated traffic volumes, assumptions, traffic modelling, results, and analysis to determine likely impacts on the safety and efficiency of the adjoining local roads, and mitigation actions if required. The assessment provides a comparison of estimated traffic for the local road network between the “without development traffic” and “with development traffic” scenarios to ascertain the impacts of the development.

1.3 Scope and limitations

This report: has been prepared by GHD for Gladstone Regional Council and may only be used and relied on by Gladstone Regional Council for the purpose agreed between GHD and Gladstone Regional Council as set out in this report.

GHD otherwise disclaims responsibility to any person other than Gladstone Regional Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Gladstone Regional Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has received traffic information from third party sources which has not been independently verified by GHD to be correct.

1.4 Assumptions

The assumptions made in undertaking the traffic impact assessment were as follows:

– The traffic volumes are generated based on existing traffic data provided by the GRC and TMR Average Annual daily Traffic (AADT) count information, as well as assumptions made on the traffic movements.
– One intersection traffic count (Coronation Drive and Cremorne Drive) was provided by GRC as the basis of the TIA. No intersection traffic count was provided for the intersection of Tannum Sands Road and Coronation Drive.
– In the absence of intersection counts, the traffic modelling is based upon estimated distribution of traffic to individual movements at the intersection from the line counters in the AM and PM peak hours.
– The traffic modelling assesses future growth horizon for local traffic for a 10-year horizon (2032) from the anticipated date of opening of the facility.
– The peak day for traffic volumes was assumed to be a weekday.

2. Existing Conditions

The following roads are located in proximity to the proposed development site.

Tannum Sands Road

Tannum Sands Road is a State Controlled, two-lane road that connects the township of Tannum Sands in the north with the Bruce Highway to the south.

Coronation Drive

Coronation Drive is classified as an Urban 2 Lane Distributor in GRC's Road Hierarchy Policy and runs in a general east-west direction. Coronation Drive directly connects to Tannum Sands Road via an un-signalised intersection near the proposed development site. Under the GRC Road Hierarchy, an Urban Two-Lane Distributor is expected to carry up to 6,000 vehicles per day, with 3.5m wide lane and a 13m (min) carriageway width. Coronation Drive provides a key linkage between Tannum Sands State High School and the township of Tannum Sands.

Cremorne Drive

Cremorne Drive is classified as an Urban Two Lane Distributor in GRC's Road Hierarchy Policy and runs in a general north-south alignment. Under the GRC Road Hierarchy an Urban Two Lane Distributor is expected to carry up to 6,000 vehicles per day, with 3.5m wide lane and a 13m (min) carriageway width. Cremorne Drive provides another key linkage between Tannum Sands State High School and the north-western portion of the townships of Boyne Island and Tannum Sands.

Winton Way

Winton Way is classified as an Urban Residential Access Street in GRC's Road Hierarchy Policy. It provides access to a relatively small residential catchment (approx. 55 residential dwellings). Given that the expected traffic generation of this catchment is minor in comparison to the volume of vehicles using the higher order roads, this intersection has been omitted from assessment.

3. Proposed Development

3.1 Background

The proposed BTARC development consists of the following elements:

– An 8 lane, 50 m heated pool with a relocatable bulkhead for multi-use scenarios
– Twin waterslides
– Splash pool/play area
– Amenities, kiosk, seating-mound, and plant
– Carparking to support swim-carnival use
– Green space recreation area

An indicative layout is provided in Figure 2 below.

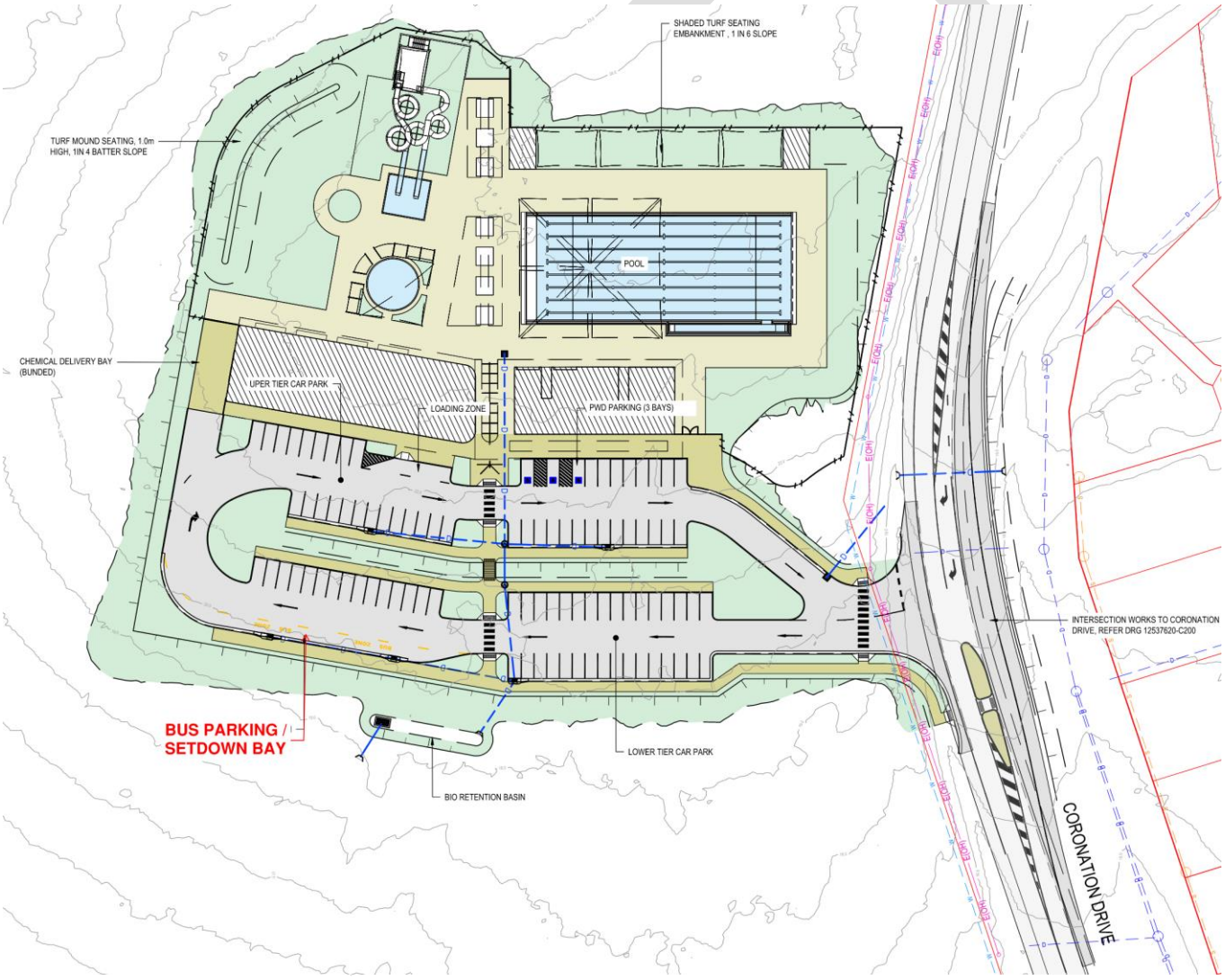


Figure 2 Proposed Development Layout

3.2 Site Access

The facility will have direct access off Coronation Drive. The minimum intersection spacing for an Urban Two lane collector such as Coronation Drive is 500m, however individual commercial access functions are permitted and are not subject to the minimum intersection spacing requirement.

To confirm the suitability of the location of the access, a sight distance assessment was undertaken along Coronation Drive for the proposed access point against the requirements of AustRoads' "Guide to Road Design (AGRD)":

– Minimum Safe Intersection Sight Distance (SISD) of 151m in accordance with *AGRD Part 4A: Unsignalised and Signalised Intersections, Table 3.2* (design speed = 70km/h and R_T = 2.0sec).

– Approach Sight Distance (ASD) of approximately 175m on the western approach and 190m on the eastern approach.

The ASD of both approaches on Coronation Drive exceed the SISD for the intersection and the location of the proposed access is considered acceptable.

It is acknowledged that the minimum 500m intersection spacing is not achieved with the proposed access, however the access has been located as far as practicable from either intersection, with an intersection spacing of 200m to the Tannum Sands Road intersection and 165m to the Winton Way intersection.

3.3 Carparking

Gladstone Regional Council's Planning Scheme Development Design Code Acceptable Outcome 9 (AO9) requires that "*Car parking and bicycle parking is provided on site in accordance with the rates specified in the Parking Rates Planning Scheme Policy".* Table SC6.10.2.1 – Minimum on-site parking rates, does not have a specific "Public Swimming Pool" use, however, the "Major Sports, Recreation and Entertainment" use, may be applicable. The Major Sports, Recreation and Entertainment use requires the following car parking provision:

– 1 space per 5 spectators able to be seated; or
– 50 spaces per playing field, or
– 30 spaces per bowling green, or
– 4 spaces per court.
– Otherwise sufficient spaces to accommodate the amount of vehicular traffic, including emergency vehicle access, likely to be generated by the particular use in accordance with a traffic management plan.

To determine if the proposed carparking and vehicle traffic likely to be generated by the use was appropriate, a review of similar facilities within nearby regions was undertaken. Table 1 summarises the car parking supply at other similar Aquatic Recreation Centres within regional cities of comparable size.

Table 1 Car parking supply at similar development sites

Similar Site	Swimming elements	Car Parking Spaces		
		Standard	People With Disability	Total
Gladstone Aquatic Centre *collocated with tennis and hockey centre*	– 8 lane, 50m pool – 6 lane, 25m pool – splashpad	94	5	99
Hervey Bay Aquatic Centre	– 8 lane, 25m pool – 8 lane, 50m pool – program pool – wading pool	58	4	62
Rockhampton 2nd World War Memorial Aquatic Centre	– 8 lane, 25m pool – 10 lane, 50m pool – program pool – splashpad – diving platform pool	85	6	91
Mackay Aquatic and Recreation Complex *collocated with athletics track*	– 8 lane, 25m pool – 10 lane, 50m pool – program pool	98	4	102
Gympie Aquatic Recreation Centre	– 8 lane, 25m pool – 8 lane, 50m pool	54	4	58

Similar Site	Swimming elements	Car Parking Spaces			
		Standard	People With Disability		Total
	– 2 no. waterslides – Splashpad – health club				
Boyne Tannum Aquatic Recreation Centre (proposed)	– *8 lane, 50m pool* – *2 no. waterslides* – *splashpad*	*91*	*3*	*94*	

Note: The number of car parks has been counted using aerial imagery, therefore values above represent an approximate number.

The proposed development comprises 94 car parking spaces, including three (3) parking spaces for People With a Disability (PWD) and a coach set down. The number of car parks nominated for BTARC is above the supply that the similar facilities provide on a per-pool and per-lane basis. Therefore, the proposed car parking provision is considered to be sufficient to meet the needs of the use. Should additional parking spaces be required, there is sufficient area within the remainder of the site for the construction of overflow parking.

3.4 Manoeuvrability

The access to the site has been designed to accommodate the movements of a 14.5m Coach (Figure 3). Service vehicles, 12.5m Heavy Rigid Vehicle and 6.4m Small Rigid Vehicle, have been used to design the chemical delivery bay and general delivery bay (Figure 5).

The carpark and circulation aisles have been designed to accommodate the swept path movements of design vehicles as shown in Figure 3, Figure 4, and Figure 5.

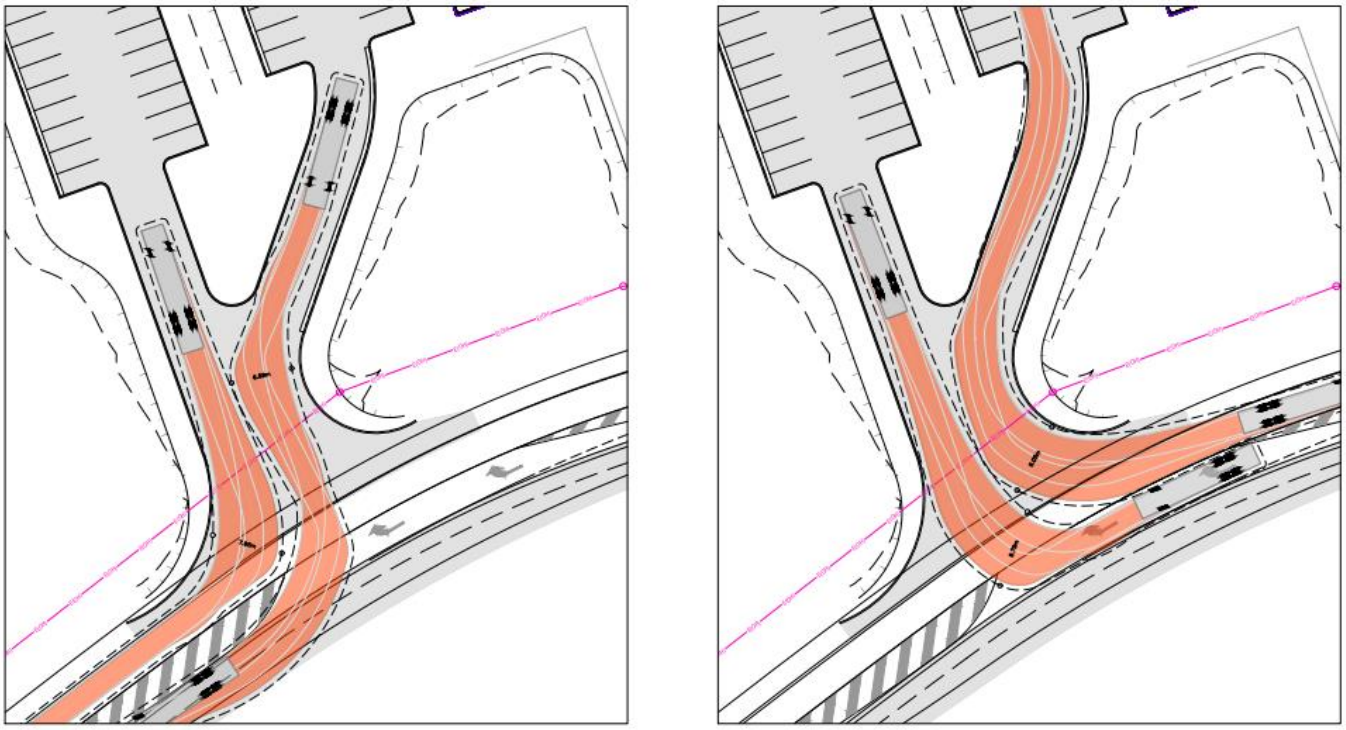


Figure 3 Swept Path of 14.5m Coach Entering and Departing the Site

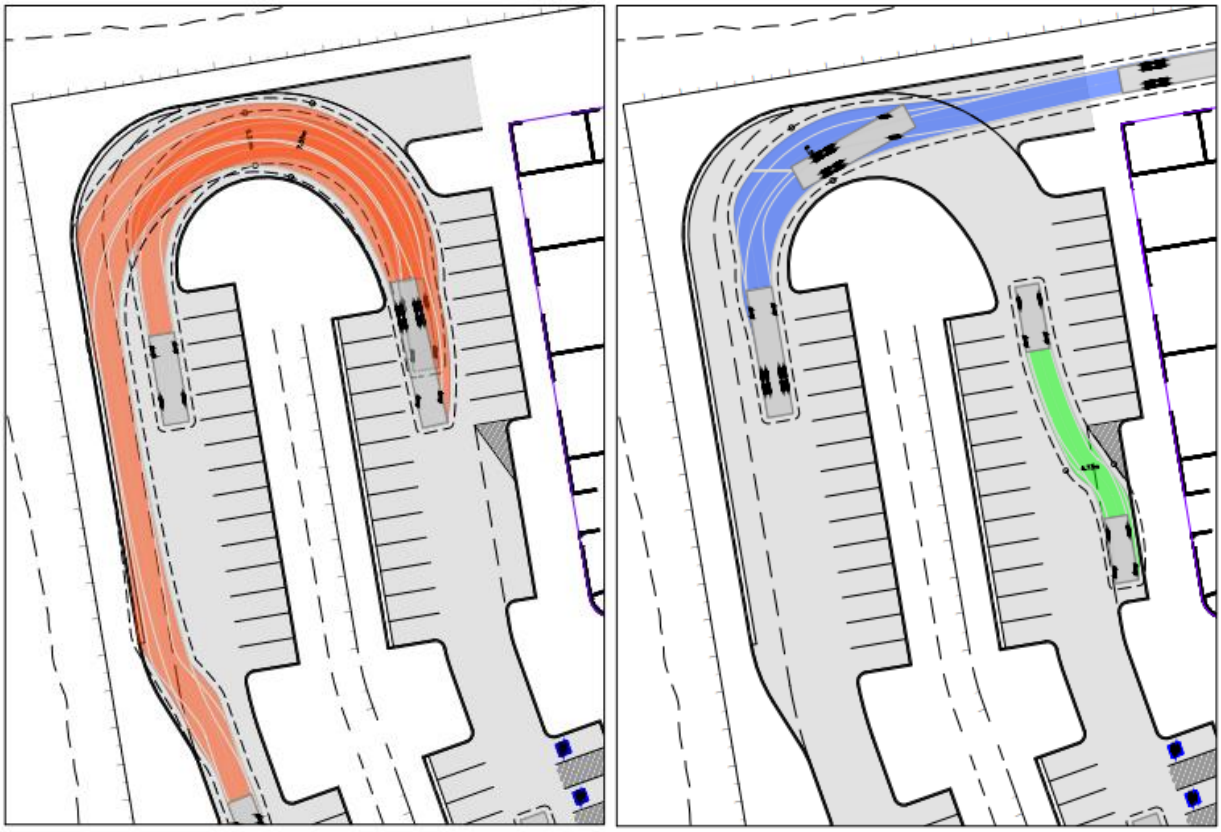


Figure 4 *(Left) Swept Path of 14.5m Coach accessing bus set-down and manoeuvring through carpark*

Figure 5 *(Right) Swept Path Movements of Service Deliveries by 12.5m Medium Rigid Vehicle (Blue) and 6.4m Small Rigid Vehicle (Green)*

4. Traffic Modelling

4.1 Modelling approach

To demonstrate the impacts the development will have on the existing local traffic network, four traffic scenarios were modelled, as detailed below:

– Base Case (2022) – Existing traffic network ***without*** new development intersection, traffic data reflective of the year 2022 to align with anticipated completion year of the development.
– Base Case (2022) – Existing traffic network ***with*** new development intersection, traffic data reflective of the year 2022 to align with anticipated completion year of the development.
– Future Case (2032) – Existing traffic network ***without*** new development intersection, traffic data reflective of the year 2032 to align with a 10-year planning horizon.
– Future Case (2032) – Existing traffic network ***with*** new development intersection, traffic data reflective of the year 2032 to align with a 10-year planning horizon.

The intersections included in the assessment of the existing network were:

– Intersection 1 – Tannum Sands Road and Coronation Drive
– Intersection 2 – Coronation Drive and Proposed Site Access
– Intersection 3 – Coronation Drive and Cremorne Drive.

The intersections identified in Figure 6 were modelled as un-signalised two-way give-way/yield intersections.

Modelling these three intersections using estimated traffic volumes provided an understanding of the potential impact from the development on the surrounding network both initially and for future growth. The traffic modelling parameters are detailed in the following section.

Figure 6 Intersections included in traffic modelling assessment (GRC Geocortex 2022)

4.2 Modelling parameters

The approach to the traffic modelling for this traffic study was to assess the existing and potential future network performance using SIDRA Intersection 9 (SIDRA). The intersection and network configurations and lane geometry for the modelling were determined based on aerial imagery, local knowledge, and assumptions (namely approach

lane length). It is noted that SIDRA applies an additional 5% margin on all traffic volumes as a fixed function of the program applied to all intersection analysis to ensure a factor of safety.

SIDRA default parameters were assumed in the base case and future intersection upgrade analysis. The intersections and networks were analysed and evaluated in terms of the three core performance elements:

– Degree of Saturation (DoS)
– Level of Service (LoS)
– 95% Back of Queue Distance.

The definition of these performance criteria and quantified acceptable levels are detailed below.

4.2.1 Degree of Saturation (DoS)

Degree of saturation is defined as the ratio of demand (arrival) flow to capacity, or volume/capacity (v/c) ratio. Key metrics for DoS are:

– DoS > 1.0 oversaturated conditions (demand flow exceeds capacity)
– DoS < 1.0 undersaturated conditions (demand flows are below capacity)

NSW RMS *Traffic Modelling Guidelines* (2013) identify a maximum practical degree of saturation for different intersection types, as provided in the extract in Figure 7.

Table 14.2 Maximum practical degree of saturation

Intersection type	Maximum practical degree of saturation
Signals	0.90
Roundabouts	0.85
Sign-controlled	0.80
Continuous lanes	0.98

Figure 7 Extract from RMS Traffic Modelling Guidelines

4.2.2 Level of Service (LoS)

Level of Service is based on the average control delay (overall delay with geometric delay) as the LoS measure for an un-signalised intersection. SIDRA Intersection output includes LoS results based on the concept described in the US Highway Capacity Manual (HCM). The HCM method identifies the following range of average control delay and corresponding Level of Service this represents, as indicated in Figure .

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F[1]	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.
1. If the volume-to-capacity (v/c) ratio exceeds 1.0, LOS F is assigned an individual lane group for all unsignalized intersections, or minor street approach at two-way stop-controlled intersections. Overall intersection LOS is determined solely by control delay.

Figure 8 Extract from HCM Traffic Modelling

LoS A is most desirable and LoS F the least acceptable. However, levels of service can be accepted given the context of the traffic modelling. AUSTROADS' Guide to Traffic Management Part 3: Traffic Studies and Analysis describes Levels of Service and are outlined in the Table 2 for reference.

This traffic study will consider LoS D or above as acceptable. Any LoS outside this range may be deemed acceptable, depending on the criteria justifying the LOS rating. This is identified throughout the assessment.

Table 2 AUSTROADS' LoS definition

Level of Service	AUSTROADS' Definition
LoS A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
LoS B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is a little less than with level of service A.
LoS C	Also, in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
LoS D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.
LoS E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.
LoS F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result

4.2.3 95% back of queue distance

A percentile queue length is a value below which the specified percentage of the average queue length values observed for the individual cycles fall. For example, the 95th percentile queue length is the value below which 95% of all observed cycle queue lengths fall, or 5% of all observed queue lengths exceed. SIDRA intersection uses the 95% value of the back of queue. This value also represents the storage length of a lane and forms part of the overall lane length assessment. The following ratios describe the performance:

– 95% average back of queue storage ratio > 1.0 the queue exceeds the storage capacity.
– 95% average back of queue storage ratio < 1.0 the queue does not exceed the storage capacity.

5. Traffic Volumes

5.1 Traffic data sources

The traffic data used to determine the traffic volume for the modelling was provided from existing traffic records as summarised in the following sections.

5.1.1 GRC provided traffic data

GRC provided weekly traffic counts, assumed to be tube counters, and an intersection count. Traffic counter data from counter classifiers were provided including directional counts to inform the traffic analysis. Counter data was provided as follows:

– Coronation Drive Ch. 0.11, captured November 2020
– Cremorne Drive (between Pryde Street and Keating Street), captured February/March 2021
– Intersection of Coronation Drive and Cremorne Drive, captured 23 October 2018.

The approximate locations of the traffic and intersection counts are identified in the Figure .

Figure 9 GRC provided traffic counts, locations. Oct 2018, Nov 2020, Feb 2021. (GRC Geocortex 2022)

The intersection count at the intersection of Cremorne Drive and Coronation Drive was undertaken on Tuesday 23 October 2018, between 5:00am and 7:00pm. Review of the data identified the following:

– AM Peak Hour was observed to be between 7:50am and 8:50am, assumed to be school drop off.
– PM Peak Hour was observed to be between 2:50pm and 3:50pm, assumed to be school pick up.

The weekly vehicle counter classifier data were undertaken for a 7-day period. Review of the data found the following:

– Average AM Peak period is 08:00-09:00 AM
– Average PM Peak period is 02:30-03:30 PM

These peak hours typically align with the peak hours identified within the intersection count and generally appear to align with the drop-off/pick-up periods of the nearby schools. Therefore, for the purposes of this report, the AM Peak hour has been assumed to be 7:50am-8:50am, whilst the PM Peak hour has been assumed to be 2:50pm-3:50pm.

The GRC supplied traffic data is provided within Appendix A.

5.1.2 TMR provided traffic data

TMR traffic information was sourced from the 2020 Traffic Census Data for Tannum Sands Road (1805) at Site 61206 – Tannum Sands Road, 190m South of Coronation Drive, 7.78km and Site 61615 – Tannum Sands Road, 120m North of Beach Avenue, 8.83km. Review of the data identified the following:

Table 3 TMR Provided Traffic Data Summary

Description	Site 61206 (7.78km)	Site 61615 (8.83km)
2020 bidirectional AADT	2,738 veh/day	1,457 veh/day
Calculated 2022 AADT (1)	2,801 veh/day	1,490 veh/day
Calculated 2032 AADT (1)	3,091 veh/day	1,645 veh/day
Calculated Peak Hour Traffic Volume (2)	280 / 309 veh/hr	149 / 165 veh/hr

1. *Assumed 10-year growth in AADT of 0.76% based off TMR AADT growth data for Site 61615 (Highest 10-year Growth Rate).*
2. *Assumed 10% of AADT is peak hour traffic volume.*
3. *Assumed that majority of vehicles travel towards Tannum Sands in the AM Peak, and that the majority of vehicles depart from Tannum Sands in the PM Peak.*
4. *AADT taken from a weekday AADT average to align with regular local traffic movement.*
5. *AM and PM Peak Hours assumed to align with GRC provided data peaks.*

Without an intersection traffic count, assumptions were required to be made for the northbound and southbound traffic split on Tannum Sands Road. For the purposes of this assessment, it has been assumed that in the AM peak hour 50% of traffic is northbound, with 50% southbound, with the inverse proposed in the PM peak hour.

A copy of the TMR supplied traffic data is provided within Appendix B.

5.1.3 Development generated traffic

The New South Wales' department of Transport Roads Maritime Services' (TRMS) "Guide to Traffic Generating Development" (GTGD) is the traffic industry reference to determine the traffic potentially generated by proposed facilities. Section 3 – land use traffic generation, does not provide "public swimming pool facilities" or an applicable "outdoor sport and recreation" use. However, clause 3.8 recreational and tourist facilities notes:

– Recreational and tourist facilities are site and type specific in their operation and traffic generation, often with seasonal variations in usage. Ideally, analysis of proposed developments should be based on surveys of similar developments. If this is not possible a first principles analysis is required.
– Traffic generation rates for Squash Court, Tennis Court and Gymnasium uses, which the proposed use does not readily fit within.

As such, the traffic generated from the development was determined using a first principles assessment. The first principles analysis is based off the following assumptions based on industry experience:

– Swimming pool visits (for recreation, learn to swim, squad training or aquatic exercise classes) are typically between 45 minutes and 60 minutes.

– More patrons arrive in the AM Peak Hour than the PM Peak Hour.
– Maximum arrival rate within the AM Peak Hour is equivalent to the full capacity of parking spaces, whilst the PM Peak Hour is equivalent to half the capacity of the parking spaces.
– More patrons depart in the PM Peak Hour than the AM Peak Hour
– Maximum departure rate within the AM Peak Hour is equivalent to half the capacity of parking spaces, whilst the PM Peak Hour is equivalent to the full capacity of the parking spaces.
– Parking provision is only expected to reach capacity when competitions or events are held at the swimming pool. These competitions or events are typically scheduled during school hours or on weekends and are unlikely to coincide with weekday Peak Hours.

Based on the above assessment it has been assumed that the development generated traffic consists of:

– AM Peak Hour
  - 100% of carpark spaces enter: 94 entry movements per hour (94 veh/hr),
  - 50% of carparking spaces leave: 47 exit movements per hour (47 veh/hr),
– PM Peak Hour
  - 50% of carpark spaces enter: 47 entry movements per hour (47veh/hr),
  - 100% of carparking spaces leave: 94 exit movements per hour (94 veh/hr),

This corresponds to a total traffic movement during the peak hour of 141 trips generated by the proposed development. Given that the patronage of the pool is unlikely to exceed the capacity of parking spaces within any peak hour (noting that this would be a minimum allocation of 11 patrons per lane), this assessment is considered to be a conservative scenario.

5.2 Growth rate

The growth rate used to determine the projected road network traffic for the 2022 and 2032 traffic scenarios was determined based on the "*Population Growth Rate for the Boyne Island / Tannum Sands Statistical Area 2*" provided by GRC. The population growth rate for Boyne Island / Tannum Sands are stated as follows in Table 4.

Table 4 Population growth rates for Boyne Island, Tannum Sands as provided by GRC

Year	Population	Compound Average Growth Rate
Current	10,073	+0.3%
2026	10,358	+0.6%
2031	10,715	+0.7%
2036	11,014	+0.6%
2041	11,294	+0.5%

Based on the review of population statistics, it was determined that there was a generally consistent growth rate across population and corresponding traffic demands, of approximately +0.6% per annum. This is considered to be a low growth rate, therefore in order to provide a conservative estimate of expected traffic impacts from the proposed development, a growth rate of 3% per annum has been applied.

It has been assumed that maximum patronage and vehicles movements for the proposed development will occur at construction and no growth rate is applied to these movements.

5.3 Assumptions and movement splits

Assumed traffic distributions were applied to the existing bidirectional volume count and intersection traffic count to use as a basis for the intersection modelling.

5.3.1 Intersection 1 – Tannum Sands Road and Coronation Drive

No intersection count was available from TMR for the intersection of Tannum Sands Road and Coronation Drive. The anticipated traffic volumes use for the assessment have therefore been derived TMR's AADT traffic census data using the following assumptions:

– Peak Hour volumes are equivalent to 10% of the AADT. Therefore, the peak hour volumes for southbound and northbound traffic on Tannum Sands Road is 149 veh/hr and 280 veh/hr, respectively.
– Traffic is split equitably during the AM and PM peak hours (e.g. 50% northbound, 50% southbound).
– Eastbound traffic on Coronation Drive has the same northbound and southbound split at 50% each direction.
– Turn movements from Coronation Drive are based on the through vehicle movements along Coronation Drive from the intersection of Coronation Drive and Cremorne Drive. 2022 AM and PM peak volumes are assumed to be 160 veh/hr and 186veh/hr, respectively.

5.3.2 Intersection 2 – Coronation Drive and Proposed Site Access

It has been assumed that 80% of the development generated traffic will arrive from and depart to the east of the development (towards Tannum/Boyne), whilst the other 20% will arrive from and depart to the west and utilise Cremorne Drive to access the wider road network. The traffic generated from the east is assumed to be split with 75% originating from the north (Tannum Sands/Boyne Island) and the other 25% originating in the south (Benaraby).

5.3.3 Intersection 3 – Coronation Drive and Cremorne Drive

The intersection count provided by GRC was used as the basis of the movement splits for this intersection, with a 3% growth rate applied to account for growth between the survey date and the proposed year of opening case.

The corresponding volume for each traffic movement at each intersection and assumptions used to derive them are detailed in Appendix C.

5.4 Traffic volumes for modelling

Based on the review of provided traffic data, assumed generated traffic data, and the assumed traffic movement distribution, the following volumes were determined for each movement at the intersection:

– Table 5 and Table 6 – Base Case (2022) and Future Case (2032) without development and with development for the AM and PM Peaks respectively.

Table 5 Generated and Projected Traffic Volumes for Base and Future Case - AM Peak

Approach	Turn	Without Development		With Development	
		Base Case (2022)	Future Case (2032)	Base Case (2022)	Future Case (2032)
INTERSECTION 1 – Tannum Sands Road and Coronation Drive					
Tannum Sands Road (South)	Left	42	56	61	75
	Through	98	132	98	132
Coronation Drive (West)	Right	80	107	89	117
	Left	80	107	108	136
Tannum Sands Road (North)	Through	52	70	52	70
	Right	22	30	79	86
INTERSECTION 2 – Coronation Drive and Proposed Site Access					
Coronation Drive (West)	Left	NA	NA	19	19
	Through	160	215	160	215
Proposed Site Access	Right	NA	NA	9	9
	Left	NA	NA	38	38
Coronation Drive (East)	Through	261	351	261	351
	Right	NA	NA	75	75
INTERSECTION 3 – Coronation Drive and Cremorne Drive					
Coronation Drive (West)	Left	122	163	122	163
	Through	123	165	123	165
Cremorne Drive (North)	Right	123	165	123	165
	Left	37	50	56	69
Coronation Drive (East)	Through	219	295	219	295
	Right	42	56	51	65

Table 6 Generated and Projected Traffic Volumes for Base and Future Case - PM Peak

Approach	Turn	Without Development		With Development	
		Base Case (2022)	Future Case (2032)	Base Case (2022)	Future Case (2032)
INTERSECTION 1 – Tannum Sands Road and Coronation Drive					
Tannum Sands Road (South)	Left	42	56	51	66
	Through	98	132	98	132
Coronation Drive (West)	Right	93	125	112	144
	Left	93	125	149	181
Tannum Sands Road (North)	Through	52	70	52	70
	Right	22	30	51	58
INTERSECTION 2 – Coronation Drive and Proposed Site Access					
Coronation Drive (West)	Left	NA	NA	9	9
	Through	186	250	186	250
Proposed Site Access	Right	NA	NA	19	19
	Left	NA	NA	75	75
Coronation Drive (East)	Through	150	201	150	201
	Right	NA	NA	38	38
INTERSECTION 3 – Coronation Drive and Cremorne Drive					
Coronation Drive (West)	Left	128	172	128	172
	Through	128	172	128	172
Cremorne Drive (North)	Right	50	67	50	67
	Left	57	77	67	87
Coronation Drive (East)	Through	101	136	101	136
	Right	48	65	67	84

6. Facility Access Design

Austroads' "Guide to Road Design Part 4: Intersections and Crossings – General", provides guidance for the design of proposed intersections. Whilst traffic management is an important consideration, the choice of intersection is also determined by the type of turning treatments required for the safe and efficient operation of the intersection. The warrants for the turn treatments of the major road are based on the through and turn movement volumes.

Determination of Q_R / Q_L

The left and right turn movements into the proposed development have been identified in Section 5.4 and are summarised in Table 7.

Table 7 Flow Rate for Left and Right Turn Movements from Coronation Drive

Flow Rate	AM		PM	
	2022	2032	2022	2032
Q_R[1]	75 veh/hr	75 veh/hr	38 veh/hr	38 veh/hr
Q_L[2]	19 veh/hr	19 veh/hr	9 veh/hr	9 veh/hr

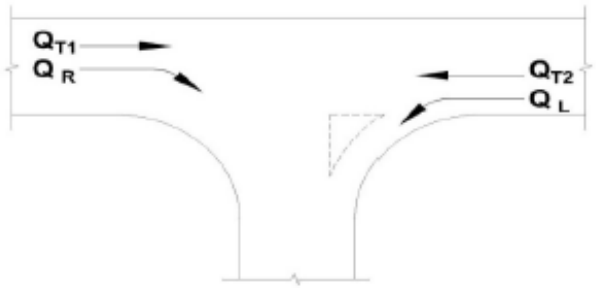
1 Coronation Drive Westbound – Right Turn

2 Coronation Drive Eastbound – Left Turn

Determination of Q_M

The determination of the major road traffic volume parameter Q_M is based on the volume of traffic that the turn movement must interact with and is demonstrated within Figure 10.

Figure A 11: Calculation of the major road traffic volume parameter Q_M



Turn type	Splitter island	Q_m (veh/h)
Right	No	$= Q_{T1} + Q_{T2} + Q_L$
Right	Yes	$= Q_{T1} + Q_{T2}$
Left	No/yes	$= Q_{T2}$

Source: Arndt and Troutbeck (2006).

Figure 10 Austroads Guide to Road Design Part 4: Intersections and Crossing – General – Figure A 11: Calculation of the major road traffic volume parameter Q_M

Based on Figure 10, the major road traffic volume parameters were derived as follows in Table 8.

Table 8 Flow Rate for Major Road Traffic Volume Parameter

Flow Rate	AM		PM	
	2022	2032	2022	2032
Right Turn Q_M	440 veh/hr	585 veh/hr	345 veh/hr	460 veh/hr
Left Turn Q_M	160 veh/hr	215 veh/hr	186 veh/hr	250 veh/hr

6.1 Turn Lane Warrants

As previously noted, turn lane warrants are a function of the major road traffic volume and turn movement volume, as depicted in Figure 11.

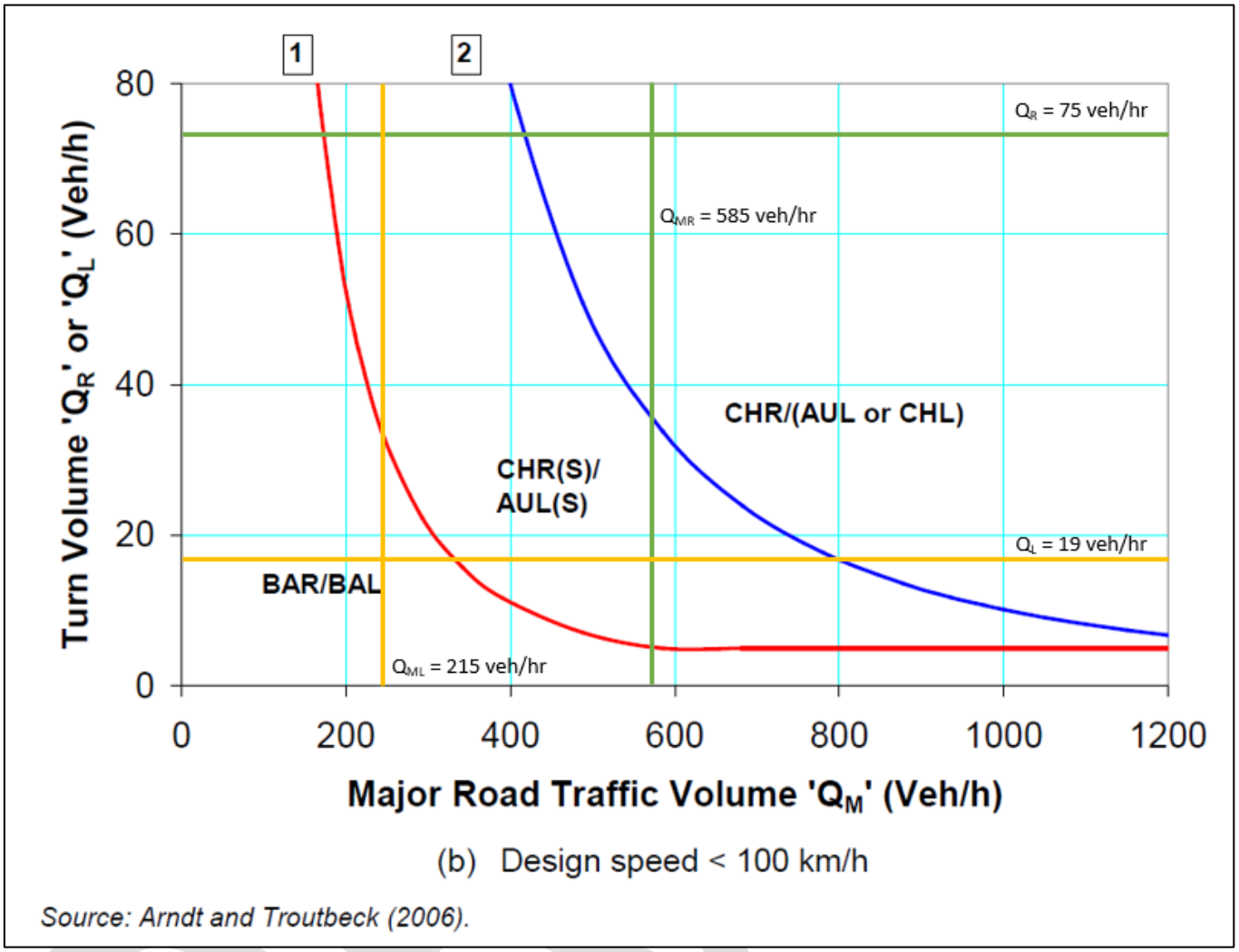


Figure 11 ***Austroads Guide to Road Design Part 4: Intersections and Crossing (2017)– General – Figure A 10 (b) Design Speed <100kph***

Applying the probable worst case scenario for the left turn (orange lines) and right turn (green lines), at the 2032 design horizon, it has been determined that the following turn treatments are required to be provided for the proposed development to ensure safe and efficient access to the development:

– Basic Left Turn (BAL) – Coronation Drive Eastbound; and
– Channelised Right Turn (CHR) – Coronation Drive Westbound.

7. SIDRA Analysis and Results

7.1 Sites and network layout

7.1.1 Without development cases

The Base Case and Future Case scenarios without development were modelled as individual, un-signalised two-way give-way/yield intersections based on aerial imagery of the Tannum Sands Road and Coronation Drive intersection, and Coronation Drive and Cremorne Drive intersection. The layout of the network as modelled in SIDRA is shown in Figure 12. Note that the intersection with Winton Way has been excluded, as noted previously within this report.

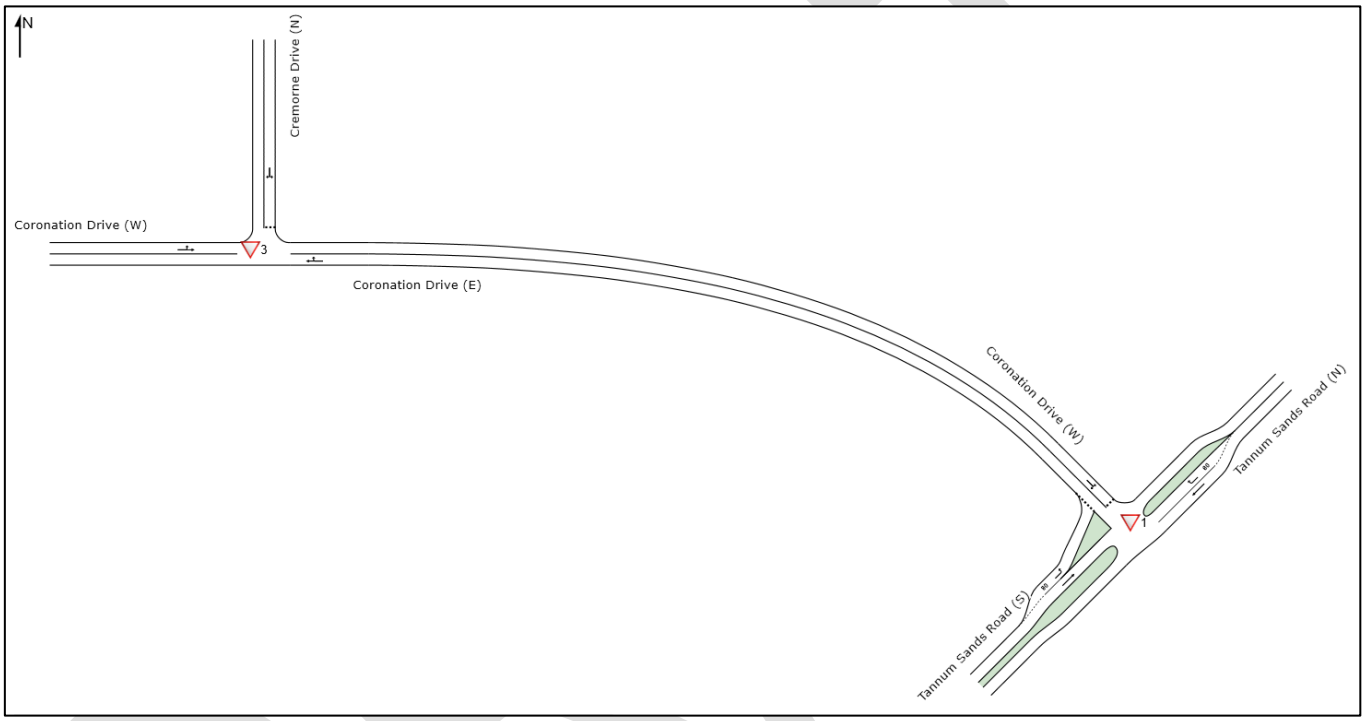


Figure 12 Existing Case Network Layout with Intersection 1 and Intersection 3

7.1.2 With development cases

The Base Case and Future Case scenarios with development were modelled as individual, un-signalised two-way give-way/yield intersections based on aerial imagery of the Tannum Sands Road / Coronation Drive intersection, the Coronation Drive / Proposed Site Access intersection and the intersection of Coronation Drive and Cremorne Drive. The layout of the network as modelled in SIDRA is shown in Figure .

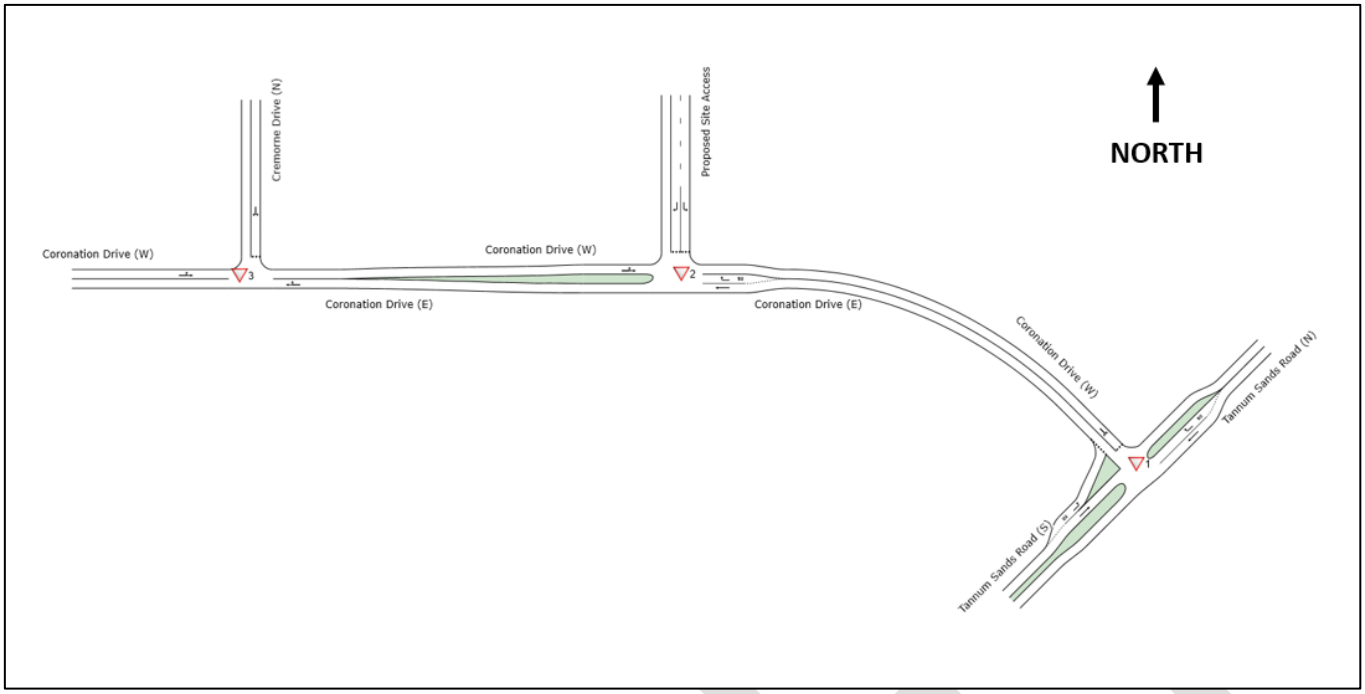


Figure 13 Network layout with the three intersections

7.2 Modelling results and analysis

7.2.1 Base Case (2022) and Future Case (2032) Without Development

The SIDRA analysis results for the Base Case (2022) Without Development for AM and PM peak have been provided in Table 9.

The Future Case (2032) Without Development for AM and PM peak is identified in Table 10.

The results are display the Level of Service and the Key Performance Criteria for each minor approach as this is the critical approach for un-signalised giveway/yield intersections. For all SIDRA analysis results refer to Appendix E and Appendix F for the Base Case and Future Case Without Development AM Peak and PM Peak, respectively.

Table 9 Base Case (2022) Without Development Peak Intersection Analysis Results

Criteria	AM Peak		PM Peak	
	Intersection 1 – Coronation Drive (Minor)	Intersection 3 – Cremorne Drive (Minor)	Intersection 1 – Coronation Drive (Minor)	Intersection 3 – Cremorne Drive (Minor)
DOS	0.144	0.182	0.167	0.098
LoS	A	A	A	A
Queue (Veh)	0.6	0.7	0.7	0.4
Queue (Dist. m)	4.3	4.6	5.1	2.5
Delay (sec)	6.3	7.3	6.3	6.9

As can be identified in Table 9, Intersection 1 and Intersection 3 are demonstrating a high LoS A and supporting performance criteria demonstrating low to non-existent delays and queuing.

Table 10 Future Case (2032) Without Development Peak Intersection Analysis Results

Criteria	AM Peak		PM Peak	
	Intersection 1 – Coronation Drive (Minor)	Intersection 3 – Cremorne Drive (Minor)	Intersection 1 – Coronation Drive (Minor)	Intersection 3 – Cremorne Drive (Minor)
DOS	0.205	0.287	0.240	0.144
LoS	A	A	A	A
Queue (Veh)	0.9	1.2	1.1	0.5
Queue (Dist. m)	6.3	8.1	7.6	3.8
Delay (sec)	6.7	9.2	6.7	6.9

From the results in Table 10, Intersection 1 and Intersection 3 are still demonstrating a high LoS A and supporting performance criteria demonstrating low to non-existent delays and queuing. The PM Peak Hour for Intersection 3 appears to show a higher degree of saturation for the Coronation Drive (West) approach. This is likely due to the higher volume of vehicles using this approach than the other approaches.

Overall, the Base Case and Future Case scenarios without the development demonstrates that Intersection 1 and Intersection 3 function at a high level of service.

7.2.2 Base Case (2022) and Future Case (2032) With Development

The SIDRA analysis results for the Base Case (2022) With Development for AM and PM Peak have been identified in Table 11 and the Future Case (2032) With Development for AM and PM Peak are identified in Table 12. The results are showing the Level of Service and the Key Performance Criteria for each minor approach as this is the critical approach for un-signalised giveway/yield intersections.

For all SIDRA analysis results refer to Appendix G and Appendix H for the Base Case and Future Case With Development AM Peak and PM Peak, respectively.

7.2.2.1 Base Case (2022) With Development

The SIDRA analysis results for the Base Case (2022) with development for the AM and PM peaks have been identified in Table 11. The results are showing the Level of Service and the Key Performance Criteria for each minor approach as this is the critical approach for un-signalised giveway/yield intersections. For all SIDRA analysis results refer to Appendix G for the Base Case and Future Case with the development for the AM Peak and Appendix H for the PM Peak.

Table 11 Base Case (2022) With Development Peak Intersection Analysis Results

Criteria	AM Peak			PM Peak		
	Intersection 1 – Coronation Drive (Minor)	Intersection 2 – Proposed Site Access (Minor)	Intersection 3 – Cremorne Drive (Minor)	Intersection 1 – Coronation Drive (Minor)	Intersection 2 – Proposed Site Access (Minor)	Intersection 3 – Cremorne Drive (Minor)
DOS	0.182	0.028	0.197	0.233	0.057	0.106
LoS	A	A	A	A	A	A
Queue (Veh)	0.8	0.1	0.7	1.1	0.2	0.4
Queue (Dist. m)	5.5	0.8	5.1	7.5	1.6	2.8
Delay (sec)	6.5	6.6	7.2	6.4	6.5	6.4

As identified in Table 11, very low queueing and delays are occurring for all intersections, which are operating at LoS A in both the AM and PM peak periods. As the access to the Aquatic Centre is the new intersection as part of the development, it can be assumed that the development generated traffic will have no negative impact on the existing local traffic. These are expected results as generally the traffic volumes are well below the lane capacities for this type of road.

The LoS demonstrated at all intersections has not worsened with the introduction of the development generated traffic as the existing case at this intersection was demonstrating the same LoS A.

In the context of safe and efficient traffic operation, the levels of queuing delay at the intersections are considered immaterial to the performance of the intersection and are acceptable.

7.2.2.2 Future Case (2032) With Development

The SIDRA analysis results for the Future Case (2032) with the development for the AM and PM Peak have been identified in Table 12. The results are showing the LoS and the Key Performance Criteria for each minor approach as this is the critical approach for un-signalised giveway/yield intersections. For all SIDRA analysis results refer to Appendix G for the Base Case and Future Case with the development for the AM Peak and Appendix H for the Base Case and Future Case PM Peak.

Table 12 Future Case (2032) With Development Peak Intersection Analysis Results

Criteria	AM Peak			PM Peak		
	Intersection 1 – Coronation Drive (Minor)	Intersection 2 – Proposed Site Access (Minor)	Intersection 3 – Cremorne Drive (Minor)	Intersection 1 – Coronation Drive (Minor)	Intersection 2 – Proposed Site Access (Minor)	Intersection 3 – Cremorne Drive (Minor)
DOS	0.249	0.030	0.304	0.310	0.061	0.153
LoS	A	B	A	A	A	A
Queue (Veh)	1.1	0.1	1.3	1.5	0.2	0.6
Queue (Dist. m)	7.9	0.5	8.9	10.4	1.7	4.1
Delay (sec)	6.9	7.1	8.5	6.9	6.9	6.9

As demonstrated in Table 12, very low queueing and delays are still occurring for intersections, with which are still generally operating at a high LoS A in both the AM and PM peak periods. This demonstrates that the proposed traffic from the BTARC is likely to have a negligible impact on the local traffic network.

This traffic assessment has provided an indication that the performance of these intersections does not require further review due to the proposed development. This traffic analysis is based on the supplied data including existing line counter data and AADT data from TMR.

8. Conclusions

In accordance with Austroads' "Guide to Road Design Part 4: Intersections and Crossings – General", and the expected traffic volumes accessing the proposed development, a Channelised Right Turn is required on the westbound approach of Coronation Drive to the proposed access to the BTARC. The left turn movement on the eastbound approach of Coronation Drive can be accommodated within the existing through movement.

The proposed parking capacity for the BTARC facility is 94 carparking spaces, including 3 PWD spaces. This proposed car parking supply is higher than similar facilities within regional centres of comparable size and functionality. Therefore, it can be concluded that the proposed parking provision is sufficient to accommodate the proposed use.

This traffic impact assessment and analysis provides a comparative assessment of performance for the scenarios "without development" and "with development" traffic based on intersection traffic counts and line counter traffic data. Traffic volumes were derived from the existing intersection traffic counts and line traffic counts using assumed movement distribution at the intersections.

This traffic impact assessment has identified that the proposed BTARC access and adjacent major intersections will function at a high LoS for the forecasted 2032 traffic demand of local traffic as well as the estimated development generated traffic.

Therefore, it can be concluded that the proposed development, will have a minor impact on the current and future, safety and efficiency of the existing local road network.

Appendix A

GRC Supplied Traffic Data

MetroCount Traffic Executive
Daily Classes by Direction

DayClassSplit-217 -- English (ENA)

Datasets:

Site:	**[Corination Drive] CH : 0.11**
Attribute:	
Direction:	8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration:	7:34 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020,
Zone:	
File:	Coronation Drive 0 2020-11-03 0709.EC0 (Plus)
Identifier:	DT1994BC MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default axle (v5.02)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020 (13.9821)**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = East, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (AustRoads94)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 16363 / 16370 (99.96%)

Daily Classes by Direction

DayClassSplit-217
Site: Corination Drive.0.1EW
Description: **CH : 0.11**
Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1-12) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Monday, 19 October 2020

	1	2	3	4	5	6	7	8	9	10	11	12	Total
Mon*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tue*	1180	14	34	0	1	0	0	0	0	0	0	0	1229
(%)	96.0	1.1	2.8	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	542	4	23	0	1	0	0	0	0	0	0	0	570
AB%	45.9	28.6	67.6	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.4
BA	638.0	10.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	659.0
BA%	54.1	71.4	32.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.6
Wed	1341	5	43	0	0	0	0	0	0	0	0	0	1389
(%)	96.5	0.4	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	615	3	28	0	0	0	0	0	0	0	0	0	646
AB%	45.9	60.0	65.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5
BA	726.0	2.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	743.0
BA%	54.1	40.0	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.5
Thu	1324	20	47	0	1	2	0	0	0	0	0	0	1394
(%)	95.0	1.4	3.4	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
AB	622	8	32	0	0	2	0	0	0	0	0	0	664
AB%	47.0	40.0	68.1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6
BA	702.0	12.0	15.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	730.0
BA%	53.0	60.0	31.9	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.4
Fri	1398	27	56	2	2	0	0	0	0	0	0	0	1485
(%)	94.1	1.8	3.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	641	14	38	2	1	0	0	0	0	0	0	0	696
AB%	45.9	51.9	67.9	100.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.9
BA	757.0	13.0	18.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	789.0
BA%	54.1	48.1	32.1	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1
Sat	530	34	11	0	0	0	1	0	0	2	0	0	578
(%)	91.7	5.9	1.9	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	
AB	259	17	9	0	0	0	1	0	0	1	0	0	287
AB%	48.9	50.0	81.8	0.0	0.0	0.0	100.0	0.0	0.0	50.0	0.0	0.0	49.7
BA	271.0	17.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	291.0
BA%	51.1	50.0	18.2	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	50.3
Sun	522	22	14	0	0	0	0	0	0	0	0	0	558
(%)	93.5	3.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	247	12	11	0	0	0	0	0	0	0	0	0	270
AB%	47.3	54.5	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.4
BA	275.0	10.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	288.0
BA%	52.7	45.5	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.6

Average daily volume

Entire week

	1023	22	34	0	1	0	0	0	0	0	0	0	1081
(%)	94.7	2.0	3.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	477	11	24	0	0	0	0	0	0	0	0	0	513
AB%	46.6	50.0	69.0	100.0	33.3	100.0	100.0	0.0	0.0	50.0	0.0	0.0	47.4
BA	546.2	10.8	10.6	0.0	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0	568.2
BA%	53.4	50.0	31.0	0.0	66.7	0.0	0.0	0.0	0.0	50.0	0.0	0.0	52.6

Weekdays

	1354	17	49	1	1	1	0	0	0	0	0	0	1423
(%)	95.2	1.2	3.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	626	8	33	1	0	1	0	0	0	0	0	0	669
AB%	46.2	48.1	67.1	100.0	33.3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0
BA	728.3	9.0	16.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	754.0
BA%	53.8	51.9	32.9	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.0

Weekend

	526	28	13	0	0	0	1	0	0	1	0	0	568
(%)	92.6	4.9	2.2	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	
AB	253	15	10	0	0	0	1	0	0	1	0	0	279
AB%	48.1	51.8	80.0	0.0	0.0	0.0	100.0	0.0	0.0	50.0	0.0	0.0	49.0
BA	273.0	13.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	289.5
BA%	51.9	48.2	20.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	51.0

*** - Incomplete**

Daily Classes by Direction

DayClassSplit-217
Site: Corination Drive.0.1EW
Description: **CH : 0.11**
Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1-12) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Monday, 26 October 2020

	1	2	3	4	5	6	7	8	9	10	11	12	Total
Mon	1283	24	52	1	1	4	0	0	0	0	0	0	1365
(%)	94.0	1.8	3.8	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	
AB	569	14	35	1	1	4	0	0	0	0	0	0	624
AB%	44.3	58.3	67.3	100.0	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	45.7
BA	714.0	10.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	741.0
BA%	55.7	41.7	32.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.3
Tue	1207	14	45	0	1	1	1	0	0	0	0	0	1269
(%)	95.1	1.1	3.5	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
AB	549	6	33	0	0	1	0	0	0	0	0	0	589
AB%	45.5	42.9	73.3	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	46.4
BA	658.0	8.0	12.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	680.0
BA%	54.5	57.1	26.7	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	53.6
Wed	1184	21	55	0	0	3	0	0	0	0	0	0	1263
(%)	93.7	1.7	4.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	
AB	542	12	44	0	0	3	0	0	0	0	0	0	601
AB%	45.8	57.1	80.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6
BA	642.0	9.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	662.0
BA%	54.2	42.9	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.4
Thu	1271	25	52	0	1	3	0	0	0	0	0	0	1352
(%)	94.0	1.8	3.8	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	
AB	590	13	40	0	1	2	0	0	0	0	0	0	646
AB%	46.4	52.0	76.9	0.0	100.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	47.8
BA	681.0	12.0	12.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	706.0
BA%	53.6	48.0	23.1	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	52.2
Fri	1365	44	43	2	3	5	1	0	0	0	0	0	1463
(%)	93.3	3.0	2.9	0.1	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	
AB	650	21	30	2	1	5	1	0	0	0	0	0	710
AB%	47.6	47.7	69.8	100.0	33.3	100.0	100.0	0.0	0.0	0.0	0.0	0.0	48.5
BA	715.0	23.0	13.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	753.0
BA%	52.4	52.3	30.2	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.5
Sat	963	33	22	0	0	0	0	0	0	0	0	0	1018
(%)	94.6	3.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	493	18	19	0	0	0	0	0	0	0	0	0	530
AB%	51.2	54.5	86.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.1
BA	470.0	15.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	488.0
BA%	48.8	45.5	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.9
Sun	518	37	10	0	0	0	0	0	0	0	0	0	565
(%)	91.7	6.5	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	239	16	10	0	0	0	0	0	0	0	0	0	265
AB%	46.1	43.2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.9
BA	279.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0
BA%	53.9	56.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1

Average daily volume

Entire week

	1113	28	40	0	1	2	0	0	0	0	0	0	1185
(%)	93.9	2.4	3.4	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	
AB	519	14	30	0	0	2	0	0	0	0	0	0	566
AB%	46.6	50.5	75.6	100.0	50.0	93.8	50.0	0.0	0.0	0.0	0.0	0.0	47.8
BA	594.1	14.0	9.7	0.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	618.6
BA%	53.4	49.5	24.4	0.0	50.0	6.3	50.0	0.0	0.0	0.0	0.0	0.0	52.2

Weekdays

	1262	26	49	1	1	3	0	0	0	0	0	0	1342
(%)	94.0	1.9	3.7	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	
AB	580	13	36	1	1	3	0	0	0	0	0	0	634
AB%	46.0	51.6	73.7	100.0	50.0	93.8	50.0	0.0	0.0	0.0	0.0	0.0	47.2
BA	682.0	12.4	13.0	0.0	0.6	0.2	0.2	0.0	0.0	0.0	0.0	0.0	708.4
BA%	54.0	48.4	26.3	0.0	50.0	6.3	50.0	0.0	0.0	0.0	0.0	0.0	52.8

Weekend

	741	35	16	0	0	0	0	0	0	0	0	0	792
(%)	93.6	4.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	366	17	15	0	0	0	0	0	0	0	0	0	398
AB%	49.4	48.6	90.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.2
BA	374.5	18.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	394.0
BA%	50.6	51.4	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.8

*** - Incomplete**

Daily Classes by Direction

DayClassSplit-217
Site: Corination Drive.0.1EW
Description: **CH : 0.11**
Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1-12) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Monday, 2 November 2020

	1	2	3	4	5	6	7	8	9	10	11	12	Total
Mon	1309	18	53	0	0	1	1	0	0	0	0	0	1382
(%)	94.7	1.3	3.8	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
AB	590	9	42	0	0	1	0	0	0	0	0	0	642
AB%	45.1	50.0	79.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5
BA	719.0	9.0	11.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	740.0
BA%	54.9	50.0	20.8	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	53.5
Tue*	50	0	3	0	0	0	0	0	0	0	0	0	53
(%)	94.3	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	26	0	2	0	0	0	0	0	0	0	0	0	28
AB%	52.0	0.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.8
BA	24.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
BA%	48.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.2
Wed*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thu*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fri*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sun*	0	0	0	0	0	0	0	0	0	0	0	0	0
(%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AB	0	0	0	0	0	0	0	0	0	0	0	0	0
AB%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BA%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Average daily volume

Entire week

	1309	18	53	0	0	1	1	0	0	0	0	0	1382
(%)	94.7	1.3	3.8	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
AB	590	9	42	0	0	1	0	0	0	0	0	0	642
AB%	45.1	50.0	79.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5
BA	719.0	9.0	11.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	740.0
BA%	54.9	50.0	20.8	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	53.5

Weekdays

	1309	18	53	0	0	1	1	0	0	0	0	0	1382
(%)	94.7	1.3	3.8	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
AB	590	9	42	0	0	1	0	0	0	0	0	0	642
AB%	45.1	50.0	79.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5
BA	719.0	9.0	11.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	740.0
BA%	54.9	50.0	20.8	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	53.5

Weekend No complete days.

*** - Incomplete**

MetroCount Traffic Executive
ALL Vehicle Counts (Virtual Day)

VirtVehicleCount-214 -- English (ENA)

Datasets:

Site:	**[Corination Drive] CH : 0.11**
Attribute:	
Direction:	8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration:	7:34 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020,
Zone:	
File:	Coronation Drive 0 2020-11-03 0709.EC0 (Plus)
Identifier:	DT1994BC MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default axle (v5.02)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020 (13.9821)**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = East, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (AustRoads94)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 16363 / 16370 (99.96%)

*** Virtual Day - Total=1170, 15 minute drops**

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1	**1**	**1**	**4**	**4**	**12**	**20**	**71**	**269**	**50**	**61**	**60**	**58**	**62**	**89**	**211**	**67**	**55**	**33**	**15**	**12**	**7**	**5**	**3**
0	0	1	0	1	3	4	8	**45**	15	15	12	17	13	16	**82**	18	14	11	5	5	3	2	1
0	0	1	0	0	4	3	16	**93**	11	17	12	15	11	16	**93**	15	15	9	3	2	1	1	1
0	0	0	0	1	3	4	20	**96**	11	15	16	13	15	**21**	20	18	14	8	4	3	1	1	1
0	0	0	3	1	2	8	27	**35**	13	15	20	12	23	**36**	17	16	12	6	3	2	2	1	1

AM Peak 0800 - 0900 (269), AM PHF=0.70 PM Peak 1430 - 1530 (231), PM PHF=0.62

Numbers have been rounded to the nearest integer.

MetroCount Traffic Executive
HVY Vehicle Counts (Virtual Day)

VirtVehicleCount-215 -- English (ENA)

Datasets:

Site: **[Corination Drive] CH : 0.11**
Attribute:
Direction: 8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration: 7:34 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020,
Zone:
File: Coronation Drive 0 2020-11-03 0709.EC0 (Plus)
Identifier: DT1994BC MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020 (13.9821)**
Included classes: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound), P = East, Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 100 metre
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile: Vehicles = 580 / 16370 (3.54%)

*** Virtual Day - Total=41, 15 minute drops**

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
0	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**8**	**2**	**2**	**2**	**3**	**3**	**2**	**9**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
0	0	0	0	0	0	0	0	**2**	1	0	0	1	1	1	**2**	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	**2**	1	1	0	1	1	1	**5**	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	**3**	0	0	1	0	1	0	**2**	1	0	0	0	0	0	0	0
0	0	0	0	0	0	1	**2**	1	0	1	1	1	1	0	**1**	1	0	0	0	0	0	0	0

AM Peak 0745 - 0845 (9), AM PHF=0.81 PM Peak 1500 - 1600 (9), PM PHF=0.49

Numbers have been rounded to the nearest integer.

MetroCount Traffic Executive
LV Vehicle Counts (Virtual Day)

VirtVehicleCount-216 -- English (ENA)

Datasets:

Site:	**[Corination Drive] CH : 0.11**
Attribute:	
Direction:	8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration:	7:34 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020,
Zone:	
File:	Coronation Drive 0 2020-11-03 0709.EC0 (Plus)
Identifier:	DT1994BC MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default axle (v5.02)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020 (13.9821)**
Included classes:	1, 2
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = East, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (AustRoads94)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 15783 / 16370 (96.41%)

*** Virtual Day - Total=1128, 15 minute drops**

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1	**1**	**1**	**4**	**4**	**11**	**18**	**68**	**260**	**48**	**60**	**58**	**55**	**60**	**87**	**203**	**64**	**54**	**33**	**15**	**12**	**7**	**5**	**3**
0	0	1	0	1	3	4	7	**42**	15	14	12	17	12	15	**80**	17	14	11	5	4	3	2	1
0	0	1	0	0	4	3	16	**91**	10	17	12	15	11	16	**88**	14	15	9	3	2	1	1	1
0	0	0	0	1	2	4	19	**93**	11	15	15	13	15	**21**	18	17	14	8	4	3	1	1	1
0	0	0	3	1	2	7	25	**34**	12	14	19	12	22	**35**	17	16	12	6	3	2	2	1	1

AM Peak 0800 - 0900 (260), AM PHF=0.70 PM Peak 1430 - 1530 (224), PM PHF=0.64

Numbers have been rounded to the nearest integer.

MetroCount Traffic Executive
Speed Statistics

SpeedStat-218 -- English (ENA)

Datasets:

Site: **[Corination Drive] CH : 0.11**
Attribute:
Direction: 8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration: 7:34 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020,
Zone:
File: Coronation Drive 0 2020-11-03 0709.EC0 (Plus)
Identifier: DT1994BC MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020 (13.9821)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound), P = East, Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 100 metre
Name: Default Profile
Scheme: Vehicle classification (AustRoads94)
Units: Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile: Vehicles = 16363 / 16370 (99.96%)

Speed Statistics

SpeedStat-218
Site: Corination Drive.0.1EW
Description: **CH : 0.11**
Filter time: **7:35 Tuesday, 20 October 2020 => 7:09 Tuesday, 3 November 2020**
Scheme: Vehicle classification (AustRoads94)
Filter: Cls(1-12) Dir(NESW) Sp(10,160) Headway(>0) Span(0 - 100) Lane(0-16)

Vehicles = 16363
Posted speed limit = 60 km/h, Exceeding = 1666 (10.18%), Mean Exceeding = 64.23 km/h
Maximum = 96.5 km/h, **Minimum** = 10.3 km/h, **Mean** = 51.4 km/h
85% Speed = 58.23 km/h, **95% Speed** = 63.18 km/h, **Median** = 51.03 km/h
20 km/h Pace = 41 - 61, **Number in Pace** = 14267 (87.19%)
Variance = 49.38, **Standard Deviation** = 7.03 km/h

Speed Bins (Partial days)

Speed	Bin	Below	Above	Energy	vMult	n * vMult
0 - 10	0 0.000%	0 0.000%	16363 100.0%	0.00	0.00	0.00
10 - 20	35 0.214%	35 0.214%	16328 99.79%	0.00	0.00	0.00
20 - 30	47 0.287%	82 0.501%	16281 99.50%	0.00	0.00	0.00
30 - 40	501 3.062%	583 3.563%	15780 96.44%	0.00	0.00	0.00
40 - 50	6517 39.83%	7100 43.39%	9263 56.61%	0.00	0.00	0.00
50 - 60	7597 46.43%	14697 89.82%	1666 10.18%	0.00	0.00	0.00
60 - 70	1523 9.308%	16220 99.13%	143 0.874%	0.00	0.00	0.00
70 - 80	132 0.807%	16352 99.93%	11 0.067%	0.00	0.00	0.00
80 - 90	9 0.055%	16361 99.99%	2 0.012%	0.00	0.00	0.00
90 - 100	2 0.012%	16363 100.0%	0 0.000%	0.00	0.00	0.00
100 - 110	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
110 - 120	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
120 - 130	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
130 - 140	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
140 - 150	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
150 - 160	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
160 - 170	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
170 - 180	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
180 - 190	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00
190 - 200	0 0.000%	16363 100.0%	0 0.000%	0.00	0.00	0.00

Total Speed Rating = 0.00
Total Moving Energy (Estimated) = 0.00

Speed limit fields (Partial days)

	Limit	Below	Above
0	60 (PSL)	14697 89.8%	1666 10.2%

MetroCount Traffic Executive
Vehicle Counts (Virtual Day)

VirtVehicleCount-642 -- English (ENA)

Datasets:

Site:	**[Cremourne Drive] Cremourne Drive between Pryde Street and Keating Street**
Attribute:	
Direction:	8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration:	9:44 Friday, 12 February 2021 => 7:33 Wednesday, 10 March 2021,
Zone:	
File:	Cremourne Drive 0 2021-03-10 0733.EC0 (Plus)
Identifier:	DR99JWRG MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default axle (v5.02)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**9:45 Friday, 12 February 2021 => 7:33 Wednesday, 10 March 2021 (25.9087)**
Included classes:	1, 2
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = East, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (AustRoads94)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 35807 / 47176 (75.90%)

*** Virtual Day - Total=1388, 15 minute drops**

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1	**1**	**0**	**4**	**4**	**17**	**31**	**71**	**195**	**76**	**80**	**83**	**77**	**83**	**137**	**149**	**117**	**104**	**74**	**42**	**24**	**9**	**6**	**3**
0	0	0	0	1	2	6	11	**28**	22	22	20	20	21	20	**69**	30	31	21	12	7	3	2	1
0	0	0	0	1	5	7	15	**53**	18	21	21	18	26	24	**28**	30	25	20	11	6	2	2	1
0	0	0	1	1	4	6	22	**73**	18	18	22	19	19	**37**	24	27	25	18	10	6	2	2	1
0	0	0	2	2	5	12	23	**41**	19	20	20	20	18	**56**	27	30	24	15	8	5	2	1	1

AM Peak 0800 - 0900 (195), AM PHF=0.67 PM Peak 1430 - 1530 (190), PM PHF=0.69

Numbers have been rounded to the nearest integer.

MetroCount Traffic Executive
Vehicle Counts (Virtual Day)

VirtVehicleCount-643 -- English (ENA)

Datasets:

Site:	**[Cremourne Drive] Cremourne Drive between Pryde Street and Keating Street**
Attribute:	
Direction:	8 - East bound A>B, West bound B>A. **Lane:** 0
Survey Duration:	9:44 Friday, 12 February 2021 => 7:33 Wednesday, 10 March 2021,
Zone:	
File:	Cremourne Drive 0 2021-03-10 0733.EC0 (Plus)
Identifier:	DR99JWRG MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default axle (v5.02)
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**9:45 Friday, 12 February 2021 => 7:33 Wednesday, 10 March 2021 (25.9087)**
Included classes:	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound), P = East, Lane = 0-16
Separation:	Headway > 0 sec, Span 0 - 100 metre
Name:	Default Profile
Scheme:	Vehicle classification (AustRoads94)
Units:	Metric (metre, kilometre, m/s, km/h, kg, tonne)
In profile:	Vehicles = 11333 / 47176 (24.02%)

* Virtual Day - Total=439, 15 minute drops

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
1	**0**	**1**	**2**	**4**	**7**	**12**	**22**	**50**	**25**	**25**	**27**	**28**	**27**	**42**	**40**	**39**	**34**	**24**	**14**	**7**	**4**	**2**	**1**
0	0	0	1	2	1	3	5	**8**	7	6	7	8	6	7	**15**	11	10	7	4	2	1	1	0
0	0	0	0	1	2	2	5	**15**	7	5	6	7	7	7	**8**	10	8	6	4	2	1	1	0
0	0	1	0	1	2	3	6	**17**	5	7	6	7	6	**12**	8	10	10	6	3	2	1	1	0
0	0	0	1	1	2	4	7	**10**	6	7	7	6	7	**16**	8	9	7	5	3	2	1	0	0

AM Peak 0800 - 0900 (50), AM PHF=0.73 PM Peak 1430 - 1530 (50), PM PHF=0.79

Numbers have been rounded to the nearest integer.

Appendix B

TMR Supplied Traffic Data

SITE	DESCRIPTION	LONGITUDE	LATITUDE	THROUGH DISTANCE	ROAD SECTION ID	ROAD NAME	THROUGH DISTANCE START	THROUGH DISTANCE END	AADT	PC CLASS 0A	PC CLASS 0B	PC CLASS 1A	PC CLASS 1B	PC CLASS 1C	PC CLASS 1D	GROWTH PC 1YR	GROWTH PC 5YR	GROWTH PC 10YR
60117	715m of N of Bruce Hwy, Benaraby	151.3636694	-24.02077797	0.715	1805	TANNUM SANDS ROAD	0	6.315	1479	87.2	12.8	87.2	9.94	1.42	1.44	-9.93	-2.25	-1.89
61206	190m S of Coronation Dr, Tannum Sands	151.3693114	-23.95781318	7.78	1805	TANNUM SANDS ROAD	6.315	8.49	2738	87.25	12.75	87.25	11.62	1.02	0.11	-9.73	-3.75	-1.57
61615	120m N of Beach Ave, Tannum Sands	151.3728443	-23.94965274	8.83	1805	TANNUM SANDS ROAD	8.49	9.11	1457	95.27	4.73	95.27	4.66	0.07	0	-7.84	0.65	0.76

SITE	DESCRIPTION	LONGITUDE	LATITUDE	THROUGH DISTANCE	ROAD SECTION ID	ROAD NAME	THROUGH DISTANCE START	THROUGH DISTANCE END	AADT	PC CLASS 2A	PC CLASS 2B	PC CLASS 2C	PC CLASS 2D	PC CLASS 2E	PC CLASS 2F	PC CLASS 2G	PC CLASS 2H	PC CLASS 2I	PC CLASS 2J	PC CLASS 2K	PC CLASS 2L
60117	715m of N of Bruce Hwy, Benaraby	151.3636694	-24.02077797	0.715	1805	TANNUM SANDS ROAD	0	6.315	1479	81.09	6.11	9.25	0.45	0.24	0.64	0.31	0.07	0.4	1.43	0.01	0
61206	190m S of Coronation Dr, Tannum Sands	151.3693114	-23.95781318	7.78	1805	TANNUM SANDS ROAD	6.315	8.49	2738	84	3.25	11.03	0.49	0.1	0.54	0.3	0.03	0.15	0.1	0.01	0
61615	120m N of Beach Ave, Tannum Sands	151.3728443	-23.94965274	8.83	1805	TANNUM SANDS ROAD	8.49	9.11	1457	94.13	1.14	4.37	0.16	0.13	0.04	0.02	0.01	0	0	0	0

SITE	DESCRIPTION	LONGITUDE	LATITUDE	THROUGH DISTANCE	ROAD SECTION ID	ROAD NAME	THROUGH DISTANCE START	THROUGH DISTANCE END	AADT	REPORTLINK
60117	715m of N of Bruce Hwy, Benaraby	151.3636694	-24.02077797	0.715	1805	TANNUM SANDS ROAD	0	6.315	1479	http://tmr.qld.gov.au/-/media/aboutus/corpinfo/Open-data/aadtsegmentreport/2020/aadtSegAndAnnualVolume-1805-60117.pdf
61206	190m S of Coronation Dr, Tannum Sands	151.3693114	-23.95781318	7.78	1805	TANNUM SANDS ROAD	6.315	8.49	2738	http://tmr.qld.gov.au/-/media/aboutus/corpinfo/Open-data/aadtsegmentreport/2020/aadtSegAndAnnualVolume-1805-61206.pdf
61615	120m N of Beach Ave, Tannum Sands	151.3728443	-23.94965274	8.83	1805	TANNUM SANDS ROAD	8.49	9.11	1457	http://tmr.qld.gov.au/-/media/aboutus/corpinfo/Open-data/aadtsegmentreport/2020/aadtSegAndAnnualVolume-1805-61615.pdf

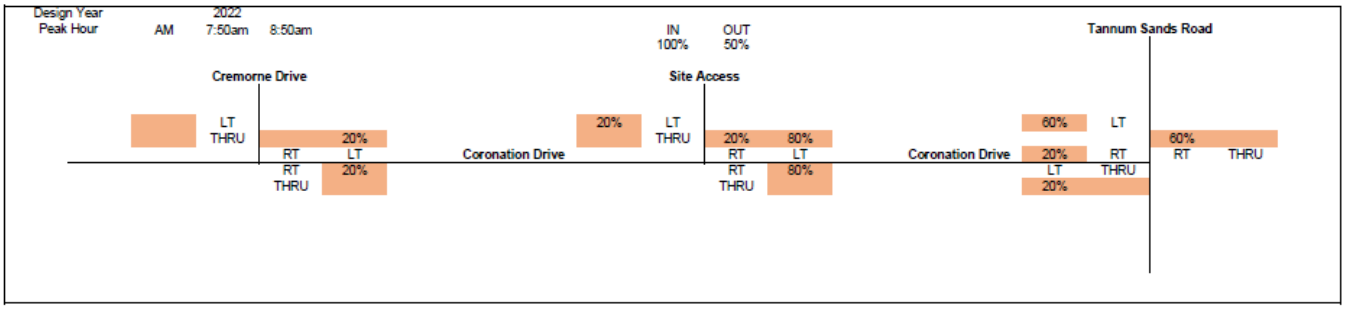
2020 Traffic Census Data

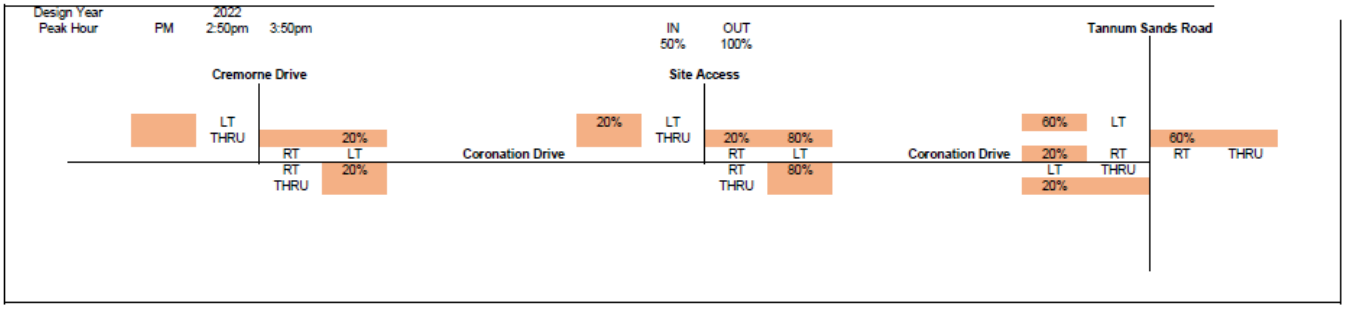
SITE	DESCRIPTION	THROUGH DISTANCE	ROAD SECTION ID	ROAD NAME	THROUGH DISTANCE START	THROUGH DISTANCE END	AADT
60117	715m of N of Bruce Hwy, Benaraby	0.715	1805	TANNUM SANDS ROAD	0	6.315	1479
61206	190m S of Coronation Dr, Tannum Sands	7.78	1805	TANNUM SANDS ROAD	6.315	8.49	2738
61615	120m N of Beach Ave, Tannum Sands	8.83	1805	TANNUM SANDS ROAD	8.49	9.11	1457

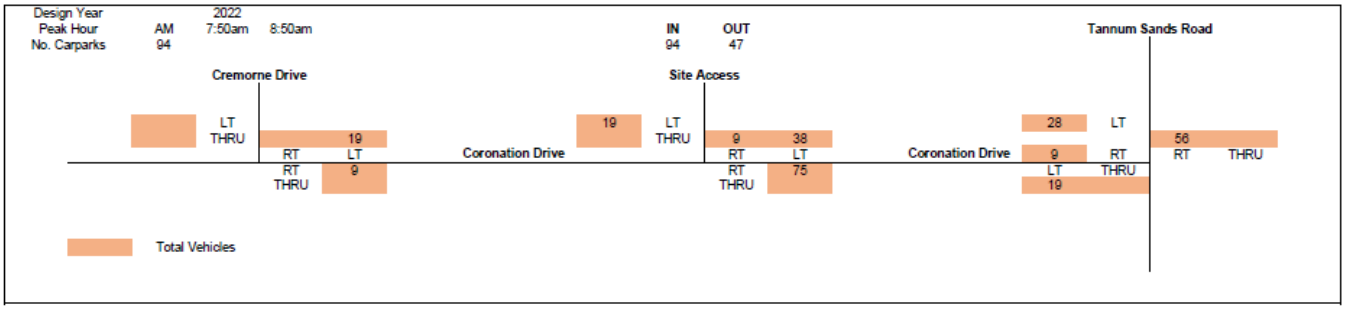
Appendix C

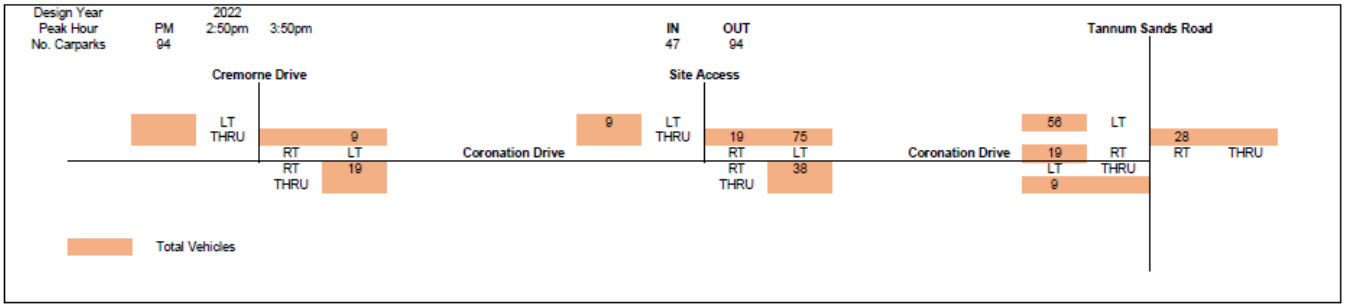
Generated Traffic Volumes and Assumptions

Development Generated Traffic





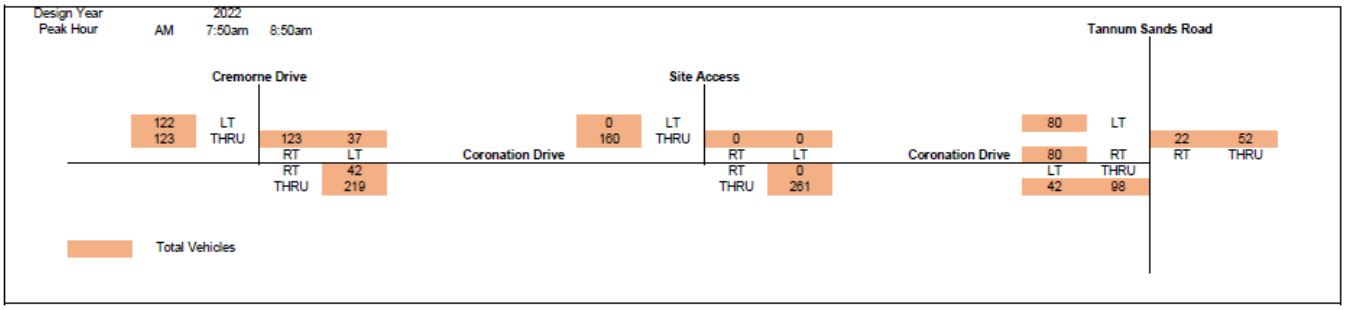


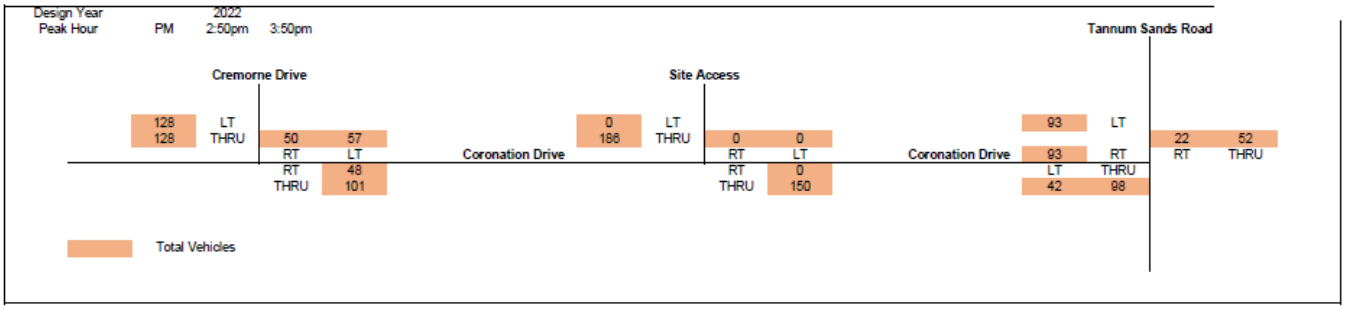


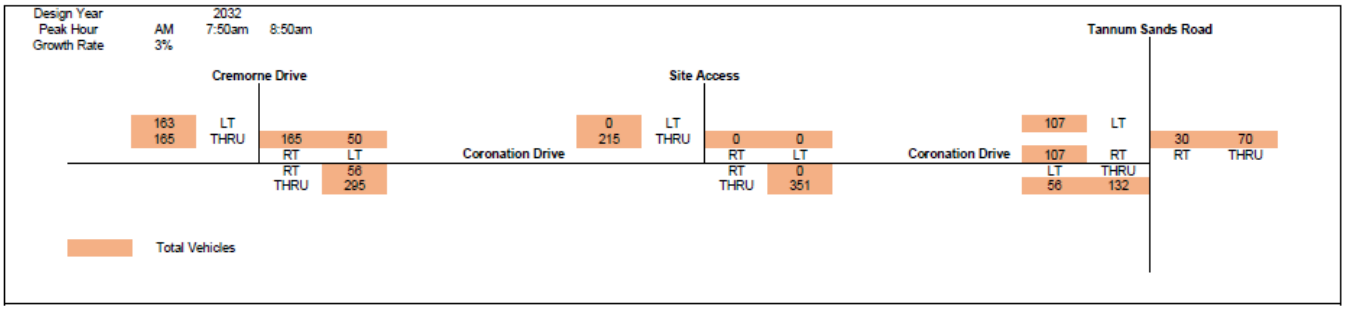
Appendix D

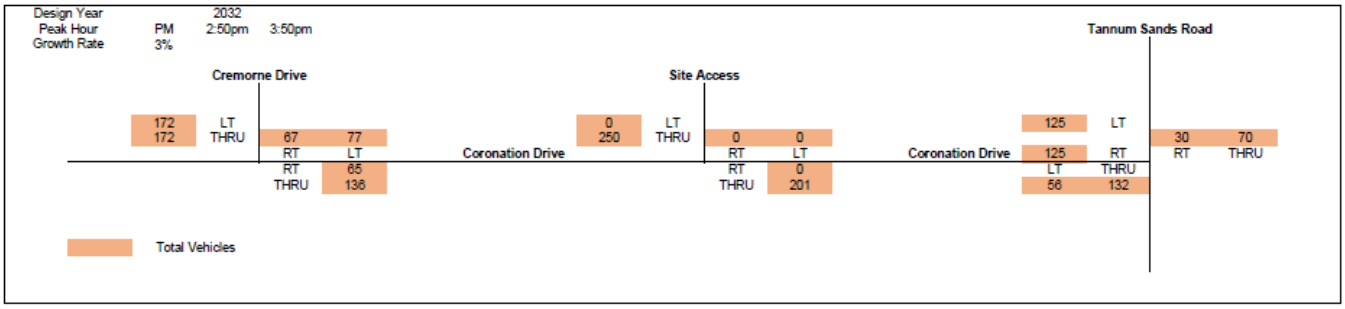
Traffic Volumes and Movements Diagrams

Base Case – WITHOUT DEVELOPMENT TRAFFIC

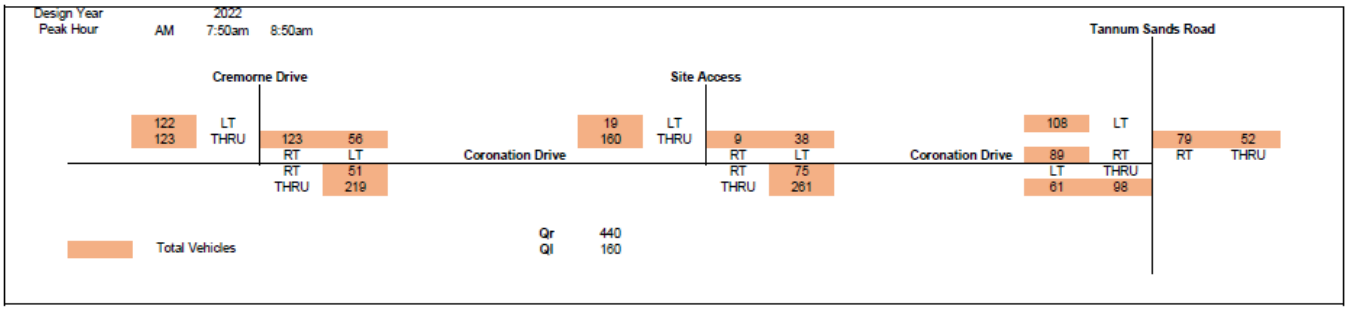


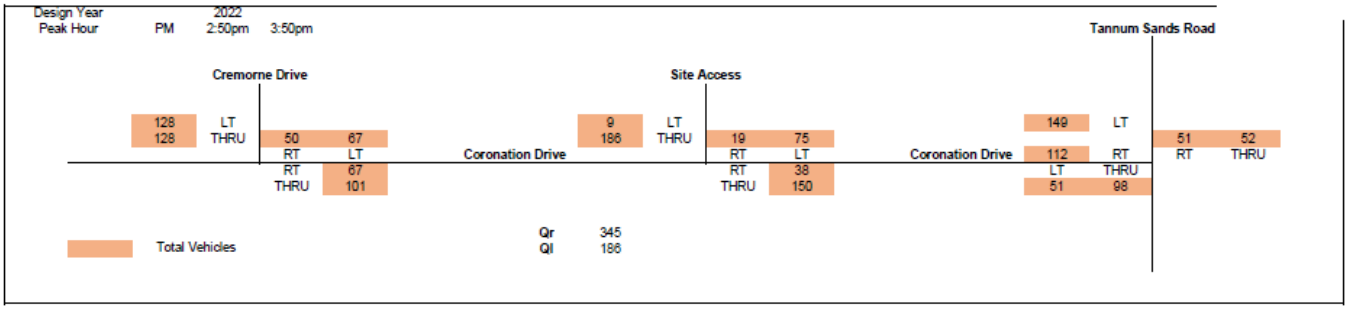


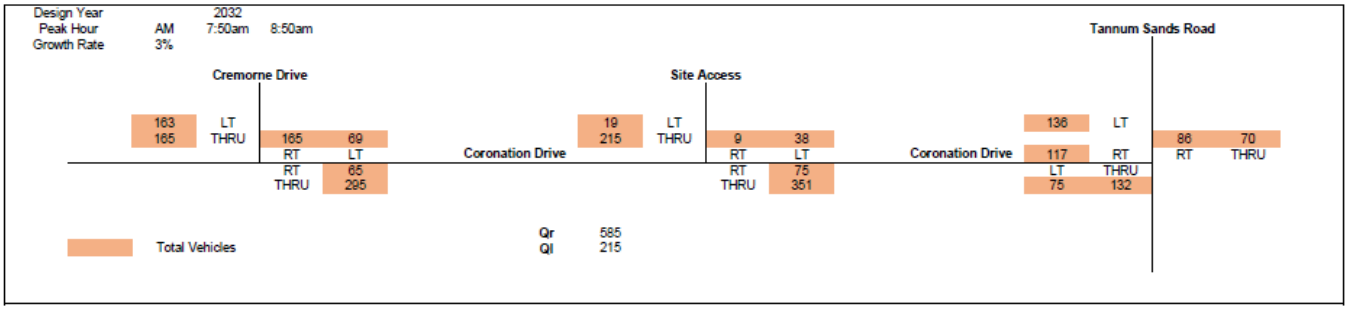


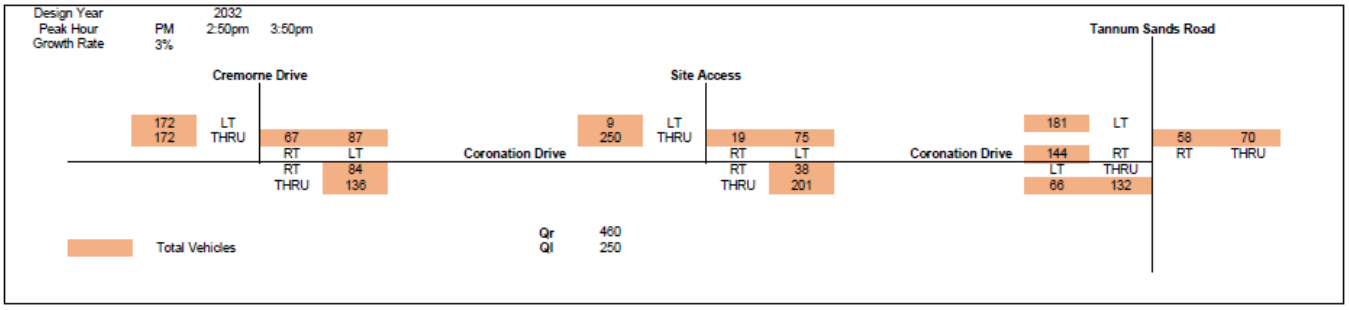


Developed Case – WITH DEVELOPMENT TRAFFIC









Appendix E

Base Case (2022) and Future Case (2032) Without Development AM Peak SIDRA Results

MOVEMENT SUMMARY

▽ Site: 1 [IS 1 - 2022 AM Peak (Site Folder: 2022 - Base Case (No DEV))]

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	52	0.0	55	0.0	0.028	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	22	0.0	23	0.0	0.014	5.7	LOS A	0.1	0.4	0.20	0.55	0.20	52.6
Approach		74	0.0	78	0.0	0.028	1.7	NA	0.1	0.4	0.06	0.16	0.06	57.6
NorthWest: Coronation Drive (W)														
10	L2	80	0.0	84	0.0	0.144	5.9	LOS A	0.6	4.3	0.26	0.57	0.26	52.8
12	R2	80	0.0	84	0.0	0.144	6.7	LOS A	0.6	4.3	0.26	0.57	0.26	52.6
Approach		160	0.0	168	0.0	0.144	6.3	LOS A	0.6	4.3	0.26	0.57	0.26	52.7
SouthWest: Tannum Sands Road (S)														
1	L2	42	0.0	44	0.0	0.028	5.7	LOS A	0.1	0.8	0.08	0.52	0.08	54.0
2	T1	98	0.0	103	0.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		140	0.0	147	0.0	0.053	1.7	LOS A	0.1	0.8	0.02	0.16	0.02	58.0
All Vehicles		374	0.0	394	0.0	0.144	3.7	NA	0.6	4.3	0.13	0.34	0.13	55.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 2 [IS 2 - 2022 AM Peak (Site Folder: 2022 - Base Case (No DEV))]

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	261	0.0	275	0.0	0.141	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	1	0.0	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.27	0.51	0.27	52.6
Approach		262	0.0	276	0.0	0.141	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Proposed Site Access														
7	L2	1	0.0	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.25	0.51	0.25	52.8
9	R2	1	0.0	1	0.0	0.001	8.1	LOS A	0.0	0.0	0.48	0.58	0.48	51.2
Approach		2	0.0	2	0.0	0.001	7.0	LOS A	0.0	0.0	0.36	0.55	0.36	52.0
West: Coronation Drive (W)														
10	L2	1	0.0	1	0.0	0.087	5.6	LOS A	0.0	0.0	0.00	0.00	0.00	58.3
11	T1	160	0.0	168	0.0	0.087	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		161	0.0	169	0.0	0.087	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		425	0.0	447	0.0	0.141	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 3 [IS 3 - 2022 AM Peak (Site Folder: 2022 - Base Case (No DEV))]

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	219	0.0	231	0.0	0.150	0.2	LOS A	0.3	2.4	0.14	0.10	0.14	58.6
6	R2	42	0.0	44	0.0	0.150	6.4	LOS A	0.3	2.4	0.14	0.10	0.14	56.4
Approach		261	0.0	275	0.0	0.150	1.2	NA	0.3	2.4	0.14	0.10	0.14	58.2
North: Cremorne Drive (N)														
7	L2	37	0.0	39	0.0	0.182	6.0	LOS A	0.7	4.6	0.35	0.67	0.35	52.3
9	R2	123	0.0	129	0.0	0.182	7.7	LOS A	0.7	4.6	0.35	0.67	0.35	51.8
Approach		160	0.0	168	0.0	0.182	7.3	LOS A	0.7	4.6	0.35	0.67	0.35	51.9
West: Coronation Drive (W)														
10	L2	122	0.0	128	0.0	0.136	5.6	LOS A	0.0	0.0	0.00	0.29	0.00	55.8
11	T1	123	0.0	129	0.0	0.136	0.0	LOS A	0.0	0.0	0.00	0.29	0.00	57.3
Approach		245	0.0	258	0.0	0.136	2.8	NA	0.0	0.0	0.00	0.29	0.00	56.6
All Vehicles		666	0.0	701	0.0	0.182	3.3	NA	0.7	4.6	0.14	0.31	0.14	56.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2032 AM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	70	0.0	74	0.0	0.038	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	30	0.0	32	0.0	0.020	5.8	LOS A	0.1	0.6	0.24	0.55	0.24	52.5
Approach		100	0.0	105	0.0	0.038	1.8	NA	0.1	0.6	0.07	0.17	0.07	57.5
NorthWest: Coronation Drive (W)														
10	L2	107	0.0	113	0.0	0.205	6.0	LOS A	0.9	6.3	0.32	0.60	0.32	52.6
12	R2	107	0.0	113	0.0	0.205	7.4	LOS A	0.9	6.3	0.32	0.60	0.32	52.4
Approach		214	0.0	225	0.0	0.205	6.7	LOS A	0.9	6.3	0.32	0.60	0.32	52.5
SouthWest: Tannum Sands Road (S)														
1	L2	56	0.0	59	0.0	0.037	5.7	LOS A	0.1	1.0	0.10	0.52	0.10	54.0
2	T1	132	0.0	139	0.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		188	0.0	198	0.0	0.071	1.7	LOS A	0.1	1.0	0.03	0.16	0.03	58.0
All Vehicles		502	0.0	528	0.0	0.205	3.8	NA	0.9	6.3	0.16	0.35	0.16	55.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2032 AM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	351	0.0	369	0.0	0.189	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	1	0.0	1	0.0	0.001	6.1	LOS A	0.0	0.0	0.32	0.51	0.32	52.5
Approach		352	0.0	371	0.0	0.189	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Proposed Site Access														
7	L2	1	0.0	1	0.0	0.001	6.2	LOS A	0.0	0.0	0.30	0.51	0.30	52.7
9	R2	1	0.0	1	0.0	0.002	9.5	LOS A	0.0	0.0	0.55	0.62	0.55	50.2
Approach		2	0.0	2	0.0	0.002	7.8	LOS A	0.0	0.0	0.42	0.57	0.42	51.4
West: Coronation Drive (W)														
10	L2	1	0.0	1	0.0	0.117	5.6	LOS A	0.0	0.0	0.00	0.00	0.00	58.3
11	T1	215	0.0	226	0.0	0.117	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		216	0.0	227	0.0	0.117	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		570	0.0	600	0.0	0.189	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2032 AM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	295	0.0	311	0.0	0.206	0.4	LOS A	0.5	3.7	0.18	0.10	0.18	58.4
6	R2	56	0.0	59	0.0	0.206	6.9	LOS A	0.5	3.7	0.18	0.10	0.18	56.3
Approach		351	0.0	369	0.0	0.206	1.4	NA	0.5	3.7	0.18	0.10	0.18	58.1
North: Cremorne Drive (N)														
7	L2	50	0.0	53	0.0	0.287	6.3	LOS A	1.2	8.1	0.44	0.75	0.48	51.3
9	R2	165	0.0	174	0.0	0.287	9.2	LOS A	1.2	8.1	0.44	0.75	0.48	50.8
Approach		215	0.0	226	0.0	0.287	8.6	LOS A	1.2	8.1	0.44	0.75	0.48	50.9
West: Coronation Drive (W)														
10	L2	163	0.0	172	0.0	0.181	5.6	LOS A	0.0	0.0	0.00	0.29	0.00	55.8
11	T1	165	0.0	174	0.0	0.181	0.0	LOS A	0.0	0.0	0.00	0.29	0.00	57.3
Approach		328	0.0	345	0.0	0.181	2.8	NA	0.0	0.0	0.00	0.29	0.00	56.6
All Vehicles		894	0.0	941	0.0	0.287	3.6	NA	1.2	8.1	0.18	0.33	0.19	55.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix F

Base Case (2022) and Future Case (2032) Without Development PM Peak SIDRA Results

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2022 PM Peak (Site Folder: 2022 - Base Case (No DEV))]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	52	0.0	55	0.0	0.028	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	22	0.0	23	0.0	0.014	5.7	LOS A	0.1	0.4	0.20	0.55	0.20	52.6
Approach		74	0.0	78	0.0	0.028	1.7	NA	0.1	0.4	0.06	0.16	0.06	57.6
NorthWest: Coronation Drive (W)														
10	L2	93	0.0	98	0.0	0.167	5.9	LOS A	0.7	5.1	0.26	0.58	0.26	52.8
12	R2	93	0.0	98	0.0	0.167	6.8	LOS A	0.7	5.1	0.26	0.58	0.26	52.6
Approach		186	0.0	196	0.0	0.167	6.3	LOS A	0.7	5.1	0.26	0.58	0.26	52.7
SouthWest: Tannum Sands Road (S)														
1	L2	42	0.0	44	0.0	0.028	5.7	LOS A	0.1	0.8	0.08	0.52	0.08	54.0
2	T1	98	0.0	103	0.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		140	0.0	147	0.0	0.053	1.7	LOS A	0.1	0.8	0.02	0.16	0.02	58.0
All Vehicles		400	0.0	421	0.0	0.167	3.9	NA	0.7	5.1	0.14	0.35	0.14	55.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2022 PM Peak (Site Folder: 2022 - Base Case (No DEV))]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	150	0.0	158	0.0	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	1	0.0	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.29	0.51	0.29	52.5
Approach		151	0.0	159	0.0	0.081	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Proposed Site Access														
7	L2	1	0.0	1	0.0	0.001	6.1	LOS A	0.0	0.0	0.27	0.51	0.27	52.8
9	R2	1	0.0	1	0.0	0.001	7.3	LOS A	0.0	0.0	0.42	0.56	0.42	51.7
Approach		2	0.0	2	0.0	0.001	6.7	LOS A	0.0	0.0	0.35	0.54	0.35	52.2
West: Coronation Drive (W)														
10	L2	1	0.0	1	0.0	0.099	5.6	LOS A	0.0	0.0	0.00	0.00	0.00	58.3
11	T1	183	0.0	193	0.0	0.099	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		184	0.0	194	0.0	0.099	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		337	0.0	355	0.0	0.099	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2022 PM Peak (Site Folder: 2022 - Base Case (No DEV))]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	101	0.0	106	0.0	0.091	0.5	LOS A	0.3	2.4	0.25	0.20	0.25	57.4
6	R2	48	0.0	51	0.0	0.091	6.4	LOS A	0.3	2.4	0.25	0.20	0.25	55.3
Approach		149	0.0	157	0.0	0.091	2.4	NA	0.3	2.4	0.25	0.20	0.25	56.7
North: Cremorne Drive (N)														
7	L2	57	0.0	60	0.0	0.098	6.0	LOS A	0.4	2.5	0.26	0.59	0.26	52.9
9	R2	50	0.0	53	0.0	0.098	6.9	LOS A	0.4	2.5	0.26	0.59	0.26	52.4
Approach		107	0.0	113	0.0	0.098	6.4	LOS A	0.4	2.5	0.26	0.59	0.26	52.6
West: Coronation Drive (W)														
10	L2	128	0.0	135	0.0	0.142	5.6	LOS A	0.0	0.0	0.00	0.30	0.00	55.8
11	T1	128	0.0	135	0.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.30	0.00	57.3
Approach		256	0.0	269	0.0	0.142	2.8	NA	0.0	0.0	0.00	0.30	0.00	56.6
All Vehicles		512	0.0	539	0.0	0.142	3.4	NA	0.4	2.5	0.13	0.33	0.13	55.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2032 PM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	70	0.0	74	0.0	0.038	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	30	0.0	32	0.0	0.020	5.8	LOS A	0.1	0.6	0.24	0.55	0.24	52.5
Approach		100	0.0	105	0.0	0.038	1.8	NA	0.1	0.6	0.07	0.17	0.07	57.5
NorthWest: Coronation Drive (W)														
10	L2	125	0.0	132	0.0	0.240	6.0	LOS A	1.1	7.6	0.33	0.61	0.33	52.6
12	R2	125	0.0	132	0.0	0.240	7.4	LOS A	1.1	7.6	0.33	0.61	0.33	52.4
Approach		250	0.0	263	0.0	0.240	6.7	LOS A	1.1	7.6	0.33	0.61	0.33	52.5
SouthWest: Tannum Sands Road (S)														
1	L2	56	0.0	59	0.0	0.037	5.7	LOS A	0.1	1.0	0.10	0.52	0.10	54.0
2	T1	132	0.0	139	0.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		188	0.0	198	0.0	0.071	1.7	LOS A	0.1	1.0	0.03	0.16	0.03	58.0
All Vehicles		538	0.0	566	0.0	0.240	4.1	NA	1.1	7.6	0.18	0.37	0.18	55.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2032 PM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	201	0.0	212	0.0	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	1	0.0	1	0.0	0.001	6.3	LOS A	0.0	0.0	0.34	0.51	0.34	52.4
Approach		202	0.0	213	0.0	0.109	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Proposed Site Access														
7	L2	1	0.0	1	0.0	0.001	6.3	LOS A	0.0	0.0	0.32	0.52	0.32	52.6
9	R2	1	0.0	1	0.0	0.002	8.3	LOS A	0.0	0.0	0.49	0.59	0.49	51.0
Approach		2	0.0	2	0.0	0.002	7.3	LOS A	0.0	0.0	0.41	0.55	0.41	51.8
West: Coronation Drive (W)														
10	L2	1	0.0	1	0.0	0.136	5.6	LOS A	0.0	0.0	0.00	0.00	0.00	58.3
11	T1	250	0.0	263	0.0	0.136	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		251	0.0	264	0.0	0.136	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		455	0.0	479	0.0	0.136	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2032 PM Peak (Site Folder: 2032 - Base Case (No DEV))]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	136	0.0	143	0.0	0.128	0.7	LOS A	0.5	3.7	0.31	0.21	0.31	57.1
6	R2	65	0.0	68	0.0	0.128	6.8	LOS A	0.5	3.7	0.31	0.21	0.31	55.1
Approach		201	0.0	212	0.0	0.128	2.7	NA	0.5	3.7	0.31	0.21	0.31	56.5
North: Cremorne Drive (N)														
7	L2	77	0.0	81	0.0	0.144	6.1	LOS A	0.5	3.8	0.32	0.63	0.32	52.6
9	R2	67	0.0	71	0.0	0.144	7.7	LOS A	0.5	3.8	0.32	0.63	0.32	52.1
Approach		144	0.0	152	0.0	0.144	6.9	LOS A	0.5	3.8	0.32	0.63	0.32	52.3
West: Coronation Drive (W)														
10	L2	172	0.0	181	0.0	0.190	5.6	LOS A	0.0	0.0	0.00	0.30	0.00	55.8
11	T1	172	0.0	181	0.0	0.190	0.0	LOS A	0.0	0.0	0.00	0.30	0.00	57.3
Approach		344	0.0	362	0.0	0.190	2.8	NA	0.0	0.0	0.00	0.30	0.00	56.5
All Vehicles		689	0.0	725	0.0	0.190	3.6	NA	0.5	3.8	0.16	0.34	0.16	55.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix G

Base Case (2022) and Future Case (2032) With Development AM Peak SIDRA Results

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2022 AM Peak (Site Folder: 2022 - Dev Case)]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	52	0.0	55	0.0	0.028	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	79	0.0	83	0.0	0.051	5.7	LOS A	0.2	1.6	0.21	0.56	0.21	52.6
Approach		131	0.0	138	0.0	0.051	3.5	NA	0.2	1.6	0.13	0.34	0.13	55.3
NorthWest: Coronation Drive (W)														
10	L2	108	0.0	114	0.0	0.182	5.9	LOS A	0.8	5.5	0.26	0.58	0.26	52.8
12	R2	89	0.0	94	0.0	0.182	7.3	LOS A	0.8	5.5	0.26	0.58	0.26	52.6
Approach		197	0.0	207	0.0	0.182	6.5	LOS A	0.8	5.5	0.26	0.58	0.26	52.7
SouthWest: Tannum Sands Road (S)														
1	L2	61	0.0	64	0.0	0.042	5.8	LOS A	0.2	1.2	0.17	0.52	0.17	53.7
2	T1	98	0.0	103	0.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		159	0.0	167	0.0	0.053	2.2	LOS A	0.2	1.2	0.07	0.20	0.07	57.4
All Vehicles		487	0.0	513	0.0	0.182	4.3	NA	0.8	5.5	0.16	0.39	0.16	54.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2022 AM Peak (Site Folder: 2022 - Dev Case)]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	261	0.0	275	0.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	75	0.0	79	0.0	0.052	6.1	LOS A	0.2	1.6	0.29	0.56	0.29	52.5
Approach		336	0.0	354	0.0	0.142	1.4	NA	0.2	1.6	0.07	0.13	0.07	58.1
North: Proposed Site Access														
7	L2	38	0.0	40	0.0	0.028	6.0	LOS A	0.1	0.8	0.25	0.55	0.25	52.8
9	R2	9	0.0	9	0.0	0.015	8.9	LOS A	0.1	0.4	0.52	0.68	0.52	50.6
Approach		47	0.0	49	0.0	0.028	6.6	LOS A	0.1	0.8	0.30	0.57	0.30	52.4
West: Coronation Drive (W)														
10	L2	19	0.0	20	0.0	0.097	5.6	LOS A	0.0	0.0	0.00	0.06	0.00	57.8
11	T1	160	0.0	168	0.0	0.097	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	59.4
Approach		179	0.0	188	0.0	0.097	0.6	NA	0.0	0.0	0.00	0.06	0.00	59.2
All Vehicles		562	0.0	592	0.0	0.142	1.6	NA	0.2	1.6	0.06	0.14	0.06	57.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2022 AM Peak (Site Folder: 2022 - Dev Case)]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	219	0.0	231	0.0	0.157	0.3	LOS A	0.4	2.9	0.17	0.12	0.17	58.3
6	R2	51	0.0	54	0.0	0.157	6.4	LOS A	0.4	2.9	0.17	0.12	0.17	56.2
Approach		270	0.0	284	0.0	0.157	1.4	NA	0.4	2.9	0.17	0.12	0.17	57.9
North: Cremorne Drive (N)														
7	L2	56	0.0	59	0.0	0.197	6.0	LOS A	0.7	5.1	0.33	0.66	0.33	52.3
9	R2	123	0.0	129	0.0	0.197	7.8	LOS A	0.7	5.1	0.33	0.66	0.33	51.8
Approach		179	0.0	188	0.0	0.197	7.2	LOS A	0.7	5.1	0.33	0.66	0.33	52.0
West: Coronation Drive (W)														
10	L2	122	0.0	128	0.0	0.136	5.6	LOS A	0.0	0.0	0.00	0.29	0.00	55.8
11	T1	123	0.0	129	0.0	0.136	0.0	LOS A	0.0	0.0	0.00	0.29	0.00	57.3
Approach		245	0.0	258	0.0	0.136	2.8	NA	0.0	0.0	0.00	0.29	0.00	56.6
All Vehicles		694	0.0	731	0.0	0.197	3.4	NA	0.7	5.1	0.15	0.32	0.15	55.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 1 [IS 1 - 2032 AM Peak (Site Folder: 2032 - Dev Case)]

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	70	0.0	74	0.0	0.038	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	86	0.0	91	0.0	0.057	5.9	LOS A	0.3	1.8	0.25	0.56	0.25	52.5
Approach		156	0.0	164	0.0	0.057	3.2	NA	0.3	1.8	0.14	0.31	0.14	55.6
NorthWest: Coronation Drive (W)														
10	L2	136	0.0	143	0.0	0.249	6.0	LOS A	1.1	7.9	0.33	0.61	0.33	52.5
12	R2	117	0.0	123	0.0	0.249	8.0	LOS A	1.1	7.9	0.33	0.61	0.33	52.3
Approach		253	0.0	266	0.0	0.249	6.9	LOS A	1.1	7.9	0.33	0.61	0.33	52.4
SouthWest: Tannum Sands Road (S)														
1	L2	66	0.0	69	0.0	0.046	5.9	LOS A	0.2	1.3	0.18	0.52	0.18	53.6
2	T1	132	0.0	139	0.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		198	0.0	208	0.0	0.071	2.0	LOS A	0.2	1.3	0.06	0.17	0.06	57.7
All Vehicles		607	0.0	639	0.0	0.249	4.4	NA	1.1	7.9	0.19	0.39	0.19	54.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 2 [IS 2 - 2032 AM Peak (Site Folder: 2032 - Dev Case)]

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	351	0.0	369	0.0	0.191	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	75	0.0	79	0.0	0.055	6.3	LOS A	0.2	1.7	0.34	0.58	0.34	52.4
Approach		426	0.0	448	0.0	0.191	1.1	NA	0.2	1.7	0.06	0.10	0.06	58.4
North: Proposed Site Access														
7	L2	38	0.0	40	0.0	0.030	6.2	LOS A	0.1	0.8	0.30	0.56	0.30	52.7
9	R2	9	0.0	9	0.0	0.019	10.6	LOS B	0.1	0.5	0.58	0.74	0.58	49.5
Approach		47	0.0	49	0.0	0.030	7.1	LOS A	0.1	0.8	0.36	0.60	0.36	52.0
West: Coronation Drive (W)														
10	L2	19	0.0	20	0.0	0.127	5.6	LOS A	0.0	0.0	0.00	0.05	0.00	57.9
11	T1	215	0.0	226	0.0	0.127	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	59.5
Approach		234	0.0	246	0.0	0.127	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.4
All Vehicles		707	0.0	744	0.0	0.191	1.3	NA	0.2	1.7	0.06	0.12	0.06	58.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 3 [IS 3 - 2032 AM Peak (Site Folder: 2032 - Dev Case)]

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	295	0.0	311	0.0	0.213	0.4	LOS A	0.6	4.3	0.20	0.12	0.20	58.2
6	R2	65	0.0	68	0.0	0.213	6.9	LOS A	0.6	4.3	0.20	0.12	0.20	56.1
Approach		360	0.0	379	0.0	0.213	1.6	NA	0.6	4.3	0.20	0.12	0.20	57.8
North: Cremorne Drive (N)														
7	L2	69	0.0	73	0.0	0.304	6.4	LOS A	1.3	8.9	0.43	0.73	0.47	51.3
9	R2	165	0.0	174	0.0	0.304	9.4	LOS A	1.3	8.9	0.43	0.73	0.47	50.9
Approach		234	0.0	246	0.0	0.304	8.5	LOS A	1.3	8.9	0.43	0.73	0.47	51.0
West: Coronation Drive (W)														
10	L2	163	0.0	172	0.0	0.181	5.6	LOS A	0.0	0.0	0.00	0.29	0.00	55.8
11	T1	165	0.0	174	0.0	0.181	0.0	LOS A	0.0	0.0	0.00	0.29	0.00	57.3
Approach		328	0.0	345	0.0	0.181	2.8	NA	0.0	0.0	0.00	0.29	0.00	56.6
All Vehicles		922	0.0	971	0.0	0.304	3.8	NA	1.3	8.9	0.19	0.34	0.20	55.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix H

Base Case (2022) and Future Case (2032) With Development PM Peak SIDRA Results

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2022 PM Peak (Site Folder: 2022 - Dev Case)]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	52	0.0	55	0.0	0.028	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	51	0.0	54	0.0	0.033	5.7	LOS A	0.1	1.0	0.20	0.56	0.20	52.6
Approach		103	0.0	108	0.0	0.033	2.8	NA	0.1	1.0	0.10	0.28	0.10	56.1
NorthWest: Coronation Drive (W)														
10	L2	149	0.0	157	0.0	0.233	5.9	LOS A	1.1	7.5	0.27	0.58	0.27	52.8
12	R2	112	0.0	118	0.0	0.233	7.1	LOS A	1.1	7.5	0.27	0.58	0.27	52.6
Approach		261	0.0	275	0.0	0.233	6.4	LOS A	1.1	7.5	0.27	0.58	0.27	52.7
SouthWest: Tannum Sands Road (S)														
1	L2	51	0.0	54	0.0	0.034	5.8	LOS A	0.1	1.0	0.13	0.52	0.13	53.8
2	T1	98	0.0	103	0.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		149	0.0	157	0.0	0.053	2.0	LOS A	0.1	1.0	0.04	0.18	0.04	57.7
All Vehicles		513	0.0	540	0.0	0.233	4.4	NA	1.1	7.5	0.17	0.40	0.17	54.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2022 PM Peak (Site Folder: 2022 - Dev Case)]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	150	0.0	158	0.0	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	38	0.0	40	0.0	0.027	6.1	LOS A	0.1	0.8	0.30	0.56	0.30	52.5
Approach		188	0.0	198	0.0	0.081	1.3	NA	0.1	0.8	0.06	0.11	0.06	58.3
North: Proposed Site Access														
7	L2	75	0.0	79	0.0	0.057	6.1	LOS A	0.2	1.6	0.28	0.56	0.28	52.7
9	R2	19	0.0	20	0.0	0.026	7.8	LOS A	0.1	0.7	0.46	0.65	0.46	51.4
Approach		94	0.0	99	0.0	0.057	6.5	LOS A	0.2	1.6	0.32	0.58	0.32	52.5
West: Coronation Drive (W)														
10	L2	9	0.0	9	0.0	0.106	5.6	LOS A	0.0	0.0	0.00	0.03	0.00	58.1
11	T1	186	0.0	196	0.0	0.106	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.7
Approach		195	0.0	205	0.0	0.106	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.6
All Vehicles		477	0.0	502	0.0	0.106	1.9	NA	0.2	1.6	0.09	0.17	0.09	57.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2022 PM Peak (Site Folder: 2022 - Dev Case)]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	101	0.0	106	0.0	0.106	0.6	LOS A	0.5	3.2	0.29	0.25	0.29	56.8
6	R2	67	0.0	71	0.0	0.106	6.4	LOS A	0.5	3.2	0.29	0.25	0.29	54.8
Approach		168	0.0	177	0.0	0.106	2.9	NA	0.5	3.2	0.29	0.25	0.29	56.0
North: Cremorne Drive (N)														
7	L2	67	0.0	71	0.0	0.106	6.0	LOS A	0.4	2.8	0.26	0.59	0.26	52.9
9	R2	50	0.0	53	0.0	0.106	7.0	LOS A	0.4	2.8	0.26	0.59	0.26	52.4
Approach		117	0.0	123	0.0	0.106	6.4	LOS A	0.4	2.8	0.26	0.59	0.26	52.6
West: Coronation Drive (W)														
10	L2	128	0.0	135	0.0	0.142	5.6	LOS A	0.0	0.0	0.00	0.30	0.00	55.8
11	T1	128	0.0	135	0.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.30	0.00	57.3
Approach		256	0.0	269	0.0	0.142	2.8	NA	0.0	0.0	0.00	0.30	0.00	56.6
All Vehicles		541	0.0	569	0.0	0.142	3.6	NA	0.5	3.2	0.15	0.34	0.15	55.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 1 [IS 1 - 2032 PM Peak (Site Folder: 2032 - Dev Case)]**

Tannum Sands Road and Coronation Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
NorthEast: Tannum Sands Road (N)														
8	T1	70	0.0	74	0.0	0.038	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	58	0.0	61	0.0	0.038	5.8	LOS A	0.2	1.2	0.24	0.56	0.24	52.5
Approach		128	0.0	135	0.0	0.038	2.7	NA	0.2	1.2	0.11	0.25	0.11	56.3
NorthWest: Coronation Drive (W)														
10	L2	181	0.0	191	0.0	0.310	6.1	LOS A	1.5	10.4	0.35	0.61	0.35	52.6
12	R2	144	0.0	152	0.0	0.310	7.9	LOS A	1.5	10.4	0.35	0.61	0.35	52.3
Approach		325	0.0	342	0.0	0.310	6.9	LOS A	1.5	10.4	0.35	0.61	0.35	52.5
SouthWest: Tannum Sands Road (S)														
1	L2	66	0.0	69	0.0	0.045	5.8	LOS A	0.2	1.3	0.14	0.52	0.14	53.8
2	T1	132	0.0	139	0.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		198	0.0	208	0.0	0.071	1.9	LOS A	0.2	1.3	0.05	0.17	0.05	57.7
All Vehicles		651	0.0	685	0.0	0.310	4.6	NA	1.5	10.4	0.21	0.41	0.21	54.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 2 [IS 2 - 2032 PM Peak (Site Folder: 2032 - Dev Case)]**

Coronation Drive and Proposed Site Access
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	201	0.0	212	0.0	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	38	0.0	40	0.0	0.029	6.4	LOS A	0.1	0.9	0.36	0.57	0.36	52.3
Approach		239	0.0	252	0.0	0.109	1.0	NA	0.1	0.9	0.06	0.09	0.06	58.6
North: Proposed Site Access														
7	L2	75	0.0	79	0.0	0.061	6.4	LOS A	0.2	1.7	0.34	0.59	0.34	52.6
9	R2	19	0.0	20	0.0	0.031	8.9	LOS A	0.1	0.8	0.52	0.70	0.52	50.6
Approach		94	0.0	99	0.0	0.061	6.9	LOS A	0.2	1.7	0.37	0.61	0.37	52.2
West: Coronation Drive (W)														
10	L2	9	0.0	9	0.0	0.140	5.6	LOS A	0.0	0.0	0.00	0.02	0.00	58.1
11	T1	250	0.0	263	0.0	0.140	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.7
Approach		259	0.0	273	0.0	0.140	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.7
All Vehicles		592	0.0	623	0.0	0.140	1.6	NA	0.2	1.7	0.08	0.14	0.08	57.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ **Site: 3 [IS 3 - 2032 PM Peak (Site Folder: 2032 - Dev Case)]**

Coronation Drive and Cremorne Drive
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Coronation Drive (E)														
5	T1	136	0.0	143	0.0	0.144	0.9	LOS A	0.6	4.5	0.35	0.25	0.35	56.7
6	R2	84	0.0	88	0.0	0.144	6.9	LOS A	0.6	4.5	0.35	0.25	0.35	54.7
Approach		220	0.0	232	0.0	0.144	3.2	NA	0.6	4.5	0.35	0.25	0.35	55.9
North: Cremorne Drive (N)														
7	L2	87	0.0	92	0.0	0.153	6.2	LOS A	0.6	4.1	0.32	0.63	0.32	52.6
9	R2	67	0.0	71	0.0	0.153	7.9	LOS A	0.6	4.1	0.32	0.63	0.32	52.1
Approach		154	0.0	162	0.0	0.153	6.9	LOS A	0.6	4.1	0.32	0.63	0.32	52.3
West: Coronation Drive (W)														
10	L2	172	0.0	181	0.0	0.190	5.6	LOS A	0.0	0.0	0.00	0.30	0.00	55.8
11	T1	172	0.0	181	0.0	0.190	0.0	LOS A	0.0	0.0	0.00	0.30	0.00	57.3
Approach		344	0.0	362	0.0	0.190	2.8	NA	0.0	0.0	0.00	0.30	0.00	56.5
All Vehicles		718	0.0	756	0.0	0.190	3.8	NA	0.6	4.5	0.18	0.35	0.18	55.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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The Power of Commitment

APPENDIX 4: STORMWATER MANAGEMENT PLAN

AP04

Boyne Tannum Aquatic Recreation Centre

Stormwater Management Plan

Gladstone Regional Council

19 August 2022

→ The Power of Commitment

Project name		Boyne Tannum Aquatic Recreation Centre (BTARC) Facility Concept Design					
Document title		Boyne Tannum Aquatic Recreation Centre | Stormwater Management Plan					
Project number		12537620					
File name		12537620-REP_Stormwater Management Plan.docx					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
			Name	**Signature**	**Name**	**Signature**	**Date**
S3	A	N. Rajbhandari	R. Gray				28/06/22
S3	B	N. Rajbhandari					19/08/22

GHD Pty Ltd | ABN 39 008 488 373

8th Floor, Cairns Corporate Tower, 15 Lake Street

Cairns, Queensland 4870, Australia

T +61 7 4044 2222 | **F** +61 7 4044 2288 | **E** cnsmail@ghd.com | **ghd.com**

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1. Introduction

GHD Pty Ltd (GHD) has been engaged by Gladstone Regional Council (GRC, Council) to undertake the Concept Design for the Boyne Tannum Aquatic Recreation Centre (BTARC) Facility. The BTARC facility is to be a contemporary community aquatic centre facility with the recreational functions and the capability to host Swimming Australia local and regional events. As part of the Stage 2 (final concept design) phase, a Site Based Stormwater Management Plan of the selected design option is required, which will be submitted as part of the Development Application.

The report aims to summarize the proposed drainage design strategy for the site and document measures to minimise contaminated water discharge to nearby waterways.

1.1 Purpose of this report

This report includes the stormwater management plan, which covers the stormwater quantity and quality aspects, for the proposed design (Option 4) to inform the Development Application.

1.2 Site description

The site is located on Lot 900, SP152499 Coronation Drive, Tannum Sands, Queensland. The selected site is centrally located in the Tannum Sands residential area with major facilities in proximity. Currently, the site is well vegetated (mainly trees and bushes). The site location and an overview of the proposed development are depicted in Figure 1.1 and Figure 1.2, respectively.

Figure 1.1 General location of the site

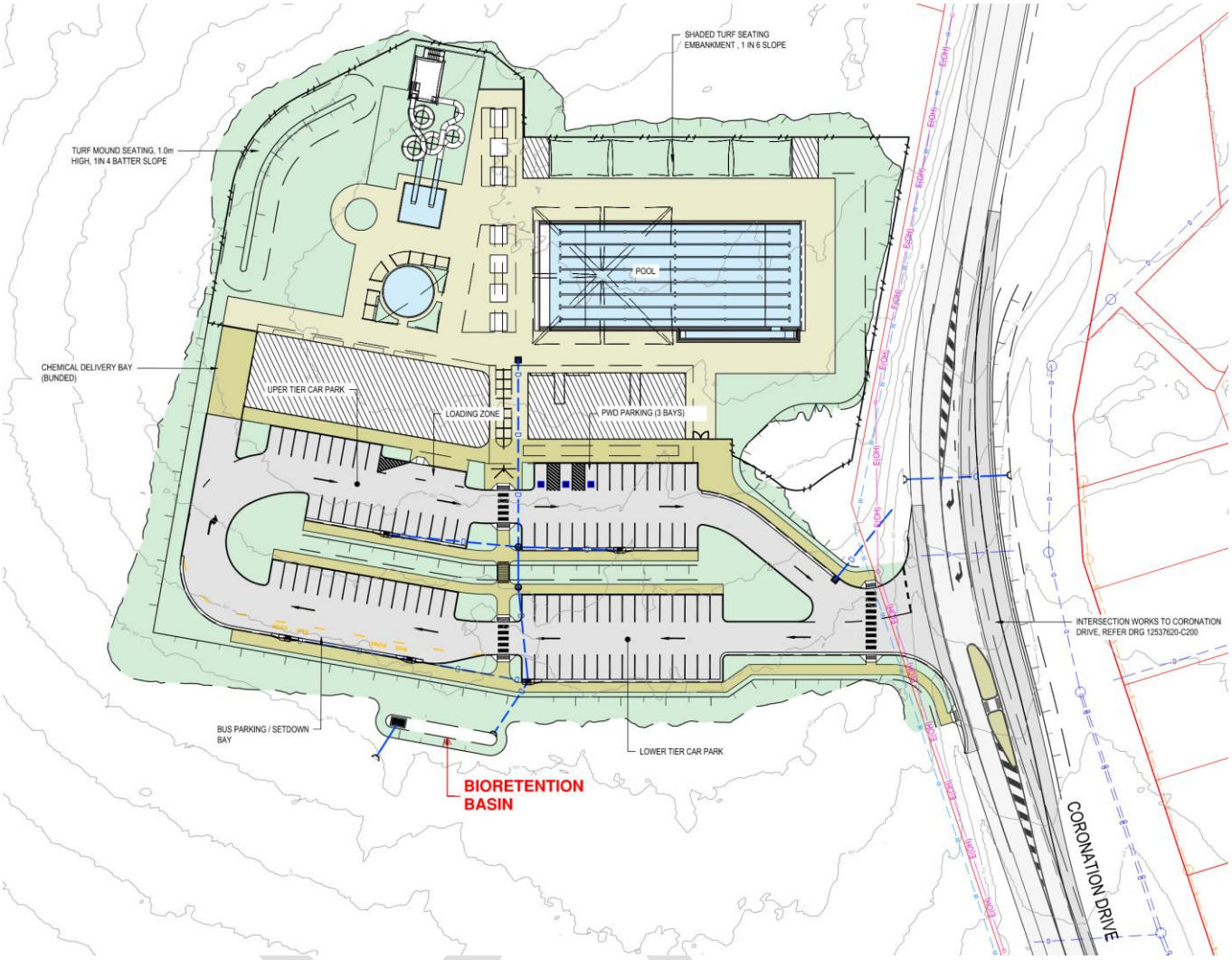

Figure 1.2 Layout view of the proposed infrastructure

1.3 Scope and limitations

This report: has been prepared by GHD for Gladstone Regional Council and may only be used and relied on by Gladstone Regional Council for the purpose agreed between GHD and Gladstone Regional Council as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Gladstone Regional Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by third party source such as ELVIS who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD (see section 2.4.1) described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Except as may otherwise be indicated, this report has been prepared in accordance with the procedures described in Australian Rainfall and Runoff (ARR)

2. Stormwater quantity assessment

2.1 Overview

The objective of the local stormwater quantity assessment was to propose an overall drainage strategy for the proposed infrastructure and assess the impact of the stormwater infrastructure on the system as well as the surrounding area. A key thing to note is that the on-site stormwater management study and pipe sizing has been done considering the developed site catchment, whereas the pre- vs post-development comparative study (to confirm no increase in peak discharge due to the development) was done considering the catchment outlet of the property lot (Lot 900, SP152499).

2.2 Catchments

2.2.1 Site catchments

The site catchment was sub-divided based on the proposed pit and pipe network system. Time of concentration (ToC) was considered to have a minimum of five (5) minutes based on the Queensland Urban Drainage Manual (QUDM) (IPWEAQ, 2016). Impervious fractions were assigned based on the design solution layout of the proposed infrastructure. The sub-catchment properties are presented in Table 2.1 and visually represented in Figure 2.1.

Table 2.1 Post-development site catchment parameters

Sub-catchment	Area (ha)	Impervious fraction (%)
A	0.08	95
B	0.09	95
C	0.08	95
D	0.72	90
E	0.19	95

2.2.2 External downstream catchment

The downstream catchments were also studied in order to quantify and assess the pre-development and post-development peak discharge of the whole property (Lot 900, SP152499). The outlet of this property included an earthen detention basin with a 750 mm diameter pipe outlet connecting to the downstream pit and pipe network along Pryde Street (see Figure 2.2). The catchment area for this outlet was 22.1 ha with an equal area slope 2.13% and a pervious Manning's n of 0.07 given that the catchment is mainly covered by trees and heavily overgrown riparian creek.

The northern part of the external catchment consisted of impervious surface (residential houses), which covers approximately 15% of the area. In the post-development scenario, this impervious percentage was increased to 20%, considering the construction of the 1.16 ha site.

2.3 Design rainfall

Design rainfall intensities were estimated applying the procedure described in ARR (2019) and used the 2019 Intensity Frequency Duration (IFD) data from the Bureau of Meteorology (BoM). The IFDs and temporal patterns were sourced from ARR (2019) data hub from the same grid cell location (23.95575 (S), 151.36841 (E)). As the size of the whole catchment was relatively small, a single grid was sufficient to represent the design rainfall characteristics of the study area.

This catchment has been categorized as 'Commercial' and, as such, the design storm for this sizing of the minor system was adopted as the 10% AEP and for overland flow paths for major storms as the 1% AEP as per the

Capricorn Municipality Design Guideline – Stormwater Design (D5) document *Table D05.04.01* and *Table D05.04.02*, respectively (CMDG, 2022).

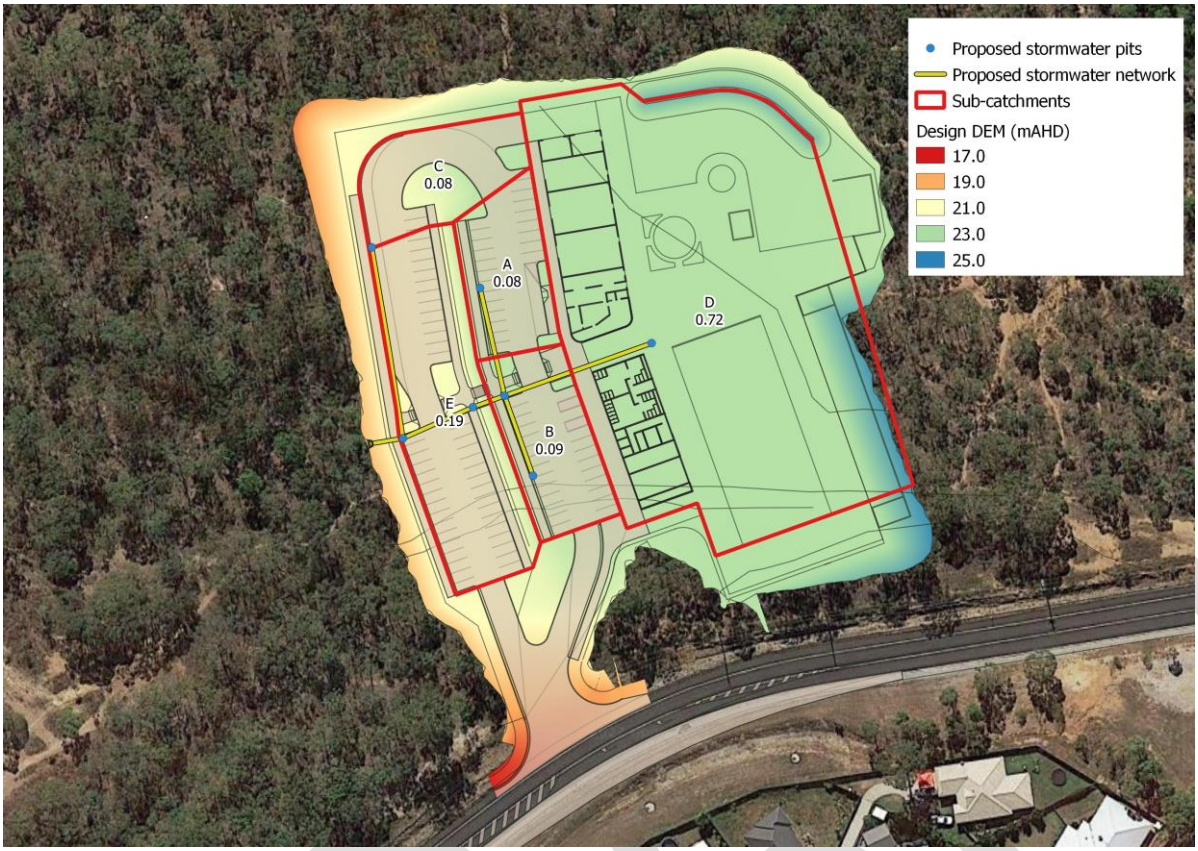

Figure 2.1 Proposed stormwater network and corresponding sub-catchments with their area in hectares

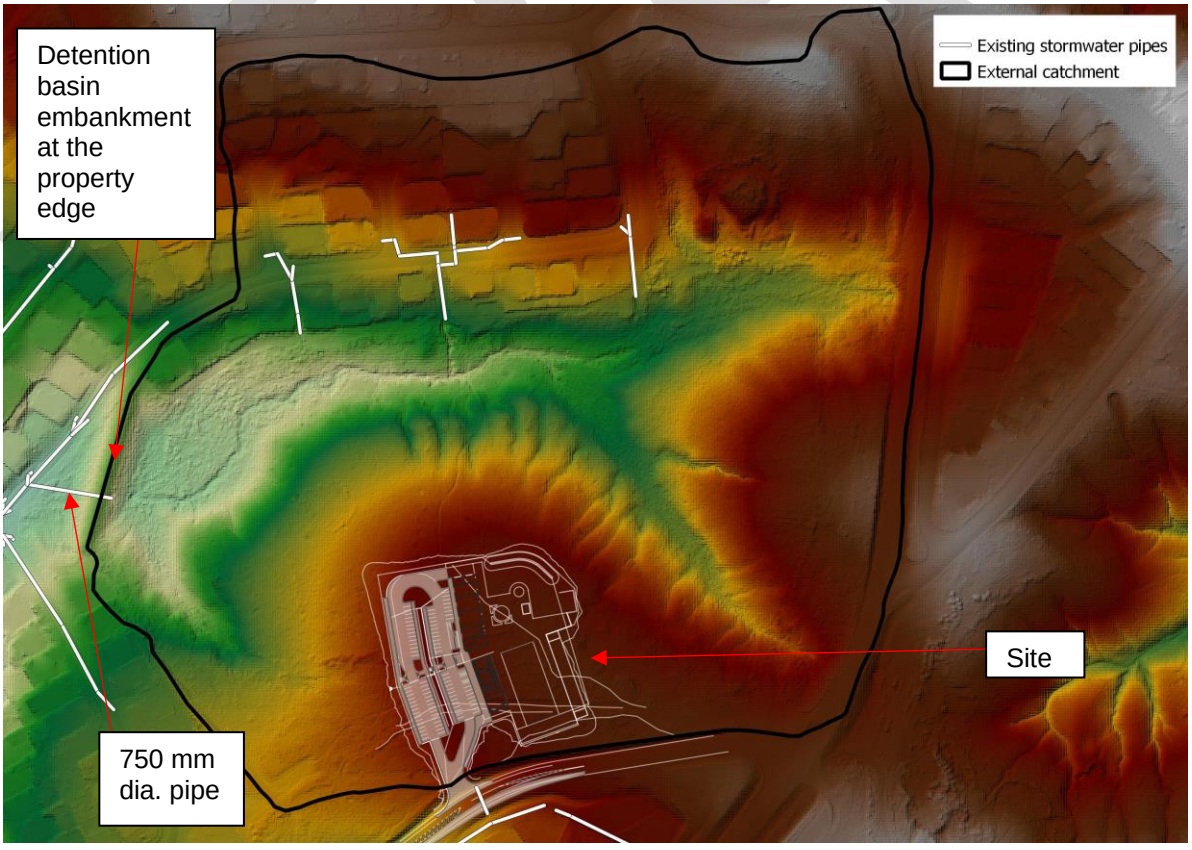

Figure 2.2 External catchment

2.4 Stormwater modelling

2.4.1 Assumptions and limitations

The following assumptions and limitations apply to the pre- and post-development aspect of this study (see section 2.4.4.2):

- All existing and proposed pit and pipe network elements are assumed to be overwhelmed for storms equal to and rarer than 2% AEP and, as such, have not been included in the 1% AEP pre- and post-development peak discharge assessment.
- The downstream boundary of the model is set at the pipe outlet from the natural detention basin.
- The detention basin was assumed to be empty at the start of the storm event.
- The detention basin is functional and the outlet pipes are free from significant blockage. Maintenance of the system should be scheduled to keep the system unblocked and free flowing.

2.4.2 Model approach

The DRAINS software model (version 2021.02) was used for the hydrologic modelling in this study. DRAINS is an industry-standard software that is widely used to undertake modelling of stormwater collection systems consisting of pit and pipe networks, channels, detention basins and overland flow paths. The ILSAX model was selected as the drainage analysis model engine as per the Capricorn Municipality Design Guideline – Stormwater Design (D5), *Table D05.06.02* (CMDG, 2022). For overland flow calculations, the Kinematic equation was adopted.

ARR (2019) guidelines were used to inform the hydrologic modelling, specifically using the Ensemble Method to simulate 10 temporal patterns for each design storm duration for each AEP event. This allowed for the selection of the critical duration (i.e. the highest peak discharge from the simulated storm durations for a given AEP event) for each catchment by analysing the median peak runoff result from the ensemble of temporal patterns. This was undertaken for each AEP, across all modelled durations.

2.4.3 Model layout

The DRAINS model layout of the post-development scenario is presented in Figure 2.3.

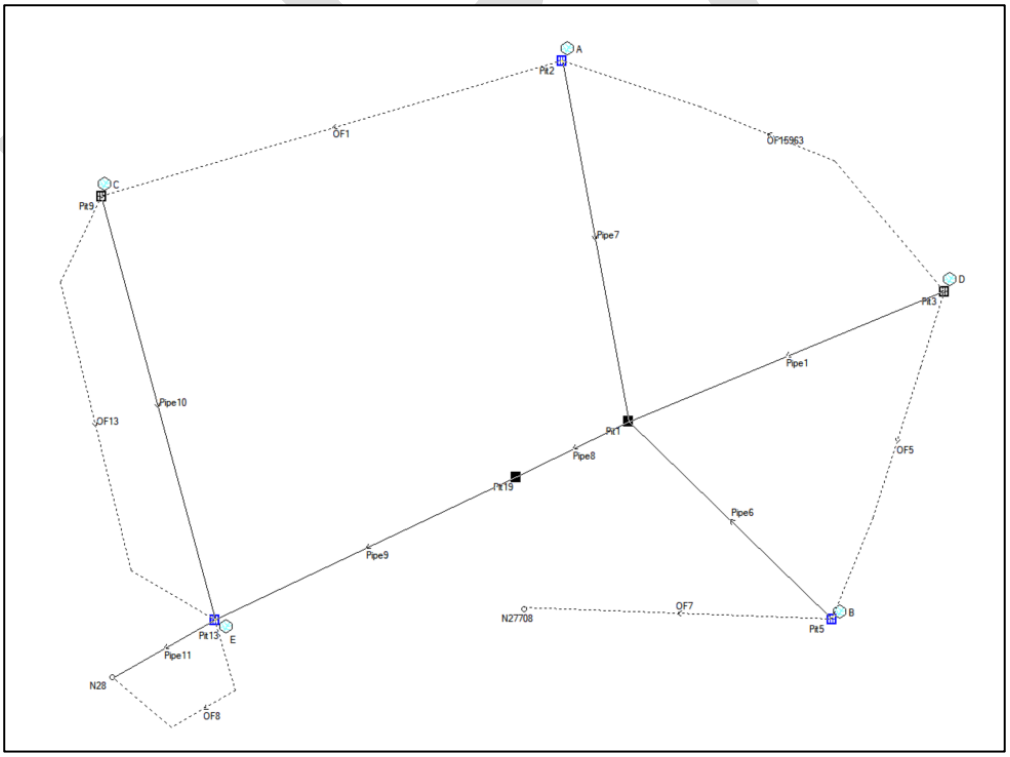

Figure 2.3 Post-development DRAINS layout

2.4.4 Results

2.4.4.1 Infrastructure sizing

The proposed infrastructure for the post-development scenario is presented in Table 2.2. A minimum pipe size of 375 mm diameter with a pipe cover of 600 mm has been proposed, in line with clause *D05.08.01* (CMDG, 2022). The water elevation long sections for these pipe networks are provided in Appendix A and the model results in a plan view is provided in Appendix B.

It should be noted that Pipe 8 was simulated to have high velocity (nearly 5 m/s) mainly because there is a drop of about 1 m between Pit 1 and Pit 19 and the slope of that pipe is approximately 10%. However, there is potential to reduce the slope by regarding the whole pipe network in the detail design phase and reduce peak velocities.

Table 2.2 Proposed pipe infrastructure sizes and their flow properties results

Pipe components	Pipe diameter (mm)	10% AEP flowrate (m^3/s)	10% AEP max velocity (m/s)
Pipe 1	450	0.21	2.0
Pipe 6	375	0.11	1.1
Pipe 7	375	0.10	1.3
Pipe 8	450	0.43	4.8
Pipe 9	525	0.41	3.3
Pipe 10	375	0.04	0.4
Pipe 11 (Outlet)	600	0.53	2.7

All overland kerb and channel flows satisfied the following depth and velocity criteria for the major storm (1% AEP) as set by QUDM:

– D.V <= 0.6 m^2/s
– Maximum flow depth < 300 mm

2.4.4.2 Pre- and post-development flow assessment

The simulated pre-development design flood peak and post-development design flood peak at the 750 mm diameter piped outlet of Lot 900 is presented in Table 2.3. This study was assessed using the 1% AEP storm event. The results show the existing detention basin has attenuated the peak flows back to near pre-development values. It should be noted that the in the post-development scenario, an additional 10 mm of water is simulated in the basin, which has contributed to an additional 0.009 m^3/s flowrate, which is within the modelling tolerance limit. As such, the results show that there is no impact as a result of the infrastructure.

Table 2.3 Pre- and post-development simulated flow rates (1% AEP) at the outlet of the detention basin

Flowrate (m^3/s)	Pre-development	Post-development	Increment (%)
Detention basin inflow	5.35	5.92	10
Detention basin outflow	0.631	0.640	1.42 (within modelling tolerance)

2.4.4.3 Lawful point of discharge

According to the QUDM (IPWEAQ, 2016), if there is a reasonable risk that the proposed development may alter the site's stormwater discharge characteristics that can cause third part damage, the lawful point of discharge must be:

– Under the lawful control of the local government from whom permission to discharge has been received.
– If not, an authority to discharge over affected properties is required.

It is noted that, as a result of the proposed upgrade (notably, the land use will change from pervious to near impervious), an increase in peak flowrate was simulated (see section 1.1.1.1). However, the location of discharge from the site is unchanged and is seen to flow through a natural watercourse and an existing detention basin (see Figure 2.4). Ultimately, it is conveyed along the road reserve of Pryde Street into the Boyne River. As such, the site has been considered to pass the lawful point of discharge test.

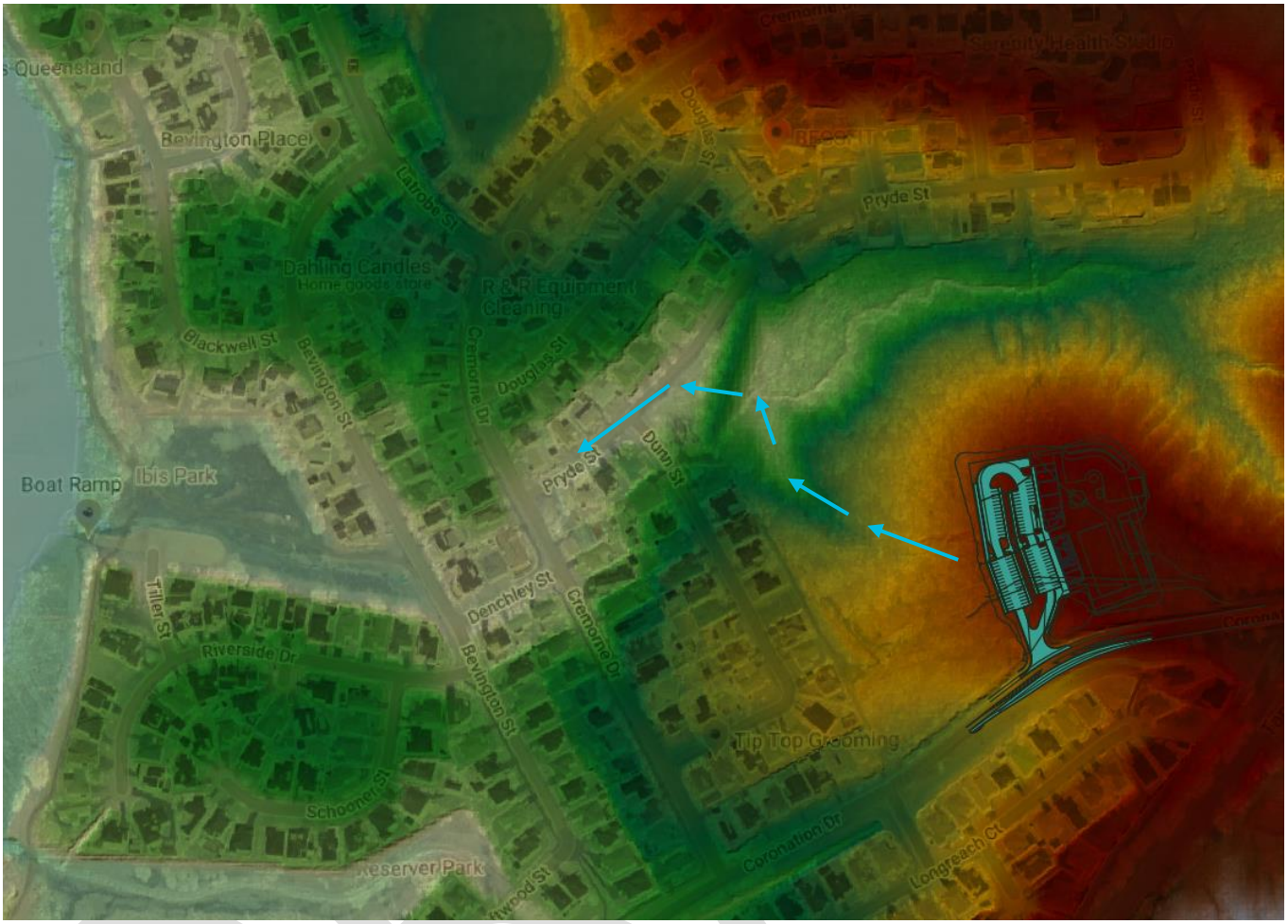

Figure 2.4 Flow path from the site

2.4.5 Sensitivity tests and validation

Sensitivity tests were undertaken for the following parameters:

– ILSAX paved and supplementary area depression storage (DRAINS recommended range 0 – 5 mm)
– ILSAX grassed area depression storage (DRAINS recommended range 2 – 10 mm)
– ILSAX soil type (1 – 4)

It was found that all tested parameters had negligible impact on the peak flow rates.

Furthermore, the model was also simulated using an IL-CL (Initial Loss – Continuing Loss) approach, where the loss values and pre-burst depths were extracted from the ARR 2019 data hub for the specified co-ordinate. The resulting peak flow rates were found to be similar to the ILSAX model, and as such, a reasonable validation has been thought to be achieved.

3. Stormwater quality assessment

3.1 Overview

In most cases, industrial development has the potential to increase stormwater pollutant and hydraulic loads, primarily due to the increase in impervious area. These surfaces accumulate a range of pollutants during dry periods and transport them rapidly to receiving waters during rainfall events. As a result, there is potential for significant stormwater pollutant loads if appropriate mitigation measures are not implemented. These increases in pollutant loads can cause adverse impacts on downstream water bodies and ecosystems.

The key pollutants generated from typical industrial development for evaluation include:

– Sediments (Suspended Solids)
– Nutrients (Total Nitrogen and Total Phosphorous)
– Gross Pollutants

3.2 Design standards

A stormwater quality investigation in MUSIC is required as per the Capricorn Municipality Design Guideline – Stormwater Design (D5) document (CMDG, 2022). The reduction targets for the key pollutants have been adopted as per State Planning Policy (SPP) 2017 (Department of Infrastructure, Local Government and Planning, 2017) for the relevant region, and presented in Table 3.1.

Table 3.1 Target reduction percentage (SPP 2017)

Region	Total suspended solids (TSS)	Total phosphorus (TP)	Total nitrogen (TN)	Gross pollutants > 5 mm
Central Queensland (south)	85	60	45	90

3.3 Water quality modelling

3.3.1 Model selection

The industry standard water quality Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was used to determine stormwater quality for the catchment.

MUSIC uses historical climate data to estimate the effectiveness of a stormwater quality treatment network. A number of in-built modules simulate the generation of pollution for different land uses, its treatment and the removal of pollution through a number of treatment devices.

3.3.2 Model layout

A representative MUSIC model was setup as shown in Figure 3.1.

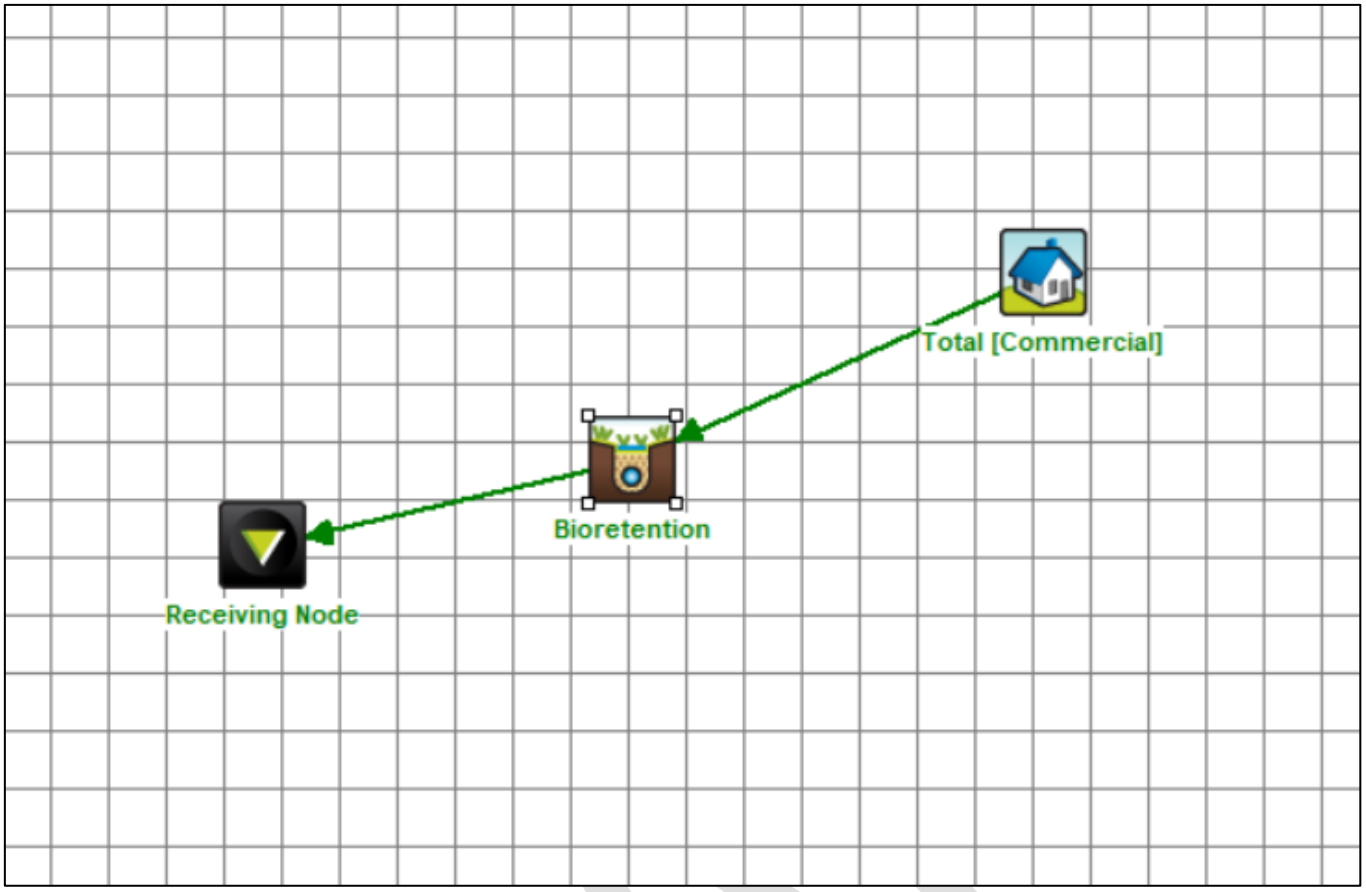

Figure 3.1 Site MUSIC model setup

3.3.3 Treatment structure

A bio-retention basin with 40 m^2 filter area and 300 mm extended detention depth was modelled with a sandy loam filter media of 500 mm depth (Hydraulic conductivity at least 150 mm/hour). Other parameters such as TN and orthophosphate content of the filter media has been taken from the 2018 MUSIC guidelines (Healthy Land and Water Limited, 2018) in lieu of site-specific data. Recommended plant species for the bioretention basin shall be selected in accordance with *Annexure D05A* (CMDG, 2022).

3.3.4 Results

The residual loads of the surface water pollutants and their reduction rate after being treated through the bio-retention basin are shown in Table 3.2. The proposed bio-retention basin has been shown to meet, and exceed, the required pollutant reduction targets per the SPP 2017 for water quality objectives for the Gladstone region post construction.

Table 3.2 MUSIC model results

Parameters	Total suspended solids (TSS)	Total phosphorus (TP)	Total nitrogen (TN)	Gross pollutants > 5 mm
Source (kg/year)	1870	5.27	26.4	203
Residual load (kg/year)	228	1.05	12.5	0
Residual load (%)	87.8	80.1	52.8	100
Percentage Reduction target (%)	85	60	45	90

4. Conclusion

GHD has developed this SMP for Gladstone Regional Council for proposed aquatic recreation centre facility. This SMP includes key aspects such as assessment of the lawful point of discharge, provision of an overall drainage strategy, and design of a bio-retention basin to minimise contaminated stormwater runoff to nearby waterways.

For the stormwater drainage strategy, pipes of diameter 375 mm to 600 mm size are proposed with minimum clear cover and slope requirements. It was seen that there is sufficient freeboard and no upwelling of the pits considering the minor storm of 10% AEP event.

Based on the stormwater modelling, the existing detention basin was simulated to attenuate the 1% AEP flows back to near pre-development flow rate of 0.64 m^3/s (1.5% incremental increase, which was considered to be within modelling tolerance). As the flows being released from the lot has not increased significantly, no mitigation has been provided, provided that the detention basin is functional and doesn't experience significant blockage (maintenance should be scheduled to maintain a free flowing system without blockage).

The outlet point remains unchanged i.e. flows are conveyed along the road reserve of Pryde Street into the Boyne River. As such, the site has been thought to pass the lawful point of discharge test.

A bio-basin of 40 m^2, 300 mm detention depth and 500 mm filter media depth was simulated as sufficient to meet the SPP 2017 quality requirements. Selection of plants should be based on the CMDG guidelines for the Gladstone regional area.

5. References

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia.

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Department of Infrastructure, Local Government and Planning. (2017). *State Planning Policy.*

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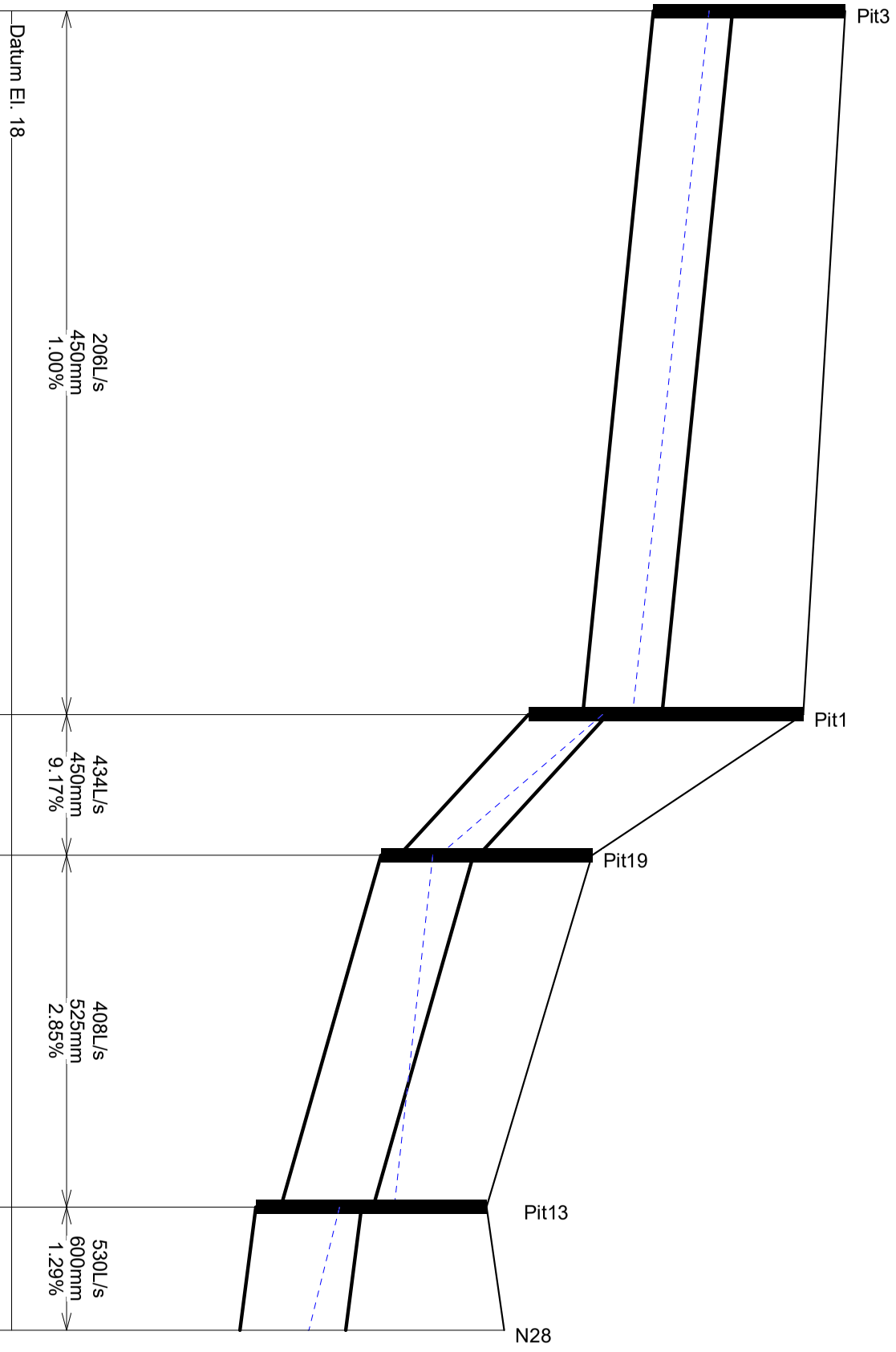
IPWEAQ. (2016). *Queensland Urban Drainage Manual - Fourth Edition.* Institute of Public Works Engineering Australasia, Queensland Division (IPWEAQ).

Appendices

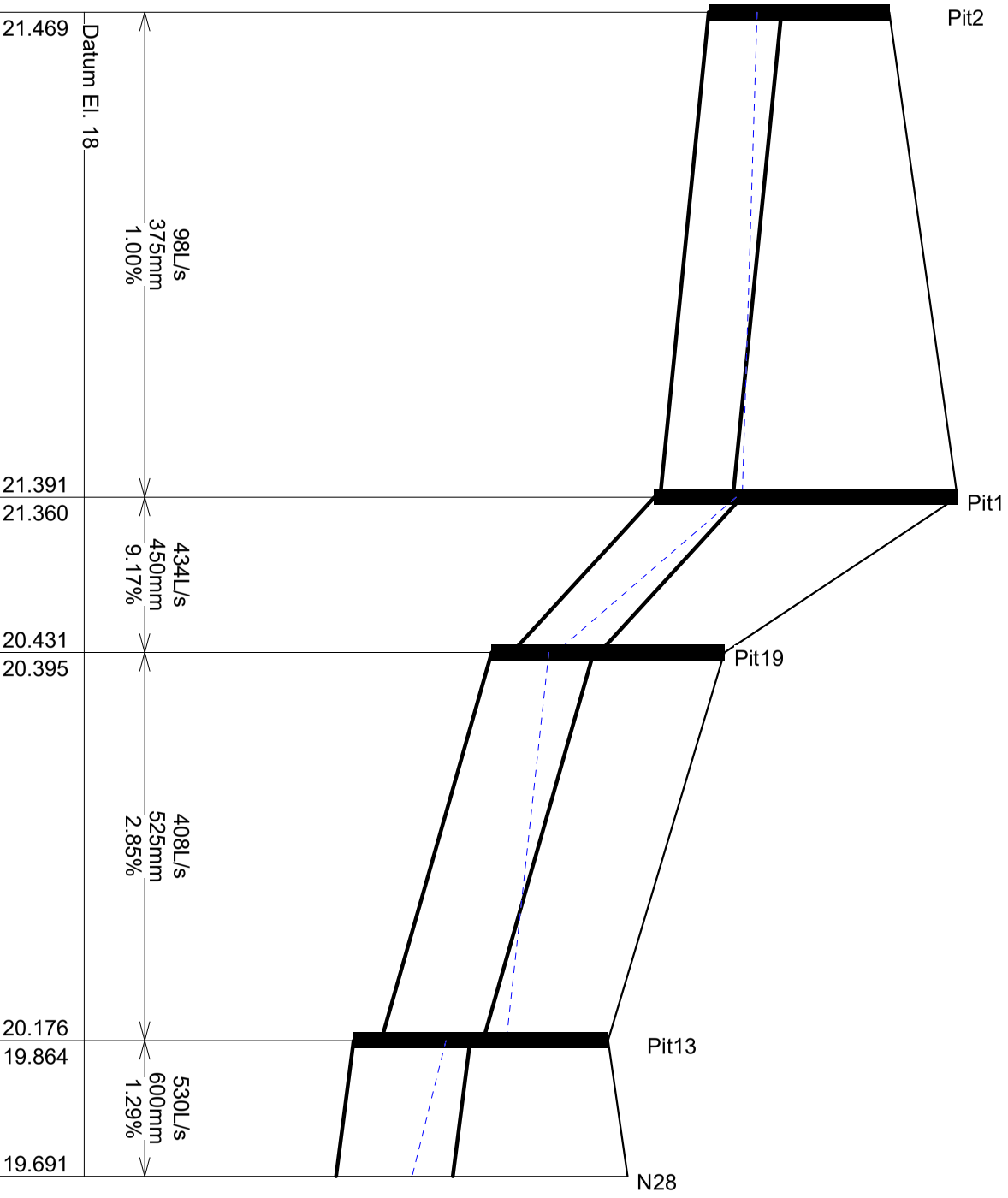
Appendix A

Post-development pipe network water surface long section

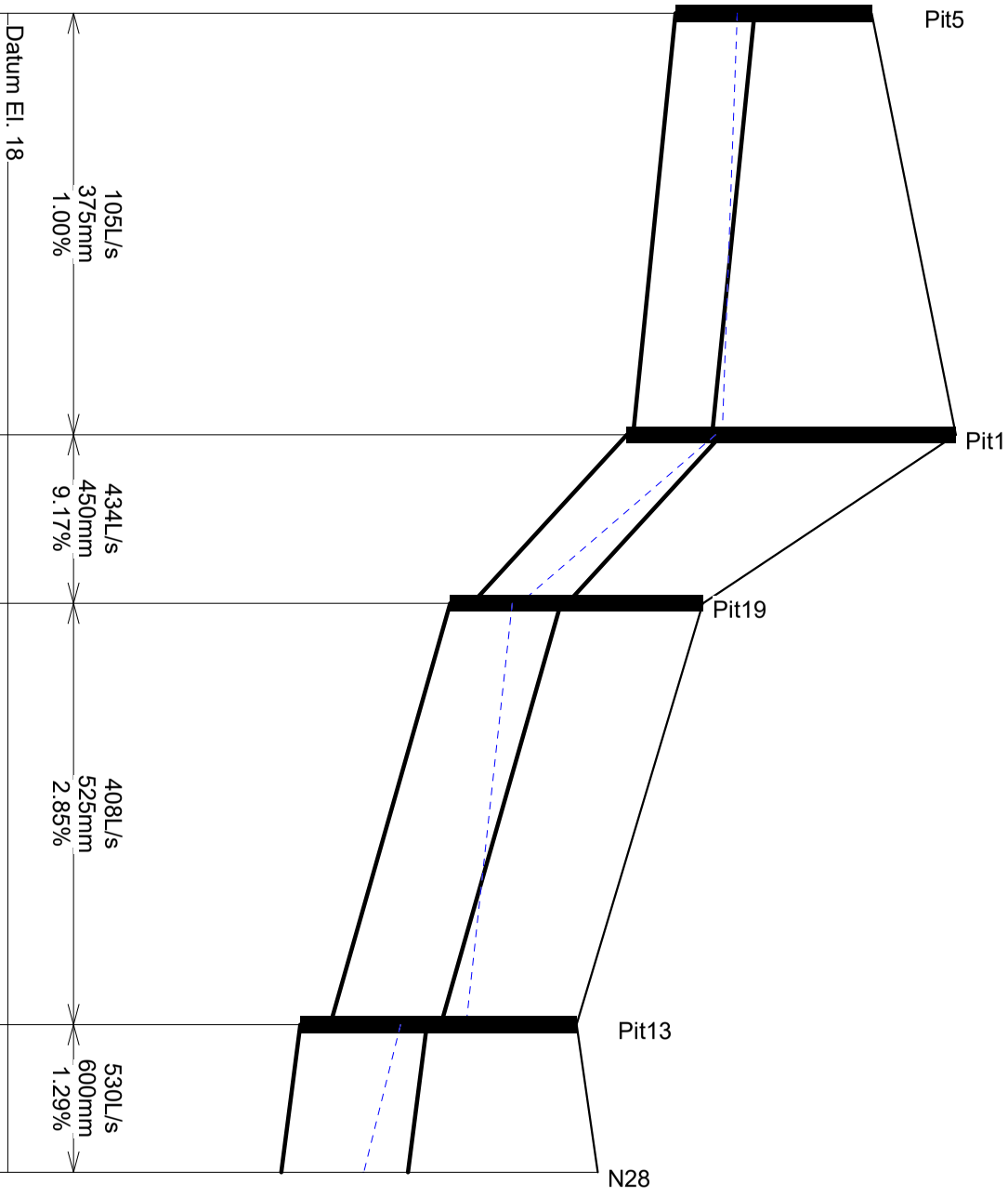
Chainage	Invert Level	Surface Level	HGL
0	21.648	22.74	21.966
	21.248		21.530
40.00	20.939	22.5	21.360
	20.205		20.431
48.00	20.100	21.3	20.395
	19.530		20.176
68.00	19.389	20.7	19.864
	19.299		19.691
75.00		20.8	



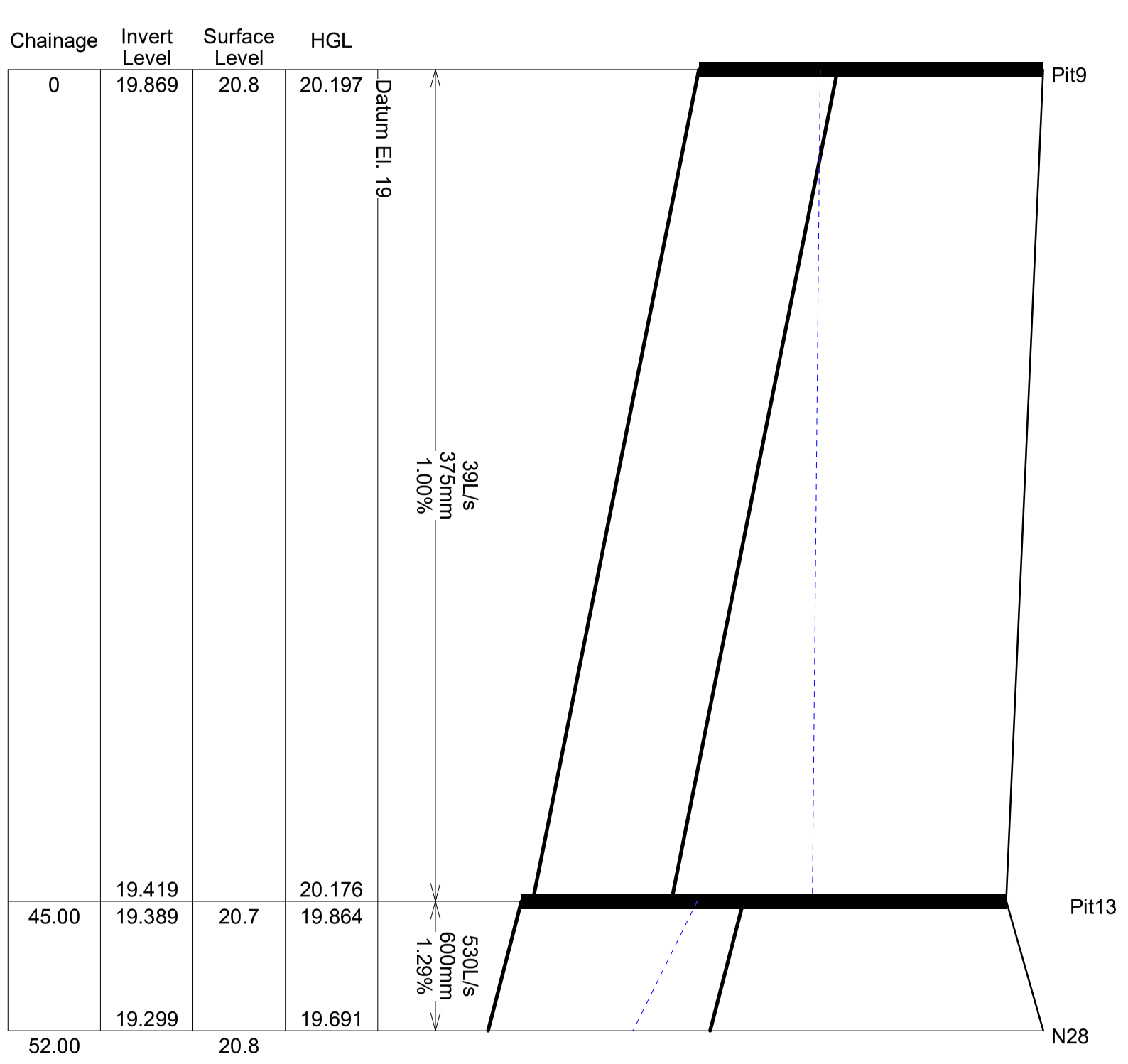
Chainage	Invert Level	Surface Level	HGL
0	21.219	22.15	21.469
	20.969		21.391
25.00	20.939	22.5	21.360
	20.205		20.431
33.00	20.100	21.3	20.395
	19.530		20.176
53.00	19.389	20.7	19.864
	19.299		19.691
60.00		20.8	



Chainage	Invert Level	Surface Level	HGL
0	21.169	22.1	21.463
	20.969		21.391
20.00	20.939	22.5	21.360
	20.205		20.431
28.00	20.100	21.3	20.395
	19.530		20.176
48.00	19.389	20.7	19.864
	19.299		19.691
55.00		20.8	



Chainage	Invert Level	Surface Level	HGL
0	19.869	20.8	20.197
	19.419		20.176
45.00	19.389	20.7	19.864
	19.299		19.691
52.00		20.8	



Appendix B

DRAINS Model 10% AEP results

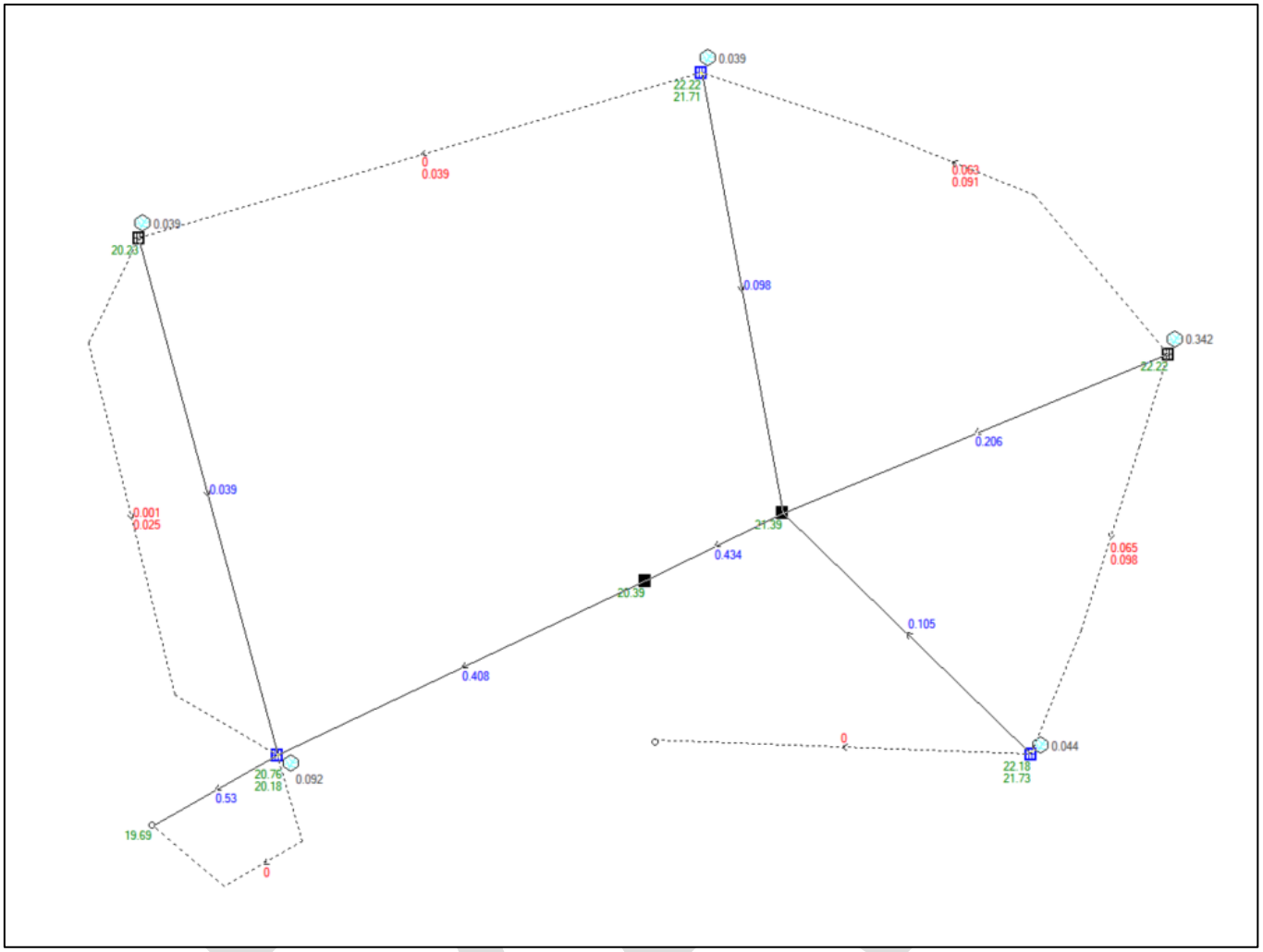


Figure B.1 10% AEP results

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The Power of Commitment

APPENDIX 5: CULTURAL HERITAGE ASSESSMENT

AP05

Excellence in your environment

niche Environment and Heritage

Boyne Tannum Aquatic Recreation Centre
Desktop Cultural Heritage Due Diligence Assessment

Prepared for PSA Consulting (Australia) | 9 November 2022

niche-eh.com

Excellence in your environment

Document control

Project number	Client	Project manager	LGA
7582	PSA Consulting (Australia)	Brodie Hartfiel-Lees	Gladstone Regional Council

Version	Author	Review	Status	Comments	Date
D01	Karene Chambers	Brodie Hartfiel-Lees	Draft	Internal Review	7 November 2022
Rev01	Karene Chambers	PSA Consulting (Australia)	Draft		9 November 2022

Niche Environment and Heritage Pty Ltd (ACN 137 111 721)
Enquiries should be addressed to Niche Environment and Heritage
PO Box 2443, Parramatta NSW 1750, Australia
Email: info@niche-eh.com

Executive summary

Niche was commissioned by PSA Consulting (Australia) (PSA) on behalf of the Gladstone Regional Council to prepare a Cultural Heritage Due Diligence Assessment (DDA) for the proposed construction of a new Aquatic Recreation Centre and associated works (the Project) located at Tannum Sands. The proposed Boyne Tannum Aquatic Recreation Centre is located on Coronation Drive, Tannum Sands, otherwise described as Lot 900 SP152499 (Figure 1).

The assessment concludes that there exists a **high** potential for the Project activities to harm cultural heritage. This was a desktop only assessment and no visual inspection was conducted for the Project.

Aboriginal cultural heritage

No places of Aboriginal heritage have been identified within the Project area. However, it was noted that the Great Barrier Reef Heritage area is located 400 m to the west of the Project area. An inspection of historical aerial imagery shows the Project area has not been subject to Significant Ground Disturbance and Surface Disturbance in the past, except for limited areas on the northernmost boundary and south-west corner. The Project area has been assessed as a mixture of Category 5 and Category 4 - High Risk as the proposed activity is inconsistent with previous levels of ground disturbance.

Where Landscape Features are present within an area, such as the areas of biogeographical significance and particular types of native vegetation, these areas may have tangible or intangible Aboriginal cultural heritage significance associated with them. In this case, it is important to be informed about the significance (if any) that may be attached to those features and it is necessary to undertake consultation with the Aboriginal Party.

Category 4 - Areas previously subject to Significant Ground Disturbance

"Where an activity is proposed in an area, which has previously been subject to Significant Ground Disturbance it is generally unlikely that the activity will harm Aboriginal cultural heritage and the activity will comply with these guidelines.

In some cases, despite an area having been previously subject to Significant Ground Disturbance, certain features of the area may have residual cultural heritage significance. It is important to be informed about any cultural heritage significance that may attach to these features and extra care must be taken prior to proceeding with any activity that may cause additional surface disturbance to the feature, or the area immediately surrounding the feature which is inconsistent with the pre-existing Significant Ground Disturbance".

Category 5 - Activities causing additional surface disturbance

"Where an activity is proposed under category 5 there is generally a high risk that it could harm Aboriginal cultural heritage. In these circumstances, the activity should not proceed without cultural heritage assessment. Cultural heritage assessment should involve consideration of the matters a Court may consider".

Recommendations

Consultation and Cultural Heritage Field Assessment

A Cultural Heritage Field Assessment (CHFA) of the Project area with representatives of the Aboriginal Party is required before commencing any Project works. Conducting the CHFA will assist in identifying any

Aboriginal cultural heritage values within the Project area. This will also provide an opportunity to develop a more detailed understanding of the Project area with input from the relevant Aboriginal Party. Consulting with the Aboriginal Party will also assist in determining management strategies, if any, for the proposed activities to avoid and/or minimise harm to any Aboriginal cultural heritage.

Cultural heritage Induction

All Project staff should be provided with a Cultural Heritage Induction prior to the commencement of Project works. This induction should include a procedure to be followed if unexpected cultural heritage objects are identified during the Project or if human remains are identified (see below). This would ensure PSA/Gladstone Regional Council, or their contractors, can demonstrate that they have met their duty of care requirements under the *Aboriginal Cultural Heritage Act 2003*.

Unexpected finds procedures

Aboriginal Cultural Heritage

- If a find is made, all works at the find location must cease immediately.
- The location, including a 5 m curtilage, must be excluded using barrier fencing to avoid harm.
- The Aboriginal Party (refer to Annex 1 for details), must be contacted to verify whether the object or place is of Aboriginal cultural heritage significance.
- No works are to continue within the excluded area until the Aboriginal Party provide written notification to PSA/Gladstone Regional Council, or their Contractor, that works may proceed.

Historical Cultural Heritage

- If a find is made, all works at the find location should cease immediately.
- The location, including a 5 m curtilage, should be established barrier fencing to avoid harm to the find.
- A suitably qualified person must be contacted to verify whether the object is of State historical cultural heritage significance.
- No works are to continue within the excluded area until the significance of the find is determined.
- If the find is determined to be of State historical cultural heritage significance, the find must be reported to the Department of Environment and Science (DES) under Section 89 of the *Queensland Heritage Act 1992*.
- If the find is determined to be of local heritage significance, Council should be contacted for advice on how to proceed.
- If the find is determined to be of no cultural heritage significance, works may proceed.

Human remains stop work provision

In the highly unlikely event that suspected human remains are encountered during the Project works, all Project works must cease immediately. The Department of Seniors and Disability Services and Aboriginal and Torres Strait Islander Partnerships (DSDSATSIP) guidelines for managing human remains must then be followed. These can be accessed online at: https://www.datsip.qld.gov.au/resources/datsima/people-communities/cultural-heritage/guidelines-human-remains.pdf.

A procedure based on these guidelines should be implemented during all Project works and include:

- Work at the find location must cease immediately.
- The location, including a 20 m curtilage, be excluded using barrier fencing to avoid further harm.
- The Police or Coroner must be advised of the presence of suspected human remains. An appropriate officer will then establish the area as a potential crime scene.

- Police will undertake appropriate scientific or other procedures to assist the Coroner in making an appropriate determination about the suspected human remains.
- If the remains are thought to be neither Aboriginal nor Torres Strait Islander in origin, related to criminal activity or are of doubtful determination, the Police may remove the remains for further analysis.
- If however the remains are determined to be ancestral remains without the need for removal, the relevant Aboriginal Party of the ancestral remains will be responsible for their management.
- In cases where ancestral remains are removed by Police and subsequently determined by the Coroner to be of Aboriginal or Torres Strait Islander origin, the remains will be released to the Minister responsible for administering the Acts (DSDSATSIP).
- DSDSATSIP is then responsible for coordinating the return of the remains to the relevant Aboriginal Party.

No works are to continue in the excluded area until the Coroner/Police provide written notification to PSA/Gladstone Regional Council, or their Contractor.

Glossary and list of abbreviations

The glossary below contains definitions sourced from the DSDSATSIP website, the *Aboriginal Cultural Heritage Act 2003* and the *Duty of Care Guidelines 2004*. Definitions were collated verbatim to avoid presenting any interpretation of the meanings.

Term or abbreviation	Definition
ACHA	Aboriginal Cultural Heritage Act 2003
Aboriginal Cultural Heritage (Section 8 ACHA)	Anything that is: • A significant Aboriginal area in Queensland. • A significant Aboriginal object. • Evidence, of archaeological or historic significance, of Aboriginal occupation of an area of Queensland.
Aboriginal Cultural Heritage Body	An entity registered under part 4 (of the ACHA) as an Aboriginal cultural heritage body for the area. The sole function of a cultural heritage body is to identify the Aboriginal or Torres Strait Islander parties for an area and serves as the first point of contact for cultural heritage matters.
Aboriginal Cultural Heritage Database	Also referred to as the DSDSATSIP Aboriginal cultural heritage database. The purpose of the database is to: • Assemble information about Aboriginal and Torres Strait Islander cultural heritage in a central and accessible location. • Provide a research and planning tool to help Aboriginal and Torres Strait Islander Parties, researchers and other persons assess the Aboriginal and Torres Strait Islander cultural heritage values of particular areas. The database is not publicly available.
Aboriginal Cultural Heritage Register	Also referred to as the DSDSATSIP Aboriginal cultural heritage register. The cultural heritage register holds: • Information regarding cultural heritage studies under Part 6 of the ACHA. • Information regarding Designated Landscape Areas. • Information regarding whether a particular area has been the subject of a cultural heritage management plan under Part 7 of the ACHA. • Information regarding cultural heritage bodies. • Details of statutory Aboriginal and Torres Strait Islander Parties. The register is available to the public.
Aboriginal human remains	Aboriginal human remains are highly significant to Aboriginal and Torres Strait Islander people and it is important not to interfere with them. All burials in Queensland are regulated under the *Criminal Code Act* 1899, *Coroners Act* 2003, *Aboriginal Cultural Heritage Act* 2003, *Torres Strait Islander Cultural Heritage Act* 2003, and local government by-laws. DSDSATSIP is responsible for administering the Aboriginal and Torres Strait Islander cultural heritage legislation. See also Burials. For information regarding the Handling and Management of human remains, follow this link: https://www.datsip.qld.gov.au/resources/datsima/people-communities/cultural-heritage/guidelines-human-remains.pdf
Aboriginal Party	In the event that there is no native title party for an area, the ACHA recognises the Aboriginal or Torres Strait Islander party for an area as being:

Term or abbreviation	Definition
	• The person recognised in accordance with tradition/custom as being responsible for the area. • An Aboriginal or Torres Strait Islander person/family/clan group with particular knowledge about traditions, observances, customs or beliefs associated with the area.
Areas of biogeographical significance, such as natural wetlands	A landscape feature as listed in Section 6.2 of the DoC Guidelines. Meaning is context dependant.
Burial	Pre-contact Aboriginal burials are commonly found in caves and rock shelters, midden deposits and sand dunes. Burial sites are sensitive places of great significance to Indigenous people. Also see Aboriginal Human Remains.
Cave	A landscape feature as listed in Section 6.2 of the DoC Guidelines. May mean any natural underground chamber in a hillside or cliff that is suitable for human habitation.
Ceremonial places	The material remains of past Aboriginal ceremonial activities may come in the form of earthen arrangements or bora grounds and their associated connecting pathways, and stone circles, arrangements and mounds. Indigenous people used these places for ceremonies, including initiation and inter-group gatherings.
Commonwealth Heritage List (CHL)	The CHL is a list of Indigenous, historic, and natural heritage places owned or controlled by the Australian Government.
Contact Site	The material remains of Indigenous participation in the development of Queensland after the arrival of European settlers. These include former or current Aboriginal missions, native mounted police barracks and historical camping sites and artefacts.
Cultural Heritage Duty of Care (Section 23 of the ACHA)	A person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage.
Cultural Heritage Find	A significant Aboriginal object or, evidence of archaeological or historic significance of Aboriginal occupation of an area of Queensland, or Aboriginal human remains, found in the course of undertaking an activity covered by the DoC Guidelines.
CHMP	Cultural Heritage Management Plan A CHMP is an agreement/contract between a land user (sponsor) and Aboriginal Party (endorsed party) developed under Part 7 of the ACHA. The CHMP explains how land use activities can be managed to avoid or minimise harm to Aboriginal or Torres Strait Islander cultural heritage. For information regarding the Cultural Heritage Management Plans, follow this link: https://www.datsip.qld.gov.au/resources/datsima/people-communities/cultural-heritage/chmp-guidelines.pdf
Cultural Heritage Study	A comprehensive study of Aboriginal cultural heritage in an area conducted under part 6 of the ACHA for the purpose of recording the findings of the study on the Aboriginal Cultural Heritage Register. For information regarding the Cultural Heritage Studies, follow this link: https://www.datsip.qld.gov.au/resources/datsima/people-communities/cultural-heritage/cultural-heritage-studies.pdf
Designated Landscape Areas	Under the repealed *Cultural Record (Landscapes Queensland and Queensland Estate) Act* 1987, an area was declared a 'designated landscape area' (DLA) if it was deemed necessary or desirable for it to be preserved or to regulate access. For information

Term or abbreviation	Definition
	regarding Designated Landscape Areas, follow this link: https://www.datsip.qld.gov.au/people-communities/aboriginal-torres-strait-islander-cultural-heritage/designated-landscape-areas
Developed Area	Means that the area is developed or maintained for a particular purpose such as use as a park, garden, railway, road or other access route, navigation channel, municipal facility or infrastructure facility, such as power lines, telecommunication lines or electricity infrastructure.
DoC Guidelines	Duty of Care Guidelines 2004 Gazetted guidelines identifying reasonable and practicable measures for ensuring activities are managed to avoid or minimise harm to Aboriginal cultural heritage. For information regarding the Cultural Heritage Duty of Care Guidelines 2004, follow this link: https://www.datsip.qld.gov.au/resources/datsima/people-communities/cultural-heritage/duty-of-care-guidelines.pdf https://www.qld.gov.au/__data/assets/word_doc/0031/175198/duty-of-care-guidelines.docx
DSDSATSIP	Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships
Fish Traps and Weirs	Fish traps and weirs are stone or wooden constructions designed to capture aquatic animals, predominantly fish. Traps are considered as structures made predominantly from stone to form a type of pen or enclosure. Weirs are constructions designed to block the natural flow of water in creeks, streams and other watercourses.
Foreshores and coastal dunes	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. May mean beach or inlet, lake shores and the dunes associated with coastal and lacustrine environments.
Grinding Groove	Grinding grooves represent the physical evidence of past tool making or food processing activities. They are generally found near water sources. The presence of long thin grooves may indicate where the edges of stone tools were ground. Food processing activities such as seed grinding can leave shallow circular depressions in rock surfaces.
Harm	Damage or injury to, or desecration or destruction of, Aboriginal cultural heritage.
Hearth	Fire-pit or fireplace.
Land user	A person carrying out, or proposing to carry out, activities on land likely to materially affect the land.
National Heritage List (NHL)	The NHL is Australia's list of natural, historic, and Indigenous places of outstanding significance to the nation.
Native Title Party	The native title party for an area is defined as: • Native title holders – that is where native title has been recognised by the Federal Court of Australia. • Registered native title claimants – native title claims currently before the Federal Court of Australia. • Previously registered native title claimants (the 'last claim standing') – native title claims that have been removed from the Register of Native Title Claims administered by the National Native Title Tribunal (NNTT). Previously registered native title claimants will continue to be the native title party for that area providing: • There is no other registered native title claimant for the area.

Term or abbreviation	Definition
	• There is not, and never has been, a native title holder for the area. The native title party maintains this status within the external boundaries of the claim even if native title has been extinguished.
Occupation sites	These are places where the material remains of human occupation are found. Such sites contain discarded stone tools, food remains, ochre, charcoal, stone and clay hearths or ovens, shell middens and shell scatters, including deposits found in rock shelters and caves. These deposits may be buried. Other evidence of occupation sites includes the remains of Aboriginal dwellings or "gunyahs".
Particular types of native vegetation	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. Native vegetation are plants that occur naturally within the region. Particular types of native vegetation may mean plants that are rare or have economic and/or social value to Aboriginal people.
Permanent and semi-permanent waterholes, natural springs	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. Waterholes (natural or cultural) and natural springs.
Project	Includes: • A development or proposed development. • An action or proposed action. • A use or proposed use of land.
Project area	In relation to a project, means the area the subject of the project, whether in construction or operational phases.
Quarry	Quarries are places where raw materials such as stone or ochre were obtained through either surface collection or sub-surface quarrying. Stone collected or extracted from stone quarries was used for the manufacture of stone tools. Ochre, a type of coloured clay, was utilised by Indigenous people in rock art and for body and wooden tool decoration.
Queensland Heritage Register (QHR)	The QHR is a list of places that have cultural heritage significance to the people of Queensland.
Registered significant area	Means an area recorded in the cultural heritage register as a significant Aboriginal area.
Registered significant object	Means an object recorded in the cultural heritage register as a significant Aboriginal object.
Rock Art	Queensland has a rich and diverse rock art heritage. Rock art sites can include engravings, paintings, stencils and drawings. Paintings, stencils and drawings may have been done for everyday purposes, but are often used for ceremonial and sacred functions. Engravings include designs scratched, pecked or abraded into a rock surface.
Rock outcrop	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. May mean a prominent boulder or cluster or boulders or a rock with an overhang suitable for human shelter.
Sand hills	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. May mean sand dunes associated with coastal and lacustrine environments or inland dune systems.
Scarred or carved trees	Scars found on large mature trees often indicate the removal of bark by Indigenous people to make material items like canoes, containers, shields and boomerangs.

Term or abbreviation	Definition
	Carved trees generally feature larger areas of bark that have been removed and carved lines deeply etched into the timber. Carvings include geometric or linear patterns, human figures, animals and birds.
Significant Aboriginal area (Section 9 of ACHA)	An area of particular significance to Aboriginal people because of either or both of the following: • Aboriginal tradition. • The history, including contemporary history of any Aboriginal Party for the area.
Significant Aboriginal object (Section 10 of ACHA)	An object of particular significance to Aboriginal people because of either or both of the following: • Aboriginal tradition. • The history, including contemporary history of any Aboriginal Party for the area.
Significant Ground Disturbance	Means: • Disturbance by machinery of the topsoil or surface rock layer of the ground, such as by ploughing, drilling or dredging. • The removal of native vegetation by disturbing root systems and exposing underlying soil.
Some hill and mound formations	A landscape feature as listed in Section 6.2 of the Duty of Care Guidelines. Possible links to intangible cultural heritage values (e.g. story places, dreaming places, etc).
Stone artefact	A stone artefact usually refers to flaked stone tools. Technologically, this would include cores, flakes and retouched flakes. Other classes of artefacts such as hammerstones are often included in this term.
Stone artefact scatter	A group of stone artefacts clustered together. Stone artefact scatters are described by their size (area), density (artefacts per m^2) and diversity (frequency of different artefact types and materials).
Surface Disturbance	Means any disturbance of an area which causes a lasting impact to the land or waters during the activity or after the activity has ceased.
Well	Rock wells are reliable water sources that have been altered by Indigenous people for the storage of water. The presence of wells often indicates the location of routes frequently travelled by Indigenous people in the past.

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1. Introduction

1.1 Background

Niche was commissioned by PSA Consulting (Australia) Pty Ltd (PSA) on behalf of the Gladstone Regional Council to conduct a cultural heritage due diligence assessment (DDA) for the construction of a new Aquatic Recreation Centre and associated works (the Project) located at Tannum Sands. The proposed Boyne Tannum Aquatic Recreation Centre is located on Coronation Drive, Tannum Sands, otherwise described as Lot 900 SP152499 (Figure 1).

1.2 The Project Activity

This Project includes the construction of a new Aquatic Recreation Centre and other associated works. The proposed Aquatic Recreation Centre Concept Design includes:

- 8 lane 50 metre outdoor heated pool with bulkhead.
- Distinct recreational zone with a twin waterslide attraction.
- Kiosk and general amenities, green space with shaded turf seating areas and spectator embankment.
- All abilities access (pool ramp) and pool shading for sun safety and comfort.
- Carparking and landscaping.

1.3 Assessment overview

The aim of this DDA is to assist PSA/Gladstone Regional Council to identify the potential for the Project area to contain any Aboriginal and/or historical cultural heritage values which could constrain the Project works and assist them to meet their duty of care under the *Aboriginal Cultural Heritage Act 2003 (*ACHA*)*. This DDA was written to ensure PSA/Gladstone Regional Council comply with the statutory requirements of the ACHA and the *Queensland Heritage Act 1992* (QHA).

The scope of this DDA includes:

- Desktop searches of statutory registers, inventories and relevant lists for cultural heritage, including:
  - DSDSATSIP Aboriginal Cultural Heritage Register and Database.
  - National Heritage List.
  - Commonwealth Heritage List.
  - Queensland Heritage Register.
  - Local Government heritage register and/or planning scheme.
- Desktop searches of non-statutory registers, inventories and relevant lists for cultural heritage, including:
  - Register of the National Estate.
  - Queensland National Trust.
  - Queensland Native Mounted Police Research Database.
  - Queensland WWII Historic Places.
  - Historic maps.
- A desktop review of available cultural heritage studies of relevance to the Project area (Aboriginal and historical studies) to provide historical context and inform the assessment of archaeological potential within the Project area.

- A desktop analysis of available historical aerial photographs of the Project area to establish the extent of disturbance caused by past land use activities to assist in determination of the activity category under the DoC Guidelines. In addition, the review will also identify any high-risk landscapes and/or geographic areas.
- Inclusion of recommendations based on an understanding of known and potential for Aboriginal and historical cultural heritage being present within the Project area and requirements and obligations under relevant heritage legislation.

This DDA will also provide advice if further cultural heritage assessments under the ACHA or QHA are required.

1.4 Authorship and acknowledgements

This report has been prepared by Karene Chambers (Heritage Consultant, Niche). It was internally reviewed by Brodie Hartfiel-Lees (Associate – Heritage, Niche) for consistency and accuracy. A copy of the report has also been provided to PSA for review.

1.5 Limitations

Consultation with the Aboriginal Party for the Project area has not taken place. Aboriginal Parties are not required to participate in the DDA process.

There has been minimal previous archaeological work in the area, and this has limited the availability of previous assessments for the Project area.

This DDA is a desktop only assessment of cultural heritage constraints, in accordance with the Project Brief no visual inspection of the Project area was undertaken.

If any of the final work's designs differ from those assessed in this DDA, then this DDA should be reviewed and updated.

Drawn by: HarrisonBinks Last updated: 24/10/2022 File: C:\OneDriveSyncFolder\Niche\GIS - APRX - APRX\a7500\a7582_BoyneTannumARC_DDA_QLD\Proja7582_BoyneTannumARC_DDA_QLD.aprx

niche Environment and Heritage

0 300 m

WGS 1984 Web Mercator

Project Area

Boyne Tannum Aquatic Recreation Centre

Niche PM: Brodie Hartfiel-Lees
Niche Proj. #: 7582
Client: PSA Consulting (Australia) Pty Ltd

Figure 1

2. Statutory

2.1 Aboriginal Cultural Heritage Act 2003

The ACHA recognises Aboriginal people as the primary authority on Aboriginal cultural heritage, aiming to facilitate the continuation of Aboriginal culture, traditions and customs (Department of Aboriginal and Torres Strait Island and Partnerships 2012).

The following fundamental principles underline ACHA's main purpose (Division 2, Section 5):

- The recognition, protection and conservation of Aboriginal cultural heritage should be based on respect for Aboriginal cultural and traditional practices.
- Aboriginal people should be recognised as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage.
- It is important to respect, preserve and maintain knowledge, innovations and practices of Aboriginal communities and to promote understand of Aboriginal cultural heritage.
- Activities involved in recognition, protect and conservation of Aboriginal cultural heritage are important because they allow Aboriginal people to reaffirm their obligations to "law and country".
- There is a need to establish timely and efficient processes for the management of activities that may harm Aboriginal cultural heritage.

The ACHA places all persons in Queensland under a Duty of Care to take all reasonable and practicable measures to ensure they do not harm Aboriginal cultural heritage whenever they undertake an activity.

Under the ACHA, Aboriginal cultural heritage is defined in Section 8 as:

a) a significant Aboriginal area in Queensland,

b) a significant Aboriginal object,

c) evidence, of archaeological or historic significance of Aboriginal occupation of an area in Queensland.

A *significant Aboriginal area* is defined as an area of particular significance to Aboriginal people because of either or both of the following: Aboriginal tradition and the history, including contemporary history, of any Aboriginal party for the area (ACHA 2003:S9).

A *significant Aboriginal object* is defined as an object of particular significance to Aboriginal people because of either or both of the following: Aboriginal tradition and the history, including contemporary history, of an Aboriginal party for an area (ACHA 2003:S10).

A cultural heritage database and cultural heritage register have been established under Part 5 of the ACHA and the *Torres Strait Islander Cultural Heritage Act 2003*. DSDSATSIP is responsible for administering the database and register. The cultural heritage database holds information on the location and type of some of the previously recorded Aboriginal cultural heritage 'sites' in Queensland. A 'site' recorded on the database may be a physical object (for example a stone artefact or scarred tree) or intangible area (for example a story place or pathway).

2.1.1 Aboriginal Cultural Heritage Database

The purpose of the cultural heritage database is to:

- Assemble information about Aboriginal and Torres Strait Islander cultural heritage in a central and accessible location; and
- Provide a research and planning tool to help Aboriginal and Torres Strait Islander parties, researchers and other persons assess the Aboriginal and Torres Strait Islander cultural heritage values of particular areas.

The database is not publicly available.

However, DSDSATSIP provides information from the database to:

- Aboriginal and Torres Strait Islander parties - if the information relates to the party's area of responsibility.
- Land users - if the information is necessary for them to satisfy their duty of care.

2.1.2 Aboriginal Cultural Heritage Register

The cultural heritage register holds:

- Information regarding cultural heritage studies under Part 6 of the legislation.
- Information regarding Designated Landscape Areas.
- Information about whether a particular area has been the subject of a cultural heritage management plan under Part 7 of the legislation.
- Information on cultural heritage bodies.
- Details of statutory Aboriginal and Torres Strait Islander parties.

The register is intended to be:

- A depository of information for consideration for land-use planning (including local government planning schemes and regional planning strategies); and
- A research and planning tool to help people in their consideration of the Aboriginal and Torres Strait Islander cultural heritage values of particular objects and areas.

The register is available to the public.

2.1.3 Landscape Features

When a proposed activity meets the criteria of Category 4 or 5, Section 6.2 of the Duty of Care Guidelines identifies landscape features that may have cultural heritage significance. These landscape features may bear no physical tangible elements of Aboriginal cultural heritage but may have significance for intangible reasons, i.e. ceremonial, spiritual or part of storylines.

These landscape features include:

- Rock outcrops.
- Caves.
- Foreshores and coastal dunes.
- Sand hills.
- Areas of biogeographical significance such as natural wetlands.
- Permanent and semi-permanent waterholes, natural springs.
- Particular types of vegetation.

- Some hill and mound formations.

The views of the Aboriginal Party for the Project area are key in helping assess the Aboriginal cultural heritage significance of these kinds of features.

2.2 Queensland Heritage Act 1992

The *Queensland Heritage Act 1992* (QHA) provides for the conservation of Queensland's cultural heritage for the benefit of the community and future generations. Administered by the Department of Environment and Science (DES), the QHA sets out a framework for identifying and protecting heritage places by establishing the Queensland Heritage Council (QHC), the Queensland Heritage Register (QHR), local heritage registers, regulating development and enabling the management of heritage places through heritage agreements.

The Queensland Heritage Register (QHR) is a record of places of cultural heritage significance to the people of Queensland. Places may be entered in the QHA under two categories - Protected Area (PA) or State Heritage Place (SHP). PA's have strong heritage values that are vulnerable and under threat. SHP's are places of significance that contribute to our understanding of the wider pattern and evolution of Queensland's history and heritage. SHP's are the most common category in the QHR. A place may be entered in the QHR under this category if it satisfies one or more of eight cultural heritage criteria specified in Section 35 of the QHA.

The criteria are:

a) The place is important in demonstrating the evolution or pattern of Queensland's history.
b) The place demonstrates rare, uncommon or endangered aspects of Queensland's cultural heritage.
c) The place has potential to yield information that will contribute to an understanding of Queensland's history.
d) The place is important in demonstrating the principal characteristics of a particular class of cultural places.
e) The place is important because of its aesthetic significance.
f) The place is important in demonstrating a high degree of creative or technical achievement at a particular period.
g) The place has a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.
h) The place has a special association with the life or work of a particular person, group or organisation of importance in Queensland's history.

2.2.1 Local heritage registers and planning schemes

The QHA enables local governments to establish a local heritage register, or to use a planning scheme to identify and manage local heritage places or use a combination of both a register and planning scheme.

The Project is within the Gladstone Region Local Government Area (LGA).

The Gladstone Regional Council considers places of local cultural heritage significance within the Gladstone Regional Council Planning Scheme 2017 Version 2.0, Schedule 6.8 – heritage. Places of local heritage significance are entered in the Gladstone Regional Council Local Heritage Register and identified in the Heritage Overlay Map.

If a development sought to impact a place of local heritage significance entered in the Gladstone Regional Council Local Heritage Register, Council may require a Statement of Impact, Conservation Management Plan, Archaeological Management Plan or Heritage Management Plan to define heritage values, understand potential impacts of development, and demonstrate how the development retains relevant cultural heritage values of the local heritage place to assist Council to assess development applications.

3. Desktop Assessments

3.1 Statutory Database search results

Searches of the Queensland Heritage Register (QHR), the Gladstone Regional Council planning scheme heritage overlay map, the National Heritage List and the Australian Heritage Database returned **no results** for the Project area.

The National Heritage listed, World Heritage listed, Commonwealth listed, and Register of the National Estate (RNE) listed Great Barrier Reef is located within 400 m west of the Project area. It is not likely to be directly impacted upon by the proposed works.

3.2 Non-Statutory Database search results

Searches of the Register of the National Estate, the Queensland National Trust, the Queensland Native Mounted Police Research Database, the Queensland WWII Historic Places and historic maps returned **no results** for the Project area.

3.3 Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Cultural Heritage Database and Register search results

A search of the Project area for Lot 900 SP152499 with a 500 m buffer (#122144) was conducted on the 18 October 2022 (Annex 1). The search returned **no previously recorded Indigenous sites, however the Great Barrier Reef National Heritage Area and World Heritage Area is located within the 500 m buffer of the DSDSATSIP search. The Great Barrier Reef Area boundary is approximately 400 m west of the Project area and should not be impacted on during works.**

3.4 Aboriginal Party for the Project area

The Aboriginal Party for the Project area is the Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People. The contact details are presented in Table 1. The Cultural Heritage Body for the Project area is First Nations Bailai Gurang Gooreng Gooreng Taribelang Bunda People Aboriginal Corporation RNTBC.

Table 1. Aboriginal Party for the Project area.

Aboriginal Party	Contact Details	Cultural Heritage Body
QCD2017/010 DET QUD6026/2001 Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People	First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC c/- PCCC Land Trust PO Box 537 BUNDABERG QLD 4670 Phone: (07) 4159 5589 Email: reception@pccctrust.com.au	First Nations Bailai Gurang Gooreng Gooreng Taribelang Bunda People Aboriginal Corporation RNTBC PO Box 537 BUNDABERG QLD 4670 Phone: (07) 4159 5589 Mobile: 0487 345 763 Email: reception@pccctrust.com.au

3.5 Local archaeology and land use history

3.5.1 Ethnographic context

The Project area is within the Traditional lands of the Bailai, Gurang, Gooreng Gooreng, and Taribelang Bunda People.

Nearby Port Curtis was named by Matthew Flinders in 1802, in honour of Admiral Sir Roger Curtis. His ship *The Investigator*, as well as the accompanying Lady Nelson, sailed into the harbour the morning of 5 August 1802, and they spent the next four days charting the area. Flinders also spent this time charting and naming several surrounding areas, including Mount Larcom, Hill View, Sea Hill, and South Trees Point (McDonald, 2001). During this time Flinders recorded meeting several Aboriginal people on the Western side of Curtis Island, noting several bark canoes on the shore with parts of a turtle and scoop nets hanging nearby (Flinders, 1814).

The next record from this area comes from an expedition by John Oxley in 1823, who sailed into the harbour looking for an area for a new convict settlement. He decided the area was unsuitable for this purpose. Before moving on, John Uniacke, another member of the expedition, reported sighting a fresh river mouth entrance to the South. This would later be named the Boyne River.

Tannum Sands was originally mapped and referred to as Red Cliff (Queensland Government 1920), renamed as Wild Cattle Creek (Queensland Government 2022a) or Wild Cattle Beach (McDonald 2001), then renamed to Tannum, before finally being gazetted as Tannum Sands in 1951 (Downey 2011; Queensland Government 2022b). The names of Wild Cattle Creek and Wild Cattle Beach may have come from scrubber cattle bred out of Boyne Island (McDonald 2001:23).

Richard Hetherington was the first white settler to utilise nearby Boyne Island, running cattle from 1855. Tannum Sands was a popular destination for fishing and picnicking, with Noel Patrick describing Tannum Creek as suitable for outboard fishermen and as being accessible from Colosseum Inlet – but only at high tide(McDonald 2001; 1981). However, due to remoteness and accessibility issues, Tannum Sands remained largely unsettled until the 1930s.

Native Mounted Police are known to have had a presence in the region since 1852, and a camp was set up at Calliope Creek in 1853. In 1854 the camp was relocated to Auckland Creek in order to be closer to the settlement at Gladstone, however after the camp was attacked in 1857 it was requested to be moved back (Burke & Wallis, 2019). Native Mounted Police presence continued until the 1860s.

Growth in the Gladstone region was slow, but gold was discovered in Calliope and mining in the region rapidly increased the population by the early 1960's.

The John Oxley Bridge was opened over the Boyne River in 1980, providing more direct access between the townships of Tannum Sands and Boyne Island, and preparing for the opening of an aluminium smelter on Boyne Island in 1982 (Laver 2020).

3.5.2 Archaeology and Aboriginal occupation

One of the earliest written accounts was by Matthew Flinders during his exploration of Port Curtis in 1802, who recorded a meeting a number of Aboriginal people on the western side of Curtis Island. He noted seven bark canoes lying on the shore; near them hung parts of a turtle and scoop nets (Flinders 1914). This contradicts John Oxley's visit to Port Curtis in 1823, noting no Aboriginal people and he believed that the area was deserted. This suggests seasonal movements in this area, which is consistent with the archaeological record.

Large social gatherings were a feature of Aboriginal life in central and southeast Queensland. It seems that groups met for ceremony, trade and social intercourse within the Gladstone area, possibly around Auckland/Police Creek, where there were large lagoons able to sustain numbers of people. It is likely that the area formed a catchment point for groups from the Targinie, Mount Larcom, Tannum, Boyne and Miriam Vale areas (Gladstone Area Water Board).

Richard Mitchell, son of the noted Surveyor General Sir Thomas Mitchell, during a sojourn at Gladstone of several weeks in 1855, noted material culture items such as boomerangs, spears, nulla nullas, waddies (club) and shields. Even by that early contact time, hoop iron from barrels had replaced stone as spear points, demonstrating the ability of rapid technological change when needed. Mitchell's diary notes that between two or three hundred Aboriginal people were camped at Barney Point and had already adopted the use of European food and tobacco (McDonald 1988).

Archaeological studies of the Curtis Coast to the south have identified a number of sites, especially along the coastal areas, wetlands and rivers, with the greatest density of sites being present on lower margins of major estuaries – though the authors warn this may be due to erosion and differential preservation as opposed to a genuine occupation pattern (Ulm and Lilley 1999).

Anecdotal evidence exists suggesting that several midden sites may be present along Wild Cattle Creek, further to the south of Tannum Sands township (The State of Queensland (Department of Education) 2022).

3.5.3 Previous heritage reports

No known previous heritage reports were available for the Project area.

Heritage reports that were conducted near to the Project area are summarised below.

South Trees – Waste Water Treatment Plant, Due Diligence Assessment, Niche 2022

Niche was commissioned to undertake a DDA for the proposed works at South Trees Waste Water Treatment Plant. The proposed activities of the project have been assessed as a mixture of Category 5 and Category 4 High risk of the DoC guidelines. The results of the DDA indicate that the project area had been subject to Surface Disturbance and Significant Ground Disturbance, but that this was limited to areas of existing infrastructure, and there was limited evidence for disturbance outside of these areas. The project area was also within the Great Barrier Reef National and World Heritage place area.

The potential to identify any Aboriginal cultural heritage across the project area was considered high.

Consultation and completion of a Cultural Heritage Field Assessment with the Aboriginal Party for the area, the Bailai Gurang Gooreng Taribelang Bunda People, was recommended should any works occur outside the existing infrastructure footprints.

Bruce Highway Bridges & Culverts – 10D Bruce Highway (Gin Gin to Benaraby) Station Creek Bridge (BIS No. 621) Project, Cultural Heritage Risk Assessment, Niche 2020

Niche was commissioned to undertake a CHRA for proposed bridge strengthening works at the Station Creek Bridge on the Bruce Highway. The project works were assessed as variable, with the bridge strengthening works assessed as low risk and the temporary platform and crossing construction across Station Creek associated with works assessed as high risk due to additional disturbance being required to a high-risk landscape feature, and limited evidence for previous Significant Ground Disturbance and Surface Disturbance in the area.

Consultation with the Aboriginal Party, the First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People, was recommended.

Cultural Heritage Due Diligence Assessment - QLD Oil Refinery Project, Gladstone, QLD, Niche 2019

Niche was commissioned by QLD Oil to prepare a Cultural Heritage Due Diligence Assessment for the proposed import and refinement of crude oil into clean, low sulphur fuels for the QLD Oil Refinery Project. The project works were assessed as High risk (Category 5) for the eastern section and Low Risk (Category 4) for the western section. It was recommended that a Cultural Heritage Field Assessment be undertaken with representatives of the Aboriginal Party of the Project area.

Gladstone to Benaraby Road, Ch. 13.220, Cultural Heritage Risk Assessment, Niche 2014

Niche was commissioned to undertake a CHRA for proposed flood recovery works including cement stabilisation on Gladstone to Benaraby Road. Significant Ground Disturbance and Surface Disturbance were identified in the project area. The proposed activities of the project were assessed as Category 1 of the DoC Guidelines, and the potential for Aboriginal cultural heritage to be present across the project area or to be harmed during project works was considered low. Two cultural heritage sites were identified during desktop searches of the DATSIMA (now DSDSATSIP) register, but these were located on different roads outside the project area boundaries.

Central Queensland Gas Pipeline 2006

Archaeo Cultural Heritage Services undertook a survey of the southern section of the proposed Central Queensland Gas Pipeline between Raglan Creek and Gladstone itself. Two routes were surveyed: one crossing the Mount Larcom Range, while the second crossed Larcom Creek near the location of the old Mount Larcombe Homestead.

A number of small artefact scatters were located along the route, but the most significant place identified was described as being an extensive source of lustrous fine-grained greenish chert in the Mount Larcom Range near Nichols and The Narrows roads. This source consisted of water-rolled cobbles present in the bed of the creek. It was thought that the quality of these cobbles was being tested via the removal of a flake from one end. Following this, the cobble was either discarded or, if considered suitable, would then be further flaked. Thousands of flaked cobbles (cores) and the flakes that have been struck from these were located at, and in proximity to, this area.

With the locations not appearing in the search results of the Queensland Aboriginal Cultural Heritage Register and Database, it can only be assumed that the results of this work were not submitted to DATSIP (now DSDSATSIP).

An Overview of the Historical Cultural Heritage Resources of the Curtis Coast, Dr Lorna McDonald 2001

Dr Lorna McDonald was commissioned by the Environmental Protection Agency in 2001 to undertake an overview of the Historical Cultural Heritage Resources of the Curtis Coast. The report includes a historical overview of the area, as well as details regarding all known cultural heritage sites in the area at that point in time.

3.6 Previous levels of disturbance

Developing an understanding of the levels of previous ground disturbance is one of the key pieces of information required to determine the Duty of Care category for the Project. Table 2 describes the different types of ground disturbance as defined by the Duty of Care (DoC) Guidelines, Section 3.

Table 2: The types of ground disturbance.

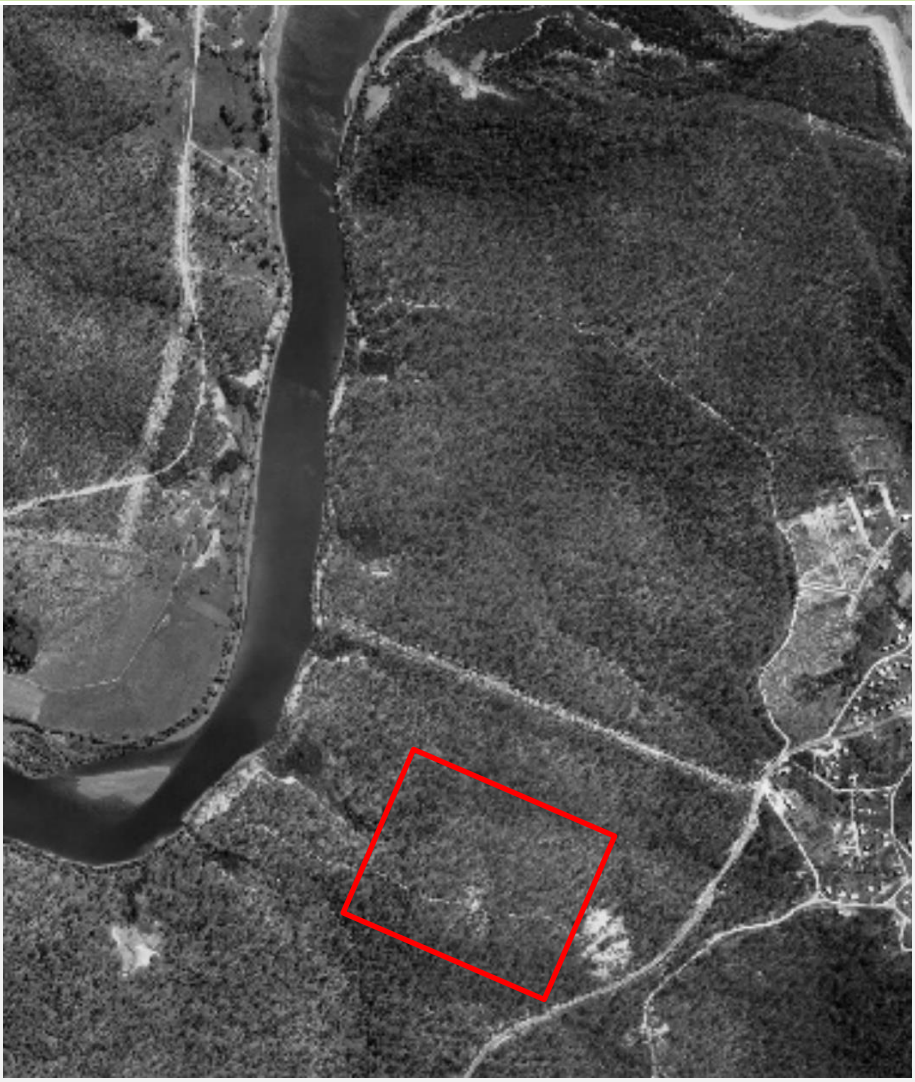
Type	Meaning
Significant Ground Disturbance	• Disturbance by machinery of the topsoil or surface rock layer of the ground, such as by ploughing, drilling or dredging. • The removal of native vegetation by disturbing root systems and exposing underlying soil.
Surface Disturbance	• Means any disturbance of an area which causes a lasting impact to the land or waters during the activity or after the activity has ceased.

3.7 Land use history and disturbance

A review of the historical aerial imagery for the Project area from 1952 to 2021 clearly demonstrates the previous land use history and disturbance of the Project area and its immediate surrounds (Table 3).

Table 3: Historic aerials of the Project area demonstrating land use over time.

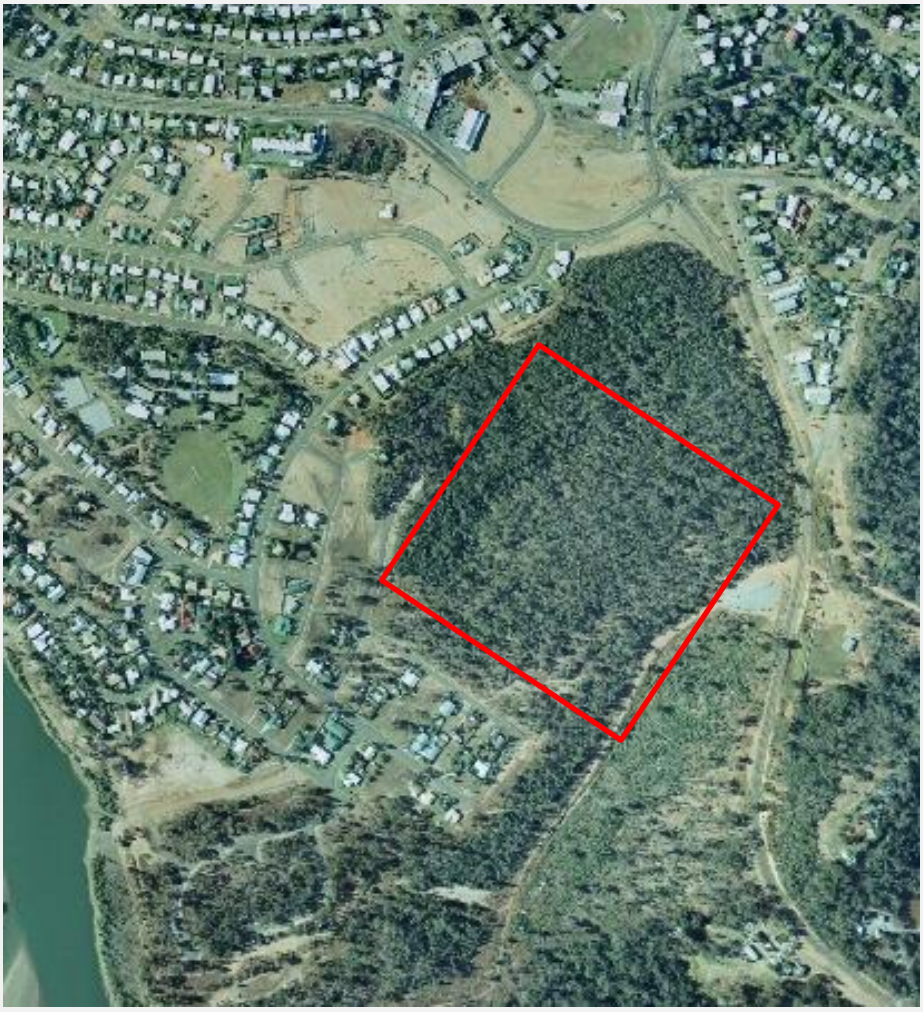
Year	Observation	Disturbance (as defined by the DoC Guidelines)
1952	 **Plate 1. 1952 QAP927 Frame 132. Aerial image of the Project area in 1952 (Source: QImagery). The Project area is denoted by the red box.** The earliest aerial photograph of the Project area dates to 1952. At this time, the nearby roads of Coronation Drive, Gregory Street, Dunn Street, and Pryde Street have not yet been constructed. Tannum Sands Road has been constructed but in a slightly different alignment and is not yet sealed. Remnant vegetation is present across the Project area, and much of the Tannum Sands township. The Boyne River can be seen to the west, and Wild Cattle Creek can be seen to the east.	• No Significant Ground Disturbance has occurred. • No Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
1965	 **Plate 2. 1965 QAP1447 Frame 247. Aerial image of the Project area in 1965 (Source: QImagery). The Project area is denoted by the red box.** No significant change within the Project area. Additional residential development and roads have been constructed adjacent to the east of the Project area, and to the west on the other side of the Boyne River. Tannum Sands Road alignment is closer to the present-day alignment. Remnant vegetation still exists in the Project area.	• No Significant Ground Disturbance has occurred. • No Surface Disturbance has occurred.

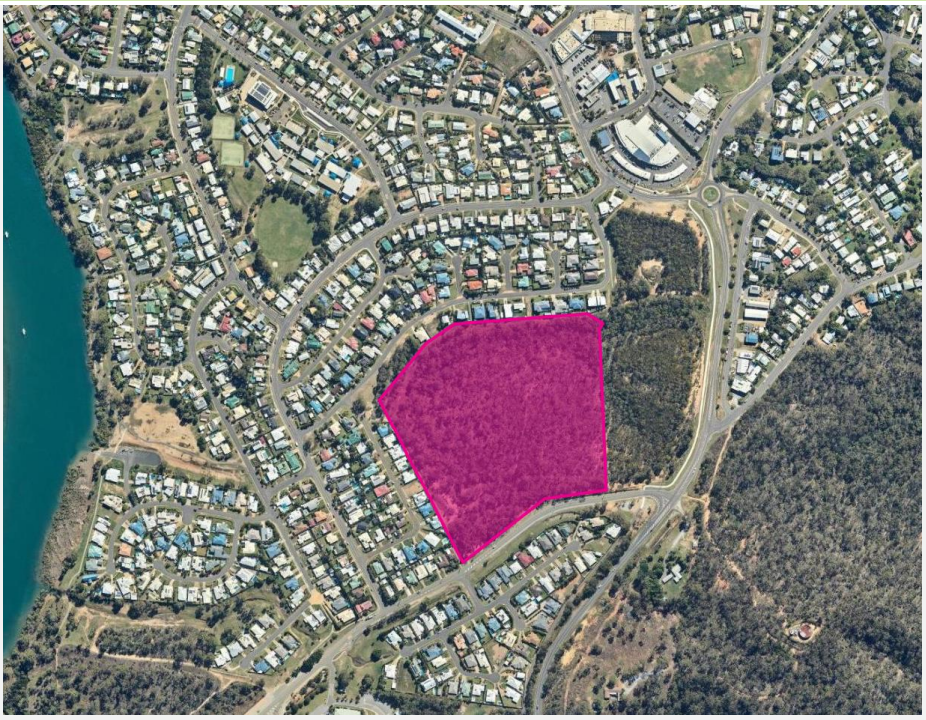
Year	Observation	Disturbance (as defined by the DoC Guidelines)
1975	 **Plate 3. 1975 QAP3138 Frame 170. Aerial image of the Project area in 1975 (Source: QImagery). The Project area is denoted by the red box.** Coronation Drive to the immediate South of the project area has now been constructed. Remnant vegetation still exists in the Project area, though some minor thinning of vegetation has occurred. More residential development has occurred to the east and north of the Project area, and further to the west on the other side of the Boyne River.	• No Significant Ground Disturbance has occurred. • No Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
1980	 **Plate 4. 1980 QAP3828 Frame 184. Aerial image of the Project area in 1980 (Source: QImagery). The Project area is denoted by the red box.** Additional residential development has occurred to the east, north and south of the Project area, and further to the west on the other side of the Boyne River. Remnant vegetation remains in the Project area but has been significantly thinned. The cause of the vegetation thinning could be natural (such as fires) or mechanical in nature – the cause is not clear from the aerial photographs.	• No Significant Ground Disturbance has occurred. • No Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
1988	 **Plate 5. 1988 QAP4716 Frame 55. Aerial image of the Project area in 1988 (Source: QImagery). The Project area is denoted by the red box.** Coronation Drive to the immediate south of the Project area has been widened and had minor realignments. Tannum Sands Road to the east has likewise been widened and is in the present-day alignment, with sealing underway. Dunn Street and part of Pryde Street have been constructed and sealed. Additional residential development has occurred surrounding the Project area. Remnant vegetation remains in the Project area, and the vegetation has regrown and thickened out from the previous aerial images. A minor area of vegetation has been cleared in the south-west corner. The underlying sand soils are visible.	• Limited Significant Ground Disturbance has occurred. • Limited Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
1996	 **Plate 6. 1996 QAP5464 Frame 166. Aerial image of the Project area in 1996 (Source: QImagery). The Project area is denoted by the red box.** Additional residential development has occurred surrounding the Project area. Tannum Sands Road has been sealed. No major changes have occurred in or in immediate proximity to the Project area. Remnant vegetation still remains inside the Project area.	• No Additional Significant Ground Disturbance has occurred. • No Additional Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
2007	 **Plate 7. 2007 Gladstone_2007_60cm_9150. Aerial image of the Project area in 2007 (Source: QldGlobe). The Project area is denoted by the purple polygon.** Coronation Drive to the immediate south of the Project area has now been sealed. Gregory Street has been constructed and sealed, and construction and sealing of Pryde Street has continued further east. Additional residential development has occurred surrounding the Project area. Remnant vegetation remains in the Project area. A minor area of vegetation has been cleared in the south-west corner and along the northernmost boundary, and some vegetation thinning has occurred.	• Limited Additional Significant Ground Disturbance has occurred. • Limited Additional Surface Disturbance has occurred.

Year	Observation	Disturbance (as defined by the DoC Guidelines)
2021	 **Plate 8. 2021 Gladstone_Urban_2021_10cm_SISP. Aerial image of the Project area in 2021 (Source: QldGlobe). The Project area is denoted by the purple polygon.** Pryde Street has been fully constructed and sealed. Additional residential development has occurred surrounding the Project area. Remnant vegetation remains in the Project area, and the vegetation has regrown and thickened out from the previous aerial images. No major changes have occurred inside the Project area and no additional direct disturbance has taken place.	• No Additional Significant Ground Disturbance has occurred. • No Additional Surface Disturbance has occurred.

3.8 Project site potential

3.8.1 Local environmental context

Through an understanding of the current and past environment, certain predictions can be made on the likelihood of occurrence for Aboriginal sites within the Project area. The presence or absence of certain environmental factors, in particular, waterways, have been shown through numerous investigations throughout Australia that correlate with the nature and distribution of Aboriginal sites (Hughes and Sullivan 1984:35). A study by Rowland and Connolly (2002) identified that nearly 50 percent of inland sites were situated within 200 m of water and 91.5 percent were situated within 700 m of water.

Patterns show the same frequency of sites located near to water sources, both permanent or ephemeral.

The closest waterway to the Project area is the Boyne River, located approximately 450 m west of the Project area, and Wild Cattle Creek, located approximately 800 m east of the Project area. The ocean is also nearby, located approximately 1 km north-east of the Project area.

3.8.2 Risk profile

The cultural heritage risk profile for the Project site is based on:

1. The likelihood that Aboriginal people used the area in the past.

2. The nature of the local environment and previous level of disturbance.
3. Whether any archaeological remains of that occupation are still present (archaeological potential).
4. The Project activities.

The Project area has been subjected to only limited Significant Ground Disturbance and Surface Disturbance in isolated areas on the northernmost boundary and in a small area in the southwest, through the clearance of vegetation in the past. The majority of the Project area has not been subject to direct Significant Ground Disturbance or Surface Disturbance, and retains remnant vegetation throughout. A summary of the Aboriginal cultural heritage risk profile for the Project area is shown in Table 4.

Table 4. Summary of the Aboriginal cultural heritage risk profile for the Project site.

Criteria	Assessment	Risk Profile
1. The likelihood that Aboriginal people used the area in the past (e.g., presence and nature of previously recorded sites)	Previously conducted cultural heritage studies and a wider search of the DSDSATSIP database does not show known sites. The Project area is nearby the Great Barrier Reef heritage area, located 400 m west of the Project area. Two major watercourses are present nearby – Boyne River 400 m to the west, and Wild Cattle Creek 700 m to the east. Based on these factors, it is likely the Project area was used by Aboriginal people in the past.	High • A search of the Project area with a 500 m buffer returned no previously recorded sites. • The Great Barrier Reef Heritage area, located 400 m west of the Project area.
2. Nature of the local environment - past land use and disturbance	The majority of the Project area contains remnant vegetation and has not been subject to Significant Ground Disturbance or Surface Disturbance. This is evident in the historical aerial photographs of the Project area dating back to 1952.	High • Only very limited and isolated vegetation clearing has taken place – no visible Significant Ground Disturbance and Surface Disturbance has occurred in the majority of the Project area, meaning the likelihood of finding Aboriginal Cultural Heritage is high.
3. Archaeological potential	The majority of the Project area has not previously been subject to Significant Ground Disturbance and Surface Disturbance, as defined in the DoC Guidelines, through the clearing of vegetation and construction of buildings and dams, except for minor isolated areas along the northernmost boundary and southwest corner. No Aboriginal cultural heritage sites have been identified within the Project area, though the Great Barrier Reef is located 400 m to the west	High • A lack of previous disturbance indicates the Archaeological potential for the Project area is high.
4. Project activities	The clearing of remnant vegetation, as well as grading/levelling of the land, and the creation of an aquatic recreation centre, car park and associated facilities is inconsistent with previous ground disturbance and will cause additional Significant Ground Disturbance and Surface Disturbance as defined by the Duty of Care guidelines across the entire Project area.	High • The Project activities of clearing remnant vegetation, grading/leveling of the land, and the creation of an aquatic recreation centre, car park and associated facilities are inconsistent with previous disturbance and therefore high risk.

3.8.3 Landscape features

Under the ACHA DoC Guidelines (Section 6.2), certain 'Landscape Features' within an area may have cultural heritage significance to Aboriginal people. These features are itemised in Table 5 below. The presence of Landscape Features in the Project area would trigger the requirement to undertake consultation with the Aboriginal Party to determine if there are any intangible or tangible heritage significance associated with those features.

Table 5. Presence of landscape features in the Project area.

Landscape Feature	Present?
Rock outcrops	No
Caves	No
Foreshore and coastal dunes	No
Sand hills	No
Areas of biogeographical significance, such as wetlands	**Yes**
Permanent and semi-permanent waterholes, natural springs	No
Particular types of native vegetation, scarred trees	**Yes**
Some hill and mound formations	No

3.8.4 Site predictions

Based on the risk profile provided above the Project area has a **high** potential for Aboriginal cultural heritage to be present. It is likely that Aboriginal people used the landscape within the Project area in the past as demonstrated by the review of previous studies and the geographical and environmental context. Additionally, minimal activities causing Significant Ground Disturbance and Surface Disturbance in the past means the potential to identify evidence of past use by Aboriginal people is **high**.

4. Duty of Care Categories and risk assessments

4.1 Duty of Care Category

The assignment of a Duty of Care Category relies on two sources of information, being the degree of disturbance caused by the proposed Project activities and the extent of previous land disturbances. Table 6 outlines these criteria for the Project.

Table 6. Calculation of DoC Category.

Project Activity	Landscape features?	Previous disturbance	Consistent with Previous land use?	DoC Category
Clearing of remnant vegetation **Grading/levelling of the land** **Construction of new aquatic recreation centre, carpark and associated facilities**	Present - Areas of biogeographical significance, and Particular types of native vegetation.	The majority of the Project area has not been previously subject to Significant Ground Disturbance and Surface Disturbance.	All proposed work is inconsistent with previous land use.	Remnant vegetation areas inside the Project area Category 5 – High Risk Areas where vegetation has been cleared previously inside the Project area Category 4 – High Risk

The Duty of Care Categories for the Boyne Tannum Aquatic Recreation Centre Project is assessed as Category 5 – High Risk for areas containing remnant vegetation, and Category 4 – High Risk for areas where vegetation has been cleared previously (Figure 2).

Category 4 – Areas previously subject to Significant Ground Disturbance

"Where an activity is proposed in an area, which has previously been subject to Significant Ground Disturbance it is generally unlikely that the activity will harm Aboriginal cultural heritage and the activity will comply with these guidelines.

In some cases, despite an area having been previously subject to Significant Ground Disturbance, certain features of the area may have residual cultural heritage significance. It is important to be informed about any cultural heritage significance that may attach to these features and extra care must be taken prior to proceeding with any activity that may cause additional surface disturbance to the feature, or the area immediately surrounding the feature which is inconsistent with the pre-existing Significant Ground Disturbance. In these circumstances, it is necessary to notify the Aboriginal Party and seek:

- *Advice as to whether the feature constitutes Aboriginal cultural heritage; and*
- *If it does, agreement as to how best manage the activity to avoid or minimise harm to any Aboriginal cultural heritage."*

Category 5 – Activities causing additional surface disturbance

"A category 5 activity is any activity, or activity in an area, that does not fall within category 1, 2, 3 or 4. Where an activity is proposed under category 5 there is generally a high risk that it could harm Aboriginal

cultural heritage. In these circumstances, the activity should not proceed without cultural heritage assessment.

Particular care must be taken where it is proposed to undertake activities causing additional surface disturbance to the features likely to have cultural heritage significance. It is important to be informed about any cultural heritage significance that may attach to these features and extra care must be taken prior to proceeding with any activity that may cause additional surface disturbance of the feature, or the area immediately surrounding the feature. Where an activity is proposed under category 5, it is necessary to notify the Aboriginal Party and seek:

- *Advice as to whether the feature constitutes Aboriginal cultural heritage; and*
- *If it does, agreement as to how best manage the activity to avoid or minimise harm to any Aboriginal cultural heritage."*

Drawn by: HarrisonBinks Last updated: 24/10/2022 File: C:\OneDriveSyncFolder\Niche\GIS - APRX - APRX\a7500\a7582_BoyneTannumARC_DDA_QLD\Proja7582_BoyneTannumARC_DDA_QLD.aprx

niche Environment and Heritage

0 500 m

WGS 1984 Web Mercator

Duty of Care Categories

Boyne Tannum Aquatic Recreation Centre

Niche PM: Brodie Hartfiel-Lees
Niche Proj. #: 7582
Client: PSA Consulting (Australia) Pty Ltd

Figure 2

5. Conclusion and Recommendations

5.1 Conclusions

Niche was commissioned by PSA Consulting (Australia) Pty Ltd on behalf of the Gladstone Regional Council to conduct a cultural heritage due diligence assessment (DDA) for the construction of a new Aquatic Recreation Centre and associated works (the Project) located at Tannum Sands. The proposed Boyne Tannum Aquatic Recreation Centre is located on Coronation Drive, Tannum Sands, otherwise described as Lot 900 SP152499 (Figure 1).

The assessment concludes that there exists a **high** potential for the Project activities to harm cultural heritage. This was a desktop only assessment and no visual inspection was conducted for the Project.

Aboriginal cultural heritage

No places of Aboriginal heritage have been identified within the Project area. However, it was noted that the Great Barrier Reef area is located 400 m to the west of the Project area. An inspection of historical aerial imagery shows the Project area has not been subject to Significant Ground Disturbance and Surface Disturbance in the past, except for limited areas on the northernmost boundary and south-west corner. The Project area has been assessed as a mixture of Category 5 and Category 4 - High Risk as the proposed activity is inconsistent with previous levels of ground disturbance.

Where Landscape Features are present within an area, such as the areas of biogeographical significance and particular types of native vegetation, these areas may have tangible or intangible Aboriginal cultural heritage significance associated with them. In this case, it is important to be informed about the significance (if any) that may be attached to those features and it is necessary to undertake consultation with the Aboriginal Party.

Category 4 - Areas previously subject to Significant Ground Disturbance

"Where an activity is proposed in an area, which has previously been subject to Significant Ground Disturbance it is generally unlikely that the activity will harm Aboriginal cultural heritage and the activity will comply with these guidelines.

In some cases, despite an area having been previously subject to Significant Ground Disturbance, certain features of the area may have residual cultural heritage significance. It is important to be informed about any cultural heritage significance that may attach to these features and extra care must be taken prior to proceeding with any activity that may cause additional surface disturbance to the feature, or the area immediately surrounding the feature which is inconsistent with the pre-existing Significant Ground Disturbance".

Category 5 - Activities causing additional surface disturbance

"Where an activity is proposed under category 5 there is generally a high risk that it could harm Aboriginal cultural heritage. In these circumstances, the activity should not proceed without cultural heritage assessment. Cultural heritage assessment should involve consideration of the matters a Court may consider".

5.2 Recommendations

Consultation and Cultural Heritage Field Assessment

Consultation with the Aboriginal Party is required as the Project area has been assessed as Category 5 (High risk) and Category 4 (High risk). A Cultural Heritage Field Assessment should be undertaken in consultation

with the Aboriginal Party (Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People), in order to identify any Aboriginal and Historical Cultural Heritage that may be present within the Project area.

Cultural heritage Induction

All Project staff should be provided with a Cultural Heritage Induction prior to the commencement of Project works. This induction should include a procedure to be followed if unexpected cultural heritage objects are identified during the Project or if human remains are identified (see below). This would ensure PSA/Gladstone Regional Council can demonstrate that they have met their duty of care requirements under the ACHA.

Unexpected finds procedures

A procedure for handling unexpected finds during proposed works should be developed and implemented. This procedure would include:

Aboriginal Cultural Heritage

- If a find is made, all works at the find location must cease immediately.
- The location, including a 5 m curtilage, must be excluded using barrier fencing to avoid harm.
- The Aboriginal Party (refer to Annex 1 for details), must be contacted to verify whether the object is of Aboriginal cultural heritage significance.
- No works are to continue within the excluded area until the Aboriginal Party provide written notification to PSA/Gladstone Regional Council, or their Contractor, that works may proceed.

Historical Cultural Heritage

- If a find is made, all works at the find location should cease immediately.
- The location, including a 5 m curtilage, should be established barrier fencing to avoid harm to the find.
- A suitably qualified person must be contacted to verify whether the object is of State cultural heritage significance.
- No works are to continue within the excluded area until the significance of the find is determined.
- If the find is determined to be of State cultural heritage significance, the find must be reported to the Department of Environment and Science (DES) under Section 89 of the QHA.
- If the find is determined to be of local heritage significance, Gladstone Regional Council should be contacted for advice on how to proceed.
- If the find is determined to be of no cultural heritage significance, works may proceed.

Human remains stop work provision

In the highly unlikely event that suspected human remains are encountered during the Project works, all Project works must cease immediately. The DSDSATSIP guidelines for managing human remains must then be followed. These can be accessed online at:
https://www.qld.gov.au/__data/assets/pdf_file/0024/175191/guidelines-human-remains.pdf

A procedure based on these guidelines should be implemented during all Project works and include:

- Work at the find location must cease immediately.
- The location, including a 20 m curtilage, be excluded using barrier fencing to avoid further harm.
- The Police or Coroner must be advised of the presence of suspected human remains. An appropriate officer will then establish the area as a potential crime scene.

- Police will undertake appropriate scientific or other procedures to assist the coroner in making an appropriate determination about the suspected human remains.
- If the remains are determined to be neither Aboriginal nor Torres Strait Islander in origin, related to criminal activity or are of doubtful determination, the Police may remove the remains for further analysis.
- If however the remains are determined to be ancestral remains without the need for removal, the relevant Aboriginal Party of the ancestral remains will be responsible for their management.
- In cases where ancestral remains are removed by Police and subsequently determined by the coroner to be of Aboriginal or Torres Strait Islander origin, the remains will be released to the Minister responsible for administering the Acts (DSDSATSIP).
- The Department of Seniors and Disability Services and Aboriginal and Torres Strait Islander Partnerships is then responsible for coordinating the return of the remains to the relevant Aboriginal Party.

No works are to continue in the excluded area until the Coroner/Police provide written notification to PSA/Gladstone Regional Council, or their Contractor.

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Annex 1: DSDSATSIP search results

Cultural Heritage Database and Register Search Report

Search report reference number: 122144

The Aboriginal and Torres Strait Islander Cultural Heritage Database (cultural heritage database) and Aboriginal and Torres Strait Islander Cultural Heritage Register (cultural heritage register) have been searched in accordance with the location description provided, and the results are set out in this report.

The cultural heritage database is intended to be a research and planning tool to help Aboriginal and Torres Strait Islander parties, researchers, and other persons in their consideration of the cultural heritage values of particular areas.

The cultural heritage register is intended to be a depository for information for consideration for land use and land use planning, and a research and planning tool to help people in their consideration of the Aboriginal cultural heritage values of particular objects and areas.

Aboriginal or Torres Strait Islander cultural heritage which may exist within the search area is protected under the *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Cultural Heritage Act 2003* (the Cultural Heritage Acts), even if the Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships (the Department) has no records relating to it.

The placing of information on the database is not intended to be conclusive about whether the information is up-to-date, comprehensive or otherwise accurate.

Under the Cultural Heritage Acts, a person carrying out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal or Torres Strait Islander cultural heritage. This applies whether or not such places are recorded in an official register and whether or not they are located on private land.

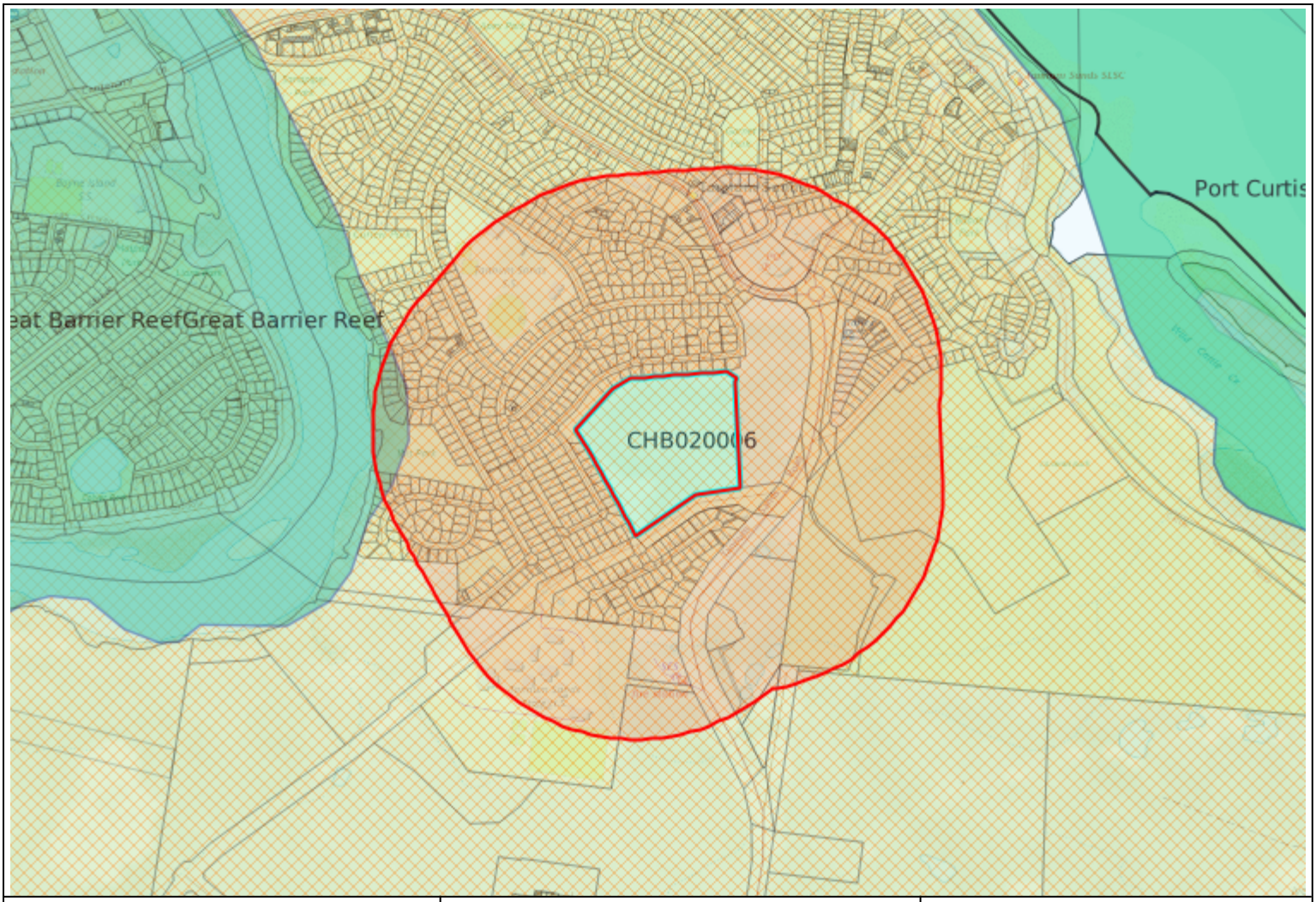
Please refer to the Department website https://www.qld.gov.au/firstnations/environment-land-use-native-title/cultural-heritage/cultural-heritage-duty-of-care to obtain a copy of the gazetted Cultural Heritage Duty of Care Guidelines, which set out reasonable and practicable measure for meeting the cultural heritage duty of care.

In order to meet your duty of care, any land-use activity within the vicinity of recorded cultural heritage should not proceed without the agreement of the Aboriginal or Torres Strait Islander Party for the area, or by developing a Cultural Heritage Management Plan under Part 7 of the Cultural Heritage Acts.

The extent to which the person has complied with Cultural Heritage Duty of Care Guidelines and the extent the person consulted Aboriginal or Torres Strait Islander Parties about carrying out the activity – and the results of the consultation – are factors a court may consider when determining if a land user has complied with the cultural heritage duty of care.

Should you have any further queries, please do not hesitate to contact the department via email: cultural.heritage@dsdsatsip.qld.gov.au or telephone: 1300 378 401.

Cultural Heritage Database and Register Search Report



LEGEND

- Parties
- Bodies
- CHMPs
- Study Areas
- DLAs

Reference Number: 122144
Search Type: Lot/Plan
Lot: 900
Plan: SP152499
Shire: Gladstone Regional

Buffer Distance: 500m

Cultural Heritage Sites

- Pre 1/7/2015 points
- Post 1/7/2015 points
- Post 1/7/2015 points (mitigated)
- Area

Map Projection: Geographic Latitude & Longitude (GDA2020).

The Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships (DSDSATSIP) is the custodian of spatial data provided by various third parties for inclusion in the Aboriginal and Torres Strait Islander cultural heritage online portal. This includes spatial data provided by the National Native Title Tribunal and Aboriginal and Torres Strait Islander parties.

Features shown on this map have been obtained from available sources. It is possible that errors and omissions may exist. The DSDSATSIP disclaims any liability for any errors or omissions that appear in this document.

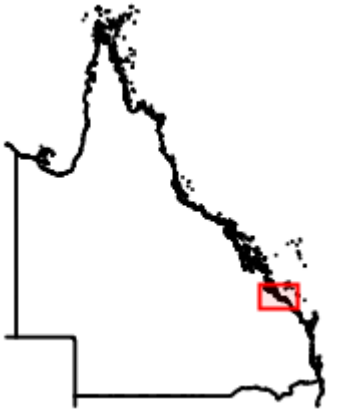
Map produced by the Cultural Heritage Unit, DSDSATSIP, Brisbane, Queensland, Australia on 18 October 2022.

Queensland Government

1:14,958

Metres 200 400 600

LOCALITY



Search report generated on Oct 18, 2022, 3:47 PM

There are no Aboriginal or Torres Strait Islander cultural heritage site points recorded in your specific search area.

There are no Aboriginal or Torres Strait Islander cultural heritage site polygons recorded in your specific search area.

Cultural Heritage Party/ies for the area:

Reference No.	Federal Court No.	Name	Contact Details
QCD2017/010 DET	QUD6026/2001	Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People	First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC c/- PCCC Land Trust PO Box 537 BUNDABERG QLD 4670 Phone: (07) 4159 5589 Email: reception@pccctrust.com.au

Cultural Heritage Body/ies for the area:

Departmental Reference No.	Name	Contact Details	Registration Date
CHB020006	First Nations Bailai Gurang Gooreng Gooreng Taribelang Bunda People Aboriginal Corporation RNTBC	First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC C/- PO Box 537 BUNDABERG QLD 4670 Phone: (07) 4159 5589 Mobile: 0487 345 763 Email: reception@pccctrust.com.au	17/06/2021

There are no Cultural Heritage Management Plans recorded in your specific search area.

There are no Designated Landscape Areas (DLA) recorded in your specific search area.

There are no Registered Cultural Heritage Study Areas recorded in your specific search area.

There are no National Heritage Areas (Indigenous values) recorded in your specific search area.

Heritage Related Areas (QLD Subset) for the area:

Data Source	Name
National Heritage Areas	Great Barrier Reef
World Heritage Areas	Great Barrier Reef

National Heritage Areas (Indigenous values): Places listed on the National Heritage areas (Indigenous values) are recognised for their outstanding indigenous cultural heritage significance to Australia and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*. These areas are now included in the cultural heritage register.

World Heritage Areas: Places inscribed on the World Heritage List pursuant to the World Heritage Convention adopted by the United Nations Education, Scientific and Cultural Organisation (UNESCO) and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*. For further information about World Heritage places in Queensland visit https://parks.des.qld.gov.au/management/managed-areas/world-heritage-areas

Glossary

Cultural Heritage Body: An entity registered under Part 4 of the Cultural Heritage Acts as an Aboriginal or Torres Strait Islander cultural heritage body for an area. The purpose of a cultural heritage body is to:

- identify the Aboriginal or Torres Strait Islander parties for an area
- serve as the first point of contact for cultural heritage matters.

Cultural Heritage Management Plan (CHMP): An agreement between a land user (sponsor) and Traditional Owners (endorsed party) developed under Part 7 of the Cultural Heritage Acts. The CHMP explains how land use activities can be managed to avoid or minimise harm to Aboriginal or Torres Strait Islander cultural heritage.

Cultural Heritage Party: Refers to a native title party for an area. A native title party is defined as:

- Registered native title holders (where native title has been recognised by the Federal Court of Australia).
- Registered native title claimants (whose native title claims are currently before the Federal Court of Australia).
- Previously registered native title claimants (the 'last claim standing') are native title claims that are no longer active and have been removed from the Register of Native Title Claims administered by the National Native Title Tribunal. Previously registered native title claimants will continue to be the native title party for that area providing:
    - there is no other registered native title claimant for the area; and
    - there is not, and never has been, a registered native title holder for the area.

The native title party maintains this status within the external boundaries of the claim even if native title has been extinguished.

Cultural heritage site points (pre 2015): Aboriginal and Torres Strait Islander cultural heritage sites and places recorded in the database as point data **before** 1 July 2015.

Cultural heritage site points (post 2015): Aboriginal and Torres Strait Islander cultural heritage sites and places recorded in the database as point data **after** 1 July 2015.

Cultural heritage site points (post 2015 mitigated): Aboriginal and Torres Strait Islander cultural heritage sites and places recorded in the database as point data after 1 July 2015 where the recorder has advised the department that the site has been mitigated.

Cultural heritage site polygons: Aboriginal and Torres Strait Islander cultural heritage sites and places recorded in the database as a polygon.

Designated Landscape Areas (DLA): Under the repealed *Cultural Record (Landscapes Queensland and Queensland Estate) Act 1987*, an area was declared a 'designated landscape area' (DLA) if it was deemed necessary or desirable for it to be preserved or to regulate access.

Indigenous Protected Areas (IPA): Areas of land and sea managed by Indigenous groups as protected areas for biodiversity conservation through voluntary agreements with the Australian Government. For further information about IPAs visit https://www.environment.gov.au/land/indigenous-protected-areas

National Heritage Areas (Indigenous values): Places listed on the National Heritage List for their outstanding heritage significance to Australia and are protected under the Environment Protection and Biodiversity Conservation Act 1999. For further information about the National Heritage List visit https://www.environment.gov.au/heritage/about/national

Registered Cultural Heritage Study Areas: Comprehensive studies of Aboriginal and or Torres Strait Islander cultural heritage in an area conducted under Part 6 of the Cultural Heritage Acts for the purpose of recording the findings of

the study on the register.

Traditional Use of Marine Resources Agreement (TUMRA): Areas subject to agreement between Great Barrier Reef Traditional Owners and the Australian and Queensland governments on the management of traditional use activities on their sea country. For further information about TUMRAs visit https://www.gbrmpa.gov.au/our-partners/traditional-owners/traditional-use-of-marine-resources-agreements

World Heritage Areas: Places inscribed on the World Heritage List pursuant to the World Heritage Convention adopted by the United Nations Education, Scientific and Cultural Organisation (UNESCO) and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*. For further information about World Heritage places in Queensland visit https://parks.des.qld.gov.au/management/managed-areas/world-heritage-areas

Disclaimer: *The Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships is the custodian of spatial data and information provided by various third parties for inclusion in the Aboriginal and Torres Strait Islander cultural heritage online portal. This includes spatial data provided by the National Native Title Tribunal and Aboriginal and Torres Strait Islander parties. Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships is not responsible for the accuracy of information provided by third parties or any errors in this search report arising from such information.*

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Contact Us

Niche Environment and Heritage
02 9630 5658
info@niche-eh.com

NSW Head Office – Sydney
PO Box 2443 North Parramatta
NSW 1750 Australia

QLD Head Office – Brisbane
PO Box 540 Sandgate
QLD 4017 Australia

Sydney
Brisbane
Cairns
Port Macquarie
Illawarra
Coffs Harbour
Central Coast
Gold Coast
Canberra

Our services

Ecology and biodiversity
Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management
Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals
Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Biodiversity offsetting
Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)

APPENDIX 6: LIGHTING TECHNICAL MEMO

AP06

Light Naturally
for generations to come

Energy Efficient Lighting Strategies
Policy Development and Implementation
Lighting / Daylighting Education / Analysis

Lighting Impact Assessment: *Boyne Tannum Aquatic Recreational Centre*

Prepared by Light Naturally

7 December 2022

Contents

1. Glossary of Lighting Terms

Brightness: a visual sensation related to the apparent luminance of an object in the field of view of an observer. It is related to the amount of light emitted by that object, but also other factors, including background luminance.

Glare: visual discomfort or visual disability (temporarily impaired vision) caused by excessive luminance in the field of view of an observer. Glare may arise from direct view of a light source, or indirectly through light reflected by a surface.

Illuminance: the amount of light incident on a surface per unit area, measured in lux (lx).

Luminaire: an apparatus that distributes the light transmitted from one or more light sources, including all the parts necessary for fixing and protecting the light sources and any means for connecting them to electric supply.

Luminance: the light intensity per unit area of a light source or illuminated surface, measured in candelas per metre squared (cd/m^2).

Luminous Intensity: the luminous flux in a given direction, measured in candela (cd).

Luminous Flux: the energy (in the visible portion of the spectrum) radiated by a light source per unit time, measured in lumens (lm).

Obtrusive Light: spill light that gives rise to annoyance, discomfort or distraction or a reduction in the ability to see essential information (e.g. signal lights)

Spill Light (stray light): light emitted by a lighting installation that falls outside the design area.

Threshold Increment (TI): the measure of disability glare, expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. *Note – higher values of TI correspond to greater disability glare.*

Upward Light Ratio (ULR): The proportion of flux of a luminaire and/or lighting installation that is emitted at and above the horizontal.

2. BTARC Site Analysis

The site for the planned Boyne Tannum Aquatic Recreation Centre (BTARC) is shown in Figure 1 below.

Figure 1: Indicative site map of BTARC (overlay) showing adjacent roadway and nearest residences (satellite map from Google Earth, November 2022)

It is noted that the BTARC Traffic Impact Assessment produced by GHD (7 October 2022) indicates that Coronation Drive is an Urban 2 Lane Distributer. According to the Gladstone Regional Council's Road Hierarchy Policy, this should be designated as lighting category V4 in the Australian/New Zealand Standard AS/NZS 1158.1.1:2022, *Lighting for Roads and Public Space – Vehicular Traffic (Category V)*.

2.1 Environmental Zone

The region surrounding the BTARC site can be classified (according to Australian/New Zealand Standard, *AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting*) as a medium district brightness (zone A3), which is characterised by suburban areas in towns and cities. Table 1 lists the environmental zones and their descriptions, from which this classification is selected.

Table 1: Definitions and examples of environmental zones from AS/NZS 4282:2019

Zone	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve, IDA Dark Sky Parks Major optical observatories No road lighting – unless specifically required by the road controlling authorities
A1	Dark	Relatively uninhabited rural areas No road lighting – unless specifically required by the road controlling authorities
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial* areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sports stadium during TV broadcasts

**NB: recreational areas are not considered commercial*

It is assumed that this Lighting Impact Assessment is not required to consider lighting for television broadcast.

2.2 Hours of Use

The standard relating to obtrusive effects of lighting at night, AS/NZS 4282:2019, has distinct performance requirements for what is considered pre-curfew (between 6am and 11pm) and curfewed hours (from 11pm to 6am). No assumptions have been made about hours of use for BTARC. Requirements for both pre-curfewed and curfewed hours will be provided in this document, and the hours of use of the facility will determine which requirements are necessary.

2.3 Sensitive Flora and Fauna

In preparing this report, Light Naturally has not been alerted to any sensitive flora or fauna identified at the site of the development that might require consideration from a lighting perspective.

2.4 Sensitive Visual Receptors – Nearest Residential Boundaries

There are three (3) residential boundaries near the BTARC site, numbered R1, R2 and R3, in Figure 2 that have been identified as potential visual receptors with respect to lighting from the site. Each boundary will be discussed in turn, with distances to the site and altitudes estimated using civil engineer site maps (where available) and Google Earth.

Figure 2: BTARC site highlighting nearby residential boundaries (R1 - R3) identified as potential sensitive visual receptors

R1 – Residential boundary on Coronation Drive, opposite BTARC site

The residential boundary on Coronation Drive immediately opposite the BTARC site is the closest boundary to the development (~ 50 m from carpark entrance). It is also the only boundary at similar altitude (with levels ranging from 17 m to 21 m) to the proposed finished development, which has planned levels ranging from approximately 21 - 22 m.

R2 – Residential boundary on Dunn Street, adjacent to site

Boundary R2 on Dunn Street is approximately 150 m from the carpark area of the site. This boundary is considerably further from and lower than the site (with altitude levels from 12 m to 17 m) compared with boundary R1.

R3 – Residential boundary on Pryde Street, adjacent to the rear of site

Boundary R3 on Pryde Street is more than 150 m from the rear of the site. Similarly to R2, this boundary is further from and lower than the site (with altitude levels around 16 m) compared with boundary R1.

By observation, boundaries R2 and R3 appear to be less likely affected by obtrusive light than the closer boundary at R1. When evaluating obtrusive light according to AS/NZS 4282:2019, local vegetation must not be considered. However in reality, it should be noted that there is (currently) considerable vegetation surrounding the site that will act to ameliorate any potential spill light, particularly to residences at boundaries R2 and R3.

2.5 Sensitive Visual Receptors – Road Users

There are 2 potential road user scenarios for vehicles driving on Coronation Drive. These are shown as T1 and T2 in Figure 3 below.

Figure 3: BTARC site highlighting vehicle approaches (T1 & T2) identified as potential sensitive visual receptors

T1 – Traffic approaching BTARC entrance, travelling east on Coronation Drive

T2 – Traffic approaching BTARC entrance, travelling west on Coronation Drive

Both near vehicle approaches to the site should be evaluated for conformance with the standard, *AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting*.

3. Relevant Standards and Guidelines for Lighting

The lighting specific benchmarks from the Gladstone Regional Council Planning Scheme's Emerging Community Zone Code (ECZC PO12) and Development Design Code (DDC PO18, 19 and 20) are summarised in Table 2 below.

Table 2: List of Performance and Acceptable Outcomes related to lighting – extracted from the relevant GRC Planning Scheme codes.

Performance Outcome	Acceptable Outcomes
ECZC PO12 Outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO12.1** Light emanating from any source complies with Australian Standard *AS4282 Control of the Obtrusive Effects of Outdoor Lighting* as amended
	AO12.2 Outdoor lighting is provided in accordance with Australian Standard *AS1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance an Installation Design Requirements* as amended
DDC PO18 External Lighting is provided in urban areas to ensure a safe environment	**AO18** Technical parameters, design, installation, operation and maintenance of outdoor lighting comply with the requirements of *AS4282 – Control of the Obtrusive Effects of Outdoor Lighting* as amended
DDC PO19 Outdoor lighting does not cause undue disturbance to any person, activity or fauna because of emission, either directly or by reflection.	**AO19** The vertical illumination resulting from direct, reflected or other incidental light coming from a site does not exceed 8 lux when measured at any point 1.5 m outside of the boundary of the property at any level from the ground up.
DDC PO20 Street lighting and signs are provided to ensure the safety of both vehicles and pedestrians, and to facilitate access and movement.	**AO20** Street Lighting and signage comply with the requirements of the *Engineering Design Planning Scheme Policy.*

To fulfill these outcomes, the following standards and guidelines require consultation:

PO12 relates to obtrusive light to nearby residences and road users. Accordingly, AO12.1 and AO 12.2 correctly stipulates review of the relevant Australian & New Zealand standards:

- **AS/NZS 4282:2019 – Control of the obtrusive effects of outdoor lighting** to ensure that obtrusive or spill light from the installation is compliant for both residents and road users, and
- **AS/NZS 1158.1.1:2022 – Lighting for Roads and Public Space – Vehicular Traffic (Category V)** for requirements for road users.

PO18 relates to the adequacy of external lighting to provide safe night-time environments. AO18 lists the obtrusive light standards, however an exterior lighting design guideline is also an appropriate reference, particularly:

- **AS/NZS 1158.3.1:2020 – Lighting for roads and public spaces Pedestrian area (Category P) lighting - Performance and design requirements** for requirements on lighting public spaces (car parks).

DDC PO19 (similarly to ECZC PO12) relates to obtrusive light to any person, activity or fauna. AO19 directly provides a technical requirement on illuminance as an acceptable outcome (i.e. vertical illuminance should not exceed 8 lux measured at any point 1.5 m outside the boundary of the property).

Although no sensitive fauna has been specifically evaluated, if it should be determined as being required; a general resource on minimising the impacts of artificial light at night on fauna can be found in the Australian Government's Department of the Environment and Energy guideline:

- **National Light Pollution Guidelines for Wildlife: including Marine Turtles, Seabirds and Migratory Shorebirds (2020)**

PO20 addresses streetlighting and roadside signage. AO20 directs to Capricorn Municipal Design Guidelines **CMDG D1-Geometric Road Design V9** (specifically section 19), which with respect to streetlighting refers directly to the standard series **AS/NZS 1158**. It is noted that no new streetlighting is considered as part of this application. However, there is the addition of an externally illuminated entrance sign (i.e. roadside signage).

For guidelines on permissible luminances for externally illuminated signage near roadways, AO20 should also refer to **AS/NZS 4282:2019**.

If the entrance sign is an LED billboard or internally illuminated sign – and not an externally illuminated sign as is currently depicted in design detail – then further review and additional requirements will be required, using **AS/NZS 4282:2019**, and also:

- **QLD Department of Transport and Main Roads, Roadside Advertising Manual (Edition 3 Technical Volume)**

4. Summary of Light Technical Parameter Requirements

Noting that the selected environmental zone for the BTARC area according to Table 3.1 in AS/NZS 4282:2019 is A3 (medium district brightness), and that the curfewed period is assumed to be from 11pm to 6am; the Lighting Technical Parameter (LTP) requirements for the development are summarised as in Table 3.

Table 3: Summary of Lighting Technical Requirements for BTARC development – General (non-TV broadcast)

Performance Outcome	Light Technical Parameter	Standard/Guideline	Requirement
Minimise obtrusive light to residents (PO12/PO19)	**1. Maximum Vertical illuminance** (lx)	AS/NZS 4282:2019	**Non-curfew maximum value: 10 lx** **Curfew maximum value: 2 lx** *Measured over a grid on a vertical plane positioned near the building line of the potentially affected dwellings, with exact position and height specified by clauses 3.3.1.3 and 3.3.1.4 of the standard, dependant on building setback from property boundary.*
		GRC Development Design Code - AO19	**Maximum value: 8 lx** *Measured at any point 1.5 m outside of the boundary of the property at any level from the ground up.* N.B. given the proximity of this measurement position to the luminous sources, during non-curfewed hours this requirement will always be more stringent than that imposed by AS/NZS 4282:2019 for maximum vertical illuminance.
	2. Maximum Luminous Intensity per Luminaire (cd)	AS/NZS 4282:2019	**Non-curfew maximum value: 12,500 cd** **Curfew maximum value: 2,500 cd** *Measured either as per the grid used for vertical illuminance calculations, and/or at specific locations where maintained views of bright luminaires will be troublesome (see Section 5.2 of this report for recommendations on measurement of this LTP)*

Performance Outcome	Light Technical Parameter	Standard or Guideline	Requirement
Minimise obtrusive light to road users (PO12/PO19)	**3. Threshold Increment (TI)**	AS/NZS 4282:2019 *which defers to* AS/NZS 1158.1.1:2022 *for Cat V roadways*	**TI for Category V4 roadway: 20%** *Calculated using an average carriageway luminance of 0.5 cd/m^2*
Minimise obtrusive light impacts (PO19)	**4. Maximum Upward Light Ratio** (ULR)	AS/NZS 4282:2019	**Maximum ULR: 0.02**
Street lighting and signs are provided to ensure the safety of both vehicles and pedestrians (PO20)	**5. Maximum Average Luminance of Surfaces** (cd/m^2)	AS/NZS 4282:2019	**Maximum Average value: 250 cd/m^2** *NB This value is for an externally lit sign in environmental zone A3. The maximum value for an externally lit sign in zone A2 (i.e., when viewed with a dark sky as background) is 150 cd/m^2.* LED billboards, or internally illuminated signs have different and additional requirements.
External Lighting is provided in urban areas to ensure a safe environment (PO18)	**6. Various, including:** ▪ Average Horizontal Illuminance, ▪ Point Horizontal Illuminance, ▪ Illuminance (horizontal) uniformity, ▪ Point Vertical Illuminance, ▪ Permissible Luminaire Type.	AS/NZS 1158.3.1:2020	As specified in **Table 2.9** of this standard, outdoor car park lighting should be designed to meet with LTP requirements for the categories: • **P11** – Parking spaces, aisles and circulation roadways, and • **P12** – Designated parking spaces specifically intended for people with disabilities.

5. Evaluating conformance with LTP requirements

The Light Technical Parameters (LTP) to be assessed to determine compliance of the installation with the relevant standards and guidelines are listed in Table 3 above, and summarised as:

1. Vertical Illuminance
2. Luminous Intensity (of luminaires)
3. Threshold Increment
4. Upward Light Ratio
5. Average Luminance (of roadside signage surface)

Additionally, as part of the lighting design process, the exterior carpark lighting design should be assessed for compliance with AS/NZS 1158.3.1:2020 (LTP criteria are listed as **LTP 6** in Table 3).

5.1 Calculation methods for conformance assessment

According to the standard AS/NZS 4282:2019, conformance should be demonstrated by the results of calculations and analysis of design methods. It is explicitly stated in this standard that measurement is not required to demonstrate conformance, going further to cite uncertainties and a range of technical factors that suggest that field measurements should be used as indicative only, rather than a definitive measure of conformance with this standard.

It is suggested that conformance with all LTP requirements is evaluated using lighting simulation software (e.g. AGI 32), noting the requirements on the use of computer programs stipulated in Clause 4.2 of AS/NZS 4282:2019; particularly related to the photometric data inputs.

5.2 Site locations for conformance assessment

For compliance with **AS/NZS 4282:2019 requirements**, vertical illuminance calculations (**LTP 1**) should be evaluated over a grid in a vertical plane near the residential boundaries of R1, R2 and R3; shown in Figure 2 – in accordance with clause 3.3.1.3 of AS/NZS 4282:2019.

Luminous intensity of any luminaires visible to residences (**LTP 2**) should also be evaluated with reference to these residential boundaries: R1, R2 and R3. Given the distance and position of residential boundaries R2 and R3, no “troublesome” views appear evident, and LTP 2 may be evaluated based on the same grid as LTP 1 for these residential boundaries. Evaluation of the closer boundary R1 may require consideration dependant on the positioning and aiming of luminaires, and should be determined at later stages of the design process (particularly luminaires designed to light the pool from the grandstand direction).

For compliance with the **GRC DDC AO19 requirement**, **LTP 1** measurements should be evaluated over a grid in a vertical plane, positioned 1.5 m from the site boundary (in all directions). It is suggested that the grid points should be spaced not more than 5 m horizontally and 1 m vertically. The statement of this requirement places no limit on the height of this measurement grid; however, it is reasonable to assume that where full cut-off luminaires are used, vertical illuminances that decrease with increasing height will continue to decrease. Therefore, it is suggested that once a trend in decreasing value of LTP 1 with grid height is established across the length of the grid, the grid can be terminated in vertical direction.

Threshold increment (**LTP 3**) should be evaluated with respect to directions T1 and T2 identified in Figure 3, and consider the impact of any exterior luminaires visible from the roadway. The calculation method for TI should be consistent with AS/NZS 1158.1.1:2022 for Category V roadways.

Upward Light Ratio (**LTP 4**) should be evaluated for the entire lighting installation.

Average luminance of the surface of the externally illuminated signage (**LTP 5**) at the entrance to the site should be evaluated from roadway directions from which it is visible to road users.

The various criteria of **LTP 6** would be evaluated as a routine element of the exterior lighting design process. LTP 6 is listed in Table 3 to explicitly respond to GRC DDC PO18 with guidance on the requirements (within AS/NZS 1158.3.1:2020) for the provision of a safe night-time environment. However, the precise limits of each of the quantities in LTP 6 require further design clarification with reference to this standard.