APPENDIX 7: ECOLOGICAL ASSESSMENT

AP07

ECO SOLUTIONS
& MANAGEMENT

BOYNE TANNUM AQUATIC RECREATION CENTRE ECOLOGICAL ASSESSMENT REPORT

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1. Introduction

1.1. Background

Eco Solutions & Management was engaged by PSA Consulting on behalf of Gladstone Regional Council to assess the ecological implications of the proposed Boyne Tannum Aquatic Recreation Centre (the project) under the Gladstone Regional Council Planning Scheme and relevant Queensland legislation and policy.

The project is proposed to be located on the edge of urbanised areas of Tannum Sands, which is a seaside township located approximately 13 km south-east of Gladstone in central Queensland (Figure 1). The study area involves Lot 900 on SP152499 and covers a vegetated area of approximately 9.9 ha in which a community aquatic centre is proposed to be constructed within a 1.7 ha footprint in the south-eastern portion of the allotment (Figure 2). The project footprint and immediate surrounds formed the study area for this assessment.

This report presents the findings of the assessment and provides recommendations and mitigations options where appropriate.

1.2. Study Area Description

The study area is located near the crest of a low rise and slopes gently towards the north and west. Regrowth native vegetation occurs throughout the study area, which is bordered to the south, west and north by residential dwellings. Coronation Drive borders the southern boundary of the study area. Native vegetation within the study area extends a little way to the east, and forms part of a larger tract of remnant vegetation to the east of the study area, and which wraps around to the south-east and further south of the study area, beyond Tannum Sands Road and the residential dwellings to the south (Figure 1).

An aerial view of the site is provided in Figure 2.

1.3. Proposed Development

Gladstone Regional Council is proposing to construct an aquatic recreation centre comprising a 50 m heated pool, splash pad and water slide with associated seating, change rooms, administration building and car parking. The total footprint of the centre with associated earthworks is approximately 1.7 ha. The proposed aquatic centre layout is shown in Figure 3.

1.4. Planning Context

1.4.1. State Planning Context

The majority of the study area has been mapped as supporting remnant vegetation belonging to the Least Concern Regional Ecosystem (RE) 12.11.6 (Figure 4). This area of vegetation is also designated as Essential Habitat (Figure 4).

The site does not fall within or adjoin a:

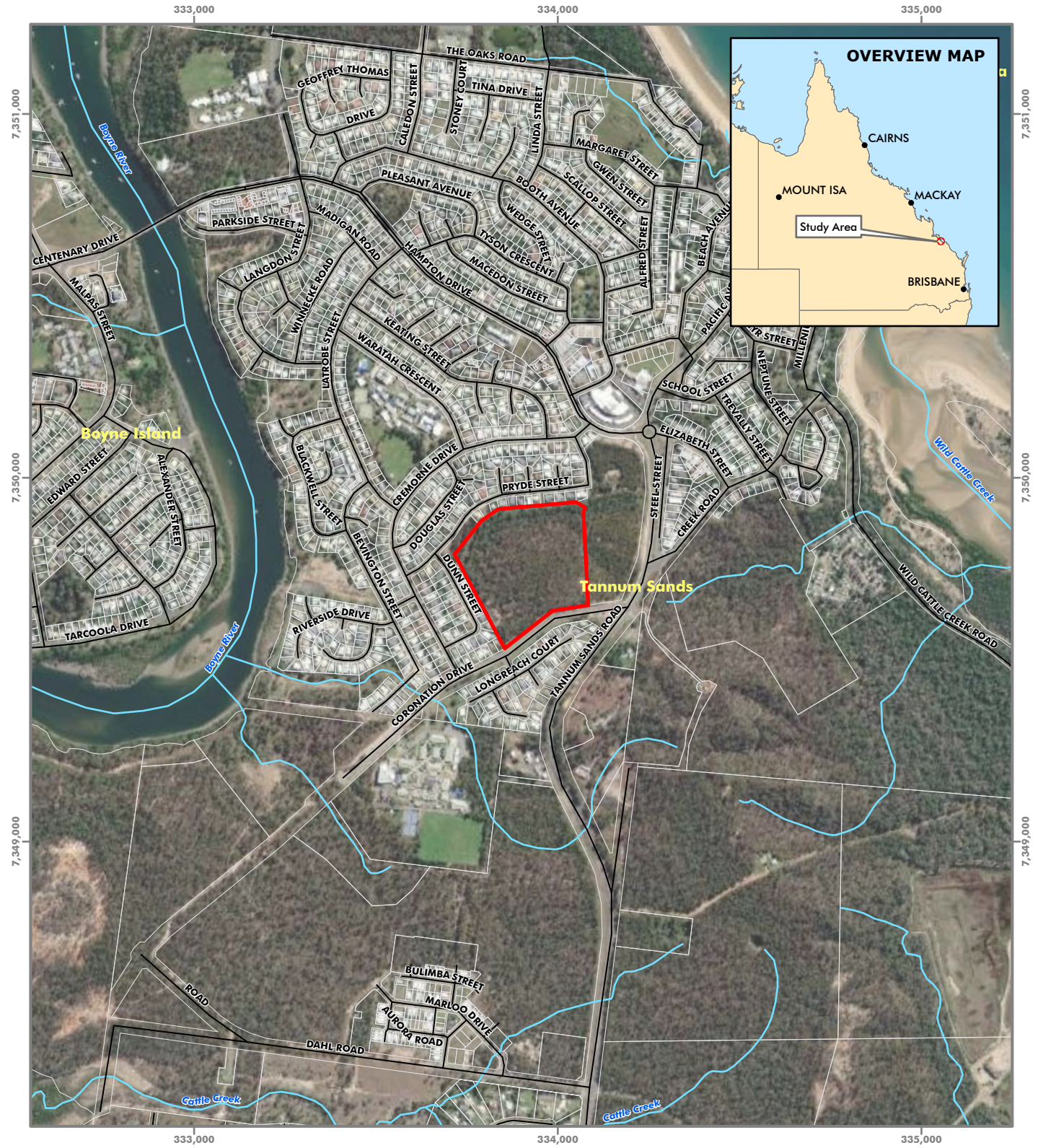
- A Koala habitat area
- High Risk Area on the Department of Environment and Science (DES) Protected Plants Flora Survey Trigger Map

- a high ecological significance or general ecological significance wetland or wetland trigger area on the Map of Referable Wetlands - Wetland Protection Areas
- Declared Fish Habitat Area
- Coastal management district.

Searches of DES' Wildlife Online database and the Commonwealth's Protected Matter Search Tool of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) indicate that a number of near threatened or threatened species or their habitats potentially occur within 5 km of the site. The potential for these species to occur within or adjacent to the site is discussed in detail in Sections 3.1 and 3.2.

1.4.2. Gladstone Regional Council Planning Context

The site is designated as Emerging Community under the Gladstone Regional Council Planning Scheme. With regard to Biodiversity Overlay Code, a small drainage line in the north of the study area is mapped as a matter of state significance (MSES) intersecting a watercourse and an area in the north-east is mapped as MSES – Wildlife Habitat (Figure 5). It is noted that the small drainage line is not mapped as a waterway in the regulated vegetation mapping (Figure 4).



Legend

- Study Area
- Road
- Vegetation Management Act watercourse
- Cadastral boundary

Figure 1 : Location of the study area

Boyne Tannum Sands Aquatic Centre
Development Assessment

Map Number: 22040_DA_01_A
Date: 17 November 2022
Map Projection: GDA2020 MGA Zone 56
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2022

0 100 200 400 600
Metres

N

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Legend

- Study Area
- Road
- Cadastral boundary

Figure 2 : Subject Site

Boyne Tannum Sands Aquatic Centre
Development Assessment

Map Number: 22040_DA_02_A
Date: 17 November 2022
Map Projection: GDA2020 MGA Zone 56
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2022

0 25 50 100
Metres

N

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Legend

- Study Area
- Road
- Cadastral boundary

Figure 3 : Proposed Aquatic Recreation Centre

Boyne Tannum Sands Aquatic Centre
Development Assessment

Map Number: 22040_DA_03_B
Date: 18 November 2022
Map Projection: GDA2020 MGA Zone 56
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2022

0 25 50 100
Metres

N

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Legend

- Study Area
- Development footprint - edge of earthworks
- Road
- Cadastral boundary
- Vegetation Management Essential Habitat - V11.0

Vegetation Management Regional Ecosystem Map - V12.02

- Category A or B that is of least concern
- Category C or R that is of least concern

Figure 4 : Queensland regional ecosystem mapping for the study area

Boyne Tannum Sands Aquatic Centre
Development Assessment

Map Number: 22040_DA_04_A
Date: 17 November 2022
Map Projection: GDA2020 MGA Zone 56
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2022

0 25 50 100
Metres

N

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Legend

- Study Area
- Development footprint - edge of earthworks
- Road
- Cadastral boundary

Biodiversity overlay mapping

- MSES - Wildlife habitat
- MSES - Regulated vegetation (intersecting a watercourse)

Figure 5 : Council overlay mapping

Boyne Tannum Sands Aquatic Centre
Development Assessment

Map Number: 22040_DA_05_A
Date: 17 November 2022
Map Projection: GDA2020 MGA Zone 56
Imagery: (c) Digital Globe
Data: Roads, Rail, Watercourse, DCDB - (c)DNRM 2022

0 25 50 100
Metres

N

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2. Methodology

2.1. Review of Existing Data

Searches were undertaken of the Wildlife Online Database and the EPBC Act Protected Matters Search Tool (PMST) for an area within 10 km of the study area (the search area) to identify near-threatened and threatened species that potentially occur within the vicinity of the study area.

Prior to the field assessment, regional ecosystem (RE) mapping and aerial photography were also examined to identify the nature and extent of vegetation on the site and within the local area.

2.2. Field Surveys

2.2.1. Flora

The following tasks were completed during the vegetation survey:

- assigning vegetation communities to Queensland REs
- conducting searches for significant plants and plant communities
- assessing the condition of the vegetation relative to its likely original floristic structure and composition.

2.2.2. Fauna

Given the generally modified nature of the study area's habitats and the relatively small area of the study area, a fauna habitat assessment with some opportunistic/targeted survey work was undertaken rather than a comprehensive fauna survey.

Two nights of spotlighting was conducted with one person hour per night spent traversing the entire study area to identify nocturnal fauna. Searches for scats were also conducted at the base of the majority of eucalypt trees within the proposed project disturbance footprint.

The potential for threatened species to occur on a site can be assessed through knowledge of species ecology, information on the occurrence of threatened species in the area and assessment of the habitat quality on the site.

The quality of fauna habitat on the site was assessed on the basis of several criteria (see below). These criteria are adapted for tree less habitat types such as grasslands or wetlands as appropriate.

Low: Many fauna habitat elements in low quality areas have been removed or altered such as mature, hollow bearing trees, fallen timber and deep leaf litter. Remnants are often small in size, support substantial weed infestations of high or moderate threat weeds (e.g. Common Lantana [**Lantana camara*]) and are poorly connected to other areas of remnant vegetation.

Moderate: Some habitat components are present but others are lacking. For example a remnant may have a reasonably intact understorey but lack mature canopy species and fallen timber. Some weed infestations are present but are relatively small in size or comprise species of low to moderate threat. Linkages with other remnant habitats in the landscape may be lacking or somewhat tenuous.

High: Most habitat components are present (e.g. old-growth trees, fallen timber, lack of weeds and deep leaf litter), the remnant is large enough to support species that are typically associated with large intact areas of habitat (e.g. Powerful Owl [*Ninox strenua*] and Greater Glider [*Petauroides volans*]) and it is well connected or contiguous with other areas of native vegetation.

2.3. Limitations

Ecological surveys often fail to record all species of flora and fauna present on a site for a variety of reasons such as seasonal absence or reduced activity during certain seasons. In addition, the ecology and nature of near threatened and/or cryptic species means that such species are often not recorded during short surveys. However, an assessment of habitat suitability is made for significant species that may occur in an area. A precautionary approach is adopted.

The primary focus of the assessment was to identify significant flora and fauna issues in the context of the potential development of the site. For this purpose, the review of existing information in combination with the habitat assessment is considered adequate. It was not the intent of the field assessment to record all species of flora and fauna species present.

3. Results

3.1. Flora

3.1.1. Vegetation Communities

As indicated, the Queensland Herbarium RE mapping for the site has mapped the majority of the study area and proposed disturbance area as supporting remnant vegetation of the Lest concern RE 12.11.6. This RE are described below.

RE 12.11.6

Open forest to woodland of Spotted Gum (*Corymbia citriodora* subsp. *variegata*) generally with Narrow-leaved Ironbark (*Eucalyptus crebra*). Other species such as Queensland Peppermint (*Eucalyptus exserta*), Queensland Blue Gum (*E. tereticornis*), Gum,-topped Box (*E. moluccana*), Silver-leaved Ironbark (*E. melanophloia*), Queensland White Mahogany (*E. acmenoides*), Moreton Bay Ash (*Corymbia tessellaris*) and Smooth-barked Apple (*Angophora leiocarpa*) may be present in scattered patches or in low densities. Understorey grassy or shrubby. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.

3.1.2. Vegetation Description

The vegetation in the study area has a canopy of mid mature Spotted Gum and Narrow leaved Ironbark with occasional Pink Bloodwood (*Corymbia intermedia*) and Queensland Peppermint and scattered Swamp Box (*Lophostemon suaveolens*). The estimated canopy cover range is from 15 to 30% cover with a height of 7 to 12 m. The great majority of trees have a diameter at breast height of 15 to 25 cm with very occasional larger trees to 45 cm DBH. No hollow bearing trees were observed on the site. The lack of mature trees on the site suggest that the vegetation on the site has been heavily thinned and disturbed in the past.

The study area has a dense to very dense shrub layer of dominated by Crowded-leaf Wattle (*Acacia conferta*) and *Acacia julifera* (no common name) with less prominent species including Bitter Bark (*Petalostigma pubescens*), Red Ash (*Alphitonia* excelsa) , Medicine Bush (*Coelospermum reticulatum*), Common Lantana (**Lantana camara*), Coffee Bush (Breynia oblongifolia) and very occasional Forest She-oak (Allocasuarina torulosa). The shrub layer ranged in height from 1.5 to 6 m with a cover of 60 to 80%.

The groundcover was dominated by native species such as Wiry Panic (Entolasia stricta), Kangaroo Grass (Themedia triandra), Black Spear Grass (Heteropogon contortus), Goodenia sp. (Mt Castletower), Rock Fern (Cheilanthes sieberi), Rough Saw-Sedge (Gahnia aspera) and Blue-flax lily (Dianella caerulea). The most common exotic species observed was Shrubby Stilo (*Stylosanthes scabra) with other species present including Thatch Grass (*Hyparrhenia rufa), Flannel Weed (**Sida cordifolia*) and Snake Weed (**Stachytarpheta cayennensis*).

The vegetation on site has been cleared and modified in the past but is correctly identified as currently being remnant for the purposes of the VM Act.

3.1.3. Significant Species

National and State significant flora species

No threatened or near threatened flora species were observed in the study area and Wildlife Online database indicates that no threatened or near-threatened species have been recorded from within 10 km of the study area. A number of Special Least Concern flora species have been recorded from the search area however this listing is related to the harvesting pressure for these species not their conservation significance.

The EPBC Act PMST database also indicates the potential presence of a number of flora species from the study area. However, it should be noted that the EPBC Act PMST database is based on predictive modelling of species occurrence as well as actual records and therefore the species listed below are likely not to have been actually recorded from the search area. These species are:

- Three-leaved Bosistoa (*Bosistoa transversa*) – vulnerable (EPBC Act)
- Cossinia (*Cossinia australiana*) – Endangered (EPBC Act & NC Act)
- Wedge-leaf Tuckeroo (*Cupaniopsis shirleyana*) – vulnerable (EPBC Act & NC Act)
- *Cycas megacarpa* (no common name)- Endangered (EPBC Act & NC Act)
- Marlborough Blue (*Cycas ophiolitica*) - Endangered (EPBC Act & NC Act)
- Bluegrass (*Dicanthium setosum*) – vulnerable (EPBC Act)
- Black Ironbox (*Eucalyptus raveretiana*) – vulnerable (EPBC Act)
- *Fontainea nervosa* (no common name) – vulnerable (EPBC Act & NC Act)
- Macadamia Nut (*Macadamia integrifolia*) – vulnerable (EPBC Act & NC Act)
- Quassia (*Samadera bidwillii*) – vulnerable (EPBC Act & NC Act)

The potential presence on the site of the threatened species listed above is assessed below.

Three-leaved Bosistoa, Cossinia, Wedge-leaf Tuckeroo, Angle-stemmed Myrtle, Macadamia Nut and Quassia all occur in rainforest, vine forest or wet sclerophyll vegetation communities (Harden et al. 2006). These species are considered unlikely to occur within the site due to a lack of preferred habitat and the modified nature of the vegetation within the site.

Cycas megacarpa occurs in eucalypt woodland between 40 and 680 m in elevation on rocky soils usually derived from acid volcanics, ironstone or mudstone (Queensland Herbarium, 2007). This is a very distinctive species and was not identified in the study area and is therefore considered unlikely to occur in the study area.

Marlborough Blue occurs on hills and slopes in open eucalypt forests between 80 and 400 m in elevation on a range of soils but appears to grow best on red clay soils derived from serpentinite (DAWE, 2022d; Melzer et al., 2007). This is a very distinctive species and was not identified in the study area and is therefore considered unlikely to occur in the study area.

Black Ironbox occurs on the banks of rivers, creeks and moderate sized watercourses and is therefore unlikely to occur in the study area due to the lack of watercourses.

Dicanthium setosum occurs on heavy basaltic black soils and red-brown loams with clay subsoil and can occur in cleared woodland, grassy roadsides and pasture (DAWE 2022). This species is considered unlikely to occur on the site due to the lack of nearby records and suitable soil types.

3.2. Fauna

3.2.1. Habitat Value

The site and surrounds have been substantially altered from the original, pre-European condition when the area would have supported dry sclerophyll open forest. While the response of native fauna to such changes in habitat are variable, clearing and fragmentation of habitat result in significant changes to faunal abundance and species diversity. Such modified habitats tend to be dominated by the few species that are best able to exploit such habitats such as the Noisy Miner (*Manorina melanocephala*), Australian Magpie (*Gymnorhina tibicen*) and Willie Wagtail (*Rhipidura leucophrys*). Species that are dependent on more intact habitats are prone to local extinction.

The habitat value of the of the site is considered moderate due to the degree of historic disturbance and lack of habitat elements such as large fallen timber and hollow bearing trees. The fencing and urbanisation of the surrounding area would also limit the ability for many terrestrial vertebrates to move in to and out of the site.

3.2.2. Amphibians

The Wildlife Online search indicated that 15 species of amphibian have been recorded from the search area, none of which are listed as threatened or near threatened under the NC Act or EPBC Act. The introduced Cane Toad (**Rhinella marina*) has also been recorded from the search area.

The EPBC Act PMST database indicates that no amphibian species listed under the EPBC Act are likely to occur within the search area.

The only amphibian speices recorded from the study area during the site assessment was the Cane Toad. The small drainage lines in the study area are likely to support common species that are adapted to modified environments such as the Common Green Treefrog (*Litoria caerulea*) and Ruddy Treefrog (*Litoria rubella*).

3.2.3. Reptiles

Habitat quality for reptiles is strongly influenced by attributes such as leaf litter, fallen logs and debris. The loss of these habitat elements very often occurs in disturbed environments such as those present on the site and often leads to a reduction in diversity and abundance of reptiles.

The Wildlife Online search indicates that 47 species of terrestrial reptile have previously been recorded from the search area excluding marine turtles. No terrestrial reptile species are listed as threatened or near threatened under the NC Act or EPBC Act.

The EPBC Act PMST database indicates that the search area may provide potential habitat for the Vulnerable Collared Delma (*Delma torquata*), Yakka Skink (*Egernia rugosa*), Dunmall's Snake (*Furina dunmalli*) and Endangered Grey Snake (*Hemiaspis damelii*).

Collared Delma has been recorded from a number of disturbed habitats in southeast Queensland, found under rocks, logs and other ground cover (Cogger 2014). The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter typically 30-100 mm thick) appear to be essential characteristics of

Collared Delma microhabitat (DCCEEW, 2022g). This species is considered unlikely to occur in the study area due to the lack of suitable microhabitat.

The Yakka Skink occurs in woodland and open forest habitats, wet/dry sclerophyll forest and ecotonal rainforest habitats and is commonly found in cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows (Wilson, 2005; Cogger, 2000; DCCEEW, 2022i). This species is considered unlikely to occur within the study area due to the lack of rocky areas or areas with abundant fallen timber to provide suitable habitat and there are no records of this species within 50 km of the study area.

Dunmall's Snake is typically associated with forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other *Acacia* species, native Cypress (*Callitris* spp) or Bulloak (*Allocasuarina luehmannii*). It is also known from Spotted Gum, Narrow-leaved Ironbark and Silver-leaved Ironbark, White Cypress Pine (*Callitris glaucophylla*) and Bulloak open forest and woodland associations on sandstone derived soils (DoEE 2018d). Although vegetation assemblages and underlying geology may be suitable for this species, it is not known from the region as there are very few recent records within 50 km of the study area

The Grey Snake occurs in Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) woodland on heavy, dark brown to black cracking clay soils, often in association with water bodies, areas with small gullies and ditches, and floodplain environments; as well as Queensland Bluegrass (*Dichanthium sericeum*) and/or Mitchell Grass (*Astrebla* spp.) grassland on alluvial plains with cracking clay soils (DCCEEW, 2022c). This speices is considered unlikely to occur in the study area due to the lack of suitable habitat.

The site may support populations of a range of common urban species such as the Garden Skink (*Lampropholis delicata*), Elegant Snake-eye Skink (*Cryptoblepharus pulcher*) and Tommy Roundhead (*Diporiphora australis*).

3.2.4. Birds

Wildlife Online data indicates that 254 bird species have been recorded within the search area, including 5 introduced species.

The vegetation in the study area provides some habitat for bird species. However, the site is likely to be suitable for the more common, disturbance tolerant species such as Noisy Miner (*Manorina melanocephala*), Torresion Crow (*Corvus orru*), Australian Magpie (*Cracticus tibicen*), Laughing Kookaburra (*Dacelo novaeguineae*) and Rainbow Lorikeet (*Trichoglossus moluccanus*), as evidenced by the numerous Wildlife Online records for each of these species and their presence during the site inspection.

The Wildlife Online and EPBC Act PMST databases include a number of records for wetland, oceanic and shorebird bird species, many of which are either listed as threatened (NC Act and EPBC Act), special least concern (NC Act) and/or migratory within the search area. As the site does not support or adjoin any marine or wetland habitat, migratory shorebirds and wetland species will not be considered further.

There are Wildlife Online records for four threatened bird species:

- Red Goshawk - vulnerable (NC Act & EPBC Act)

- White-throated Needletail – vulnerable (NC Act & EPBC Act)
- Glossy-black Cockatoo (*Calyptorhynchus lathami lathami*) – vulnerable (NC Act & EPBC Act)
- Black-breasted Button-quail (*Turnix melanogaster*) - vulnerable (NC Act & EPBC Act

The Red Goshawk is considered unlikely to occur within the study area as large remnant forest mosaics are not present in close proximity to the study area due to the built up nature of the Tannum Sands region. There are no recent records of this species within 25 km of the study area.

The White-throated Needletail is almost exclusively aerial and therefore the site is unlikely to be on any particular significance for this species.

The Glossy Black-cockatoo occurs in eucalypt woodlands with an understorey or sub-canopy of She-oaks (*Casuarina* or *Allocasuarina* spp.) on the seeds of which its diet is based (Garnett et al. 2011). This species is an obligate hollow nester, Glossy Black-cockatoos require large old trees (living or dead), usually eucalypts, for breeding (Garnett et al. 2011). The study area supports very low numbers of she-oaks and no hollow bearing trees. Therefore this species is considered unlikely to occur in the study area.

The Black-breasted Button-quail is known from coastal habitats in the region. However, the species prefers large areas of vine thicket or rainforest habitat with extensive deep litter, which is absent from the study area. In addition, no evidence in the form of platelets (shallow disks), were identified during the fauna assessment. Therefore this species is considered unlikely to occur within the study area.

The EPBC Act PMST database search also indicated the potential presence of the following additional species from the search area:

- Coxen's Fig Parrot (*Cyclopsitta diophthalma coxeni*) – endangered (NC Act & EPBC Act)
- Grey Falcon (*Falco hypoleucos*) - vulnerable (NC Act & EPBC Act)
- Squatter Pigeon (*Geophaps scripta scripta*) – vulnerable (NC Act & EPBC Act)
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*) - endangered (NC Act & EPBC Act)

Coxen's Fig Parrot typically occupies subtropical rainforest, dry rainforest, littoral and developing littoral rainforest, and vine forest. Within these rainforest habitats, this species is likely to favour alluvial areas that support figs and other trees with fleshy fruits (DAWE 2021i). The study area does not support any rainforest habitat and fig trees were not present. It is considered unlikely that this species would use habitat within the study area.

The Grey Falcon occurs in low densities across arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia (Marchant and Higgins 1993; TSSC 2019). It may periodically migrate to suitable habitat closer to coast when wet years in arid and semi-arid areas are followed by drought. The Grey Falcon is typically associated with timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined water courses (Marchant and Higgins 1993; TSSC 2019). It is considered unlikely that this

species would occur in the study area given the lack of suitable habitat and that it is only a rare vagrant visitor to more coastal areas.

The Squatter Pigeon is known from tropical dry, open sclerophyll woodlands and sometimes savanna (DoEE 2017c). It appears to favour sandy soil dissected with low gravely ridges and is less common on heavier soils with dense grass cover. It is nearly always found in close association with permanent water (DoEE 2017c). This species may occur as an occasional visitor to the region but is considered unlikely to occur in the study area due to the degree of disturbance to the vegetation present and lack of nearby records.

The Star Finch usually inhabits low dense damp grasslands bordering wetlands and waterways and also open savannah woodlands near water or subject to inundation but can also occur in some woodland (*Eucalyptus coolabah*, *E. tereticornis*, *E. tessellaris*, *Melaleuca leucadendra*, *E. camaldulensis* and *Casuarina cunninghamii*) and suburban areas (Higgins et. al. 2006, DCCEEW, 2022u). This species is considered unlikely to occur in the study area due to a lack of suitable habitat and that this species has undergone a significant range contraction and it has not been recorded in the region for quite some time.

The Wildlife Online and EPBC Act PMST database search also identify a number of terrestrial bird species listed as migratory under the EPBC Act and special least concern (SLC) under the NC Act from the search area, namely:

- Eastern Osprey (*Pandion cristatus*)
- Fork-tailed Swift (*Apus pacificus*)
- Oriental Cuckoo (*Cuculus optatus*)
- Black-faced Monarch (*Monarcha melanopsis*)
- Spectacled Monarch (*Monarcha trivirgatus*)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Yellow Wagtail (*Motacilla flava*)
- Rufous Fantail (*Rhipidura rufifrons*).

The likelihood of these species occurring on site is discussed below.

The Eastern Osprey occurs in littoral and coastal habitats and terrestrial wetlands and is therefore considered unlikely to occur within the study area due to the lack of these habitats. It may occasionally overfly the study area due to the proximity of the Boyne River.

The Fork-tailed Swift does not breed while in Australia and forages aerially over open forest, woodland and more open areas (DoEE 2018e). This species may over fly the site as part of broader movements throughout the locality.

The Black-faced Monarch, Spectacled Monarch, Satin Flycatcher and Rufus fantail are all forest dependant species typically occurring in more densely vegetated forests including rainforest, wet sclerophyll and mangroves (DoEE 2018g–i; Morcombe and Stewart 2013). These species may occur in the more densely vegetated southern portion of the site from time to time.

The Oriental Cuckoo occurs in monsoonal rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands (DotE, 2015). The study area provides marginal quality potential habitat for this species although there are

few records of the species from the region. It is therefore considered unlikely to occur in the study area.

The Yellow Wagtail is a non-breeding vagrant in Queensland mostly occurring in well-watered open grasslands and the fringes of wetlands. It roosts in mangrove and other dense vegetation (DotE 2015). This species is considered unlikely to occur on the site due to a lack of suitable habitat.

3.2.5. Mammals

Wildlife Online data indicates that 36 species of mammal are known from the search area including 5 introduced species. There are two records of the Koala (*Phascolarctos cinereus*) from the search area. The Koala is listed as endangered under the NC Act and EPBC Act.

The Short-beaked Echidna (*Tachyglossus aculeatus*) is listed as SLC under the NC Act and has also been recorded within the search area.

The EPBC Act PMST database indicates the potential presence of six additional threatened mammal species within the search area. These are:

- Northern Quoll (*Dasyurus hallucatus*) – endangered (EPBC Act)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – vulnerable (NC Act & EPBC Act)
- Ghost Bat (*Macroderma gigas*) – vulnerable (EPBC Act), endangered (NC Act)
- Greater Glider (southern and central) (*Petauroides volans*) – endangered (NC Act & EPBC Act)
- Yellow-bellied Glider (south-eastern) (*Petaurus australis australis*) – vulnerable (NC Act & EPBC Act)
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – vulnerable (EPBC Act).

The Koala is known from the broader region, although there are only one or two recent records from within 25 km of the study area and no evidence of this species in the form of scats or scratches was observed within the study area during the field assessment.

There is potentially suitable habitat for the Koala in the form of feed trees within the study area and to the south-east, into which this species could disperse from the west. However, there are a number of potential barriers between the study area and occupied habitats to the west, including cleared transmission line easements, the Bruce Highway and the Boyne River. Nonetheless, use of the study area by Koalas cannot be ruled out, although it is unlikely to be important habitat for this species due to the limited availability of habitat trees, urban pressures surrounding the study area and lack of refuge habitat.

The Northern Quoll is usually associated with dissected rocky escarpments but also known from eucalypt forest and woodlands, around human settlement and occasionally rainforest (DoEE 2018j). Populations of the Northern Quoll have declined significantly since the introduction of the Cane Toad. This species is unlikely to occur in the study area due to a lack of suitable habitat and the degree of urbanisation in the surrounding area.

Several species of microchiropteran bat have been recorded from the Wildlife Online search area, and the study area is likely to provide some foraging habitat for these species. The study area and surrounds does not contain caves or culverts to provide roosting habitat for subterranean roosting species such as the Large-eared Pied Bat and Ghost Bat and they are therefore considered unlikely to occur.

The Grey-headed Flying Fox has not been recorded from the search area. This species may forage on blossoming and fruiting trees on the study area. However, it is considered unlikely to roost on the study area due to the lack of suitable roost habitat. Roost habitat for the Grey-headed Flying Fox is typically rainforest patches, stands of *Melaleuca*, mangroves and riparian vegetation located near water.

The Greater Glider occurs in a range of eucalypt-dominated habitats, including low open forests on the coast to tall forests in the ranges and low woodland westwards of the Dividing Range (TSSC 2016). It does not use rainforest habitats (TSSC 2016). This species favours taller, montane, moist eucalypt forests with relatively old trees and abundant hollows and a diversity of eucalypt species (TSSC 2016). This species is unlikely to occur in the study area due to the lack of mature hollow bearing trees.

The Yellow-bellied Glider occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests with a preference for large patches of mature old growth forest that provide suitable trees for foraging and shelter and forests with a high proportion of winter-flowering and smooth-barked eucalypts. The presence of living, large (i.e. at least 50 cm in diameter), old hollow-bearing trees is a critical habitat feature for this species (DAWE 2022). This species is considered unlikely to occur in the study area due to the lack of hollow bearing trees and fragmentation of habitat.

The Short-beaked Echidna can occur in a wide variety of habitats providing there is an abundant supply of ants and/or termites (van Dyck and Strahan 2008), however, termites are considered to be largely absent from highly urbanised areas where control measures are widely adopted. No large termite nests or ant mounds were noted during the site assessment and the study area has little course woody debris to support termites. Given the disturbed nature of the study area, urbanised context and lack of food and shelter resources, the Short-beaked Echidna is considered unlikely to occur in the study area.

3.3. Conservation Significance

3.3.1. Corridor Values

The maintenance of landscape connectivity between patches of habitat is a fundamental aspect of conservation ecology (Endler 1977; Forman 1995). Habitat corridors are often recommended to maintain and/or enhance landscape connectivity (Bennett 1998; Lindemayer 1998).

The study area is located in a largely urbanised setting. Residential development is located to the north, west and south of the study area. A large tract of native vegetation is located to the east but is separated from the patch of vegetation that the study area forms the majority of by Tannum Sands Road. The study area essentially is at the dead end of native vegetation in the area with the urban areas of Tannum Sands location to the north, west and south and Boyne Island further west beyond the Boyne River. It is possible that the study area may be used as

part of a stepping stone corridor by highly mobile fauna such as birds and bats to move between the areas of native vegetation to the east of the study area and native vegetation to the west of Boyne Island. However this is considered to be unlikely given that such movements would require fauna to cross more than a kilometre of urban area. Therefore, the study area is considered unlikely to play a substantial role in maintain habitat connectivity in the broader area.

3.3.2. Ecological Value

In summary, vegetation in the study area has been historically disturbed and modified from its natural state. Floral composition and complexity is a primary factor in the presence of wildlife in disturbed habitats. Reduced canopy cover, understorey and regeneration have a profound effect on the utilisation of habitat by native wildlife. Reduced habitat complexity has been shown to have a major influence on vertebrate faunal assemblages including mammals, birds, reptiles and amphibians (Catling et al 2000; Green & Caterall 1998, Singh et al 2002; Parris 2002).

Therefore, the study area is considered to have a low to moderate ecological value due to a history of vegetation disturbance, landform modification and urbanisation of the surrounding areas. The study area is most likely to be used by cosmopolitan species suited to using modified urban environments. Further the study area has low connectivity values and may be used as stepping-stone habitat by only the most highly mobile fauna species. It is possible that the Koala may occur in the study area at times but this is likely to be very infrequent. The study area is unlikely to provide habitat critical to the survival of any threatened, near threatened or migratory fauna species.

4. Implications

It is proposed to construct the aquatic recreation centre that would result in the removal of approximately 1.7 ha of native vegetation with 8.2 ha of vegetation being retained. This vegetation is considered unlikely to provide habitat for any threatened or near-threatened flora species and is not representative of any threatened ecological communities.

The only threatened fauna species that are considered to potentially occur within the study area are the Koala and the White–throated Needletail. The White-throated Needle-tail is likely to only overfly the study area and therefore the proposed aquatic centre is considered highly unlikely to impact this species.

The Koala may occur in the study area at times, although the study area is considered unlikely to support any resident Koalas and the habitat is considered to be of marginal quality due to the low number of mature trees and degree of urbanization of the surrounding area. A separate report addressing Matters of National Environmental Significance (MNES) is being prepared for the EPBC Act assessment process. In the case of matters that are prescribed as being both MNES and MSES, offsets are not required under the Queensland EO Act if the same, or substantially the same, impact to the prescribed matter has been assessed under the EPBC Act.

The study area is mapped as supporting remnant vegetation (Figure 4). However, the construction of the proposed aquatic centre is considered to be exempt under Schedule 21 of the *Planning Act 2017* as the aquatic centre constitutes an urban purpose and the Emerging Community designation is considered to constitute an urban area.

The Biodiversity Overlay Code mapping indicates has mapped a small drainage line in the north of the study area as a matter of state significance (MSES) intersecting a watercourse and an area in the north-east is mapped as MSES – Wildlife Habitat (Figure 5). However as indicated on Figure 5 the proposed development footprint for the aquatic centre is located some distance from these mapped features and it is considered unlikely that they would be impacted. An assessment against the Council Biodiversity Code is provided in Appendix A.

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Appendix A

Assessment Against Codes

Table A1: Gladstone Regional council Biodiversity Code

Performance outcomes	Acceptable outcomes	Response
Environmental protection and buffering		
PO1 Development maintains and protects MNES (Matters of National Environmental Significance) and MSES (Matters of State Environmental Significance) by: a. locating in areas that avoid adverse impacts on MNES and MSES, or b. where adverse environmental impacts cannot be avoided, impacts are minimised and an environmental offset is provided for any residual adverse impacts, and c. the underlying ecological processes and biodiversity values of MNES and MSES are maintained or enhanced. Note—For MNES, consideration must be given to the requirements of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Note—To assist in demonstrating achievement of this performance outcome, a detailed environmental and ecological assessment to confirm the extent and nature of values is required to be undertaken by applicants.	**AO1** Development locates outside of an area supporting MSES (Matters of State Environmental Significance).	The proposed aquatic centre is located outside of the mapped MSES. Assessment of impacts to the Koala will be made by the Commonwealth under the EPBC Act. No other MNES are considered to have the potential to be significantly impacted.
PO2 Development is setback from and provides an adequate vegetated buffer to significant vegetation, habitats and areas containing MSES in order to: a. protect these areas and their values from threatening processes b. avoid edge effects such as undesirable microclimate effects and threats from non–native or pest fauna or flora, and c. maintain and enhance ecological connectivity.	**AO2** A buffer extending from the outside edge of an area of MSES is provided and has a minimum width of: a. 200m where located outside an urban area, or b. 50m where located within an urban area.	The proposed aquatic centre footprint is located more than 50 m from the mapped area of MSES wildlife habitat and MSES regulated vegetation (intersecting a watercourse).

Performance outcomes	Acceptable outcomes	Response
Note—Any setbacks or other areas required for bushfire management, safety, recreation, maintenance or any other purpose are provided in addition to a vegetated buffer provided for ecological and environmental protection purposes. Note—An alternative buffer width may be proposed where buffers for significant species and ecological communities, including areas of habitat for listed threatened and migratory species, are based on best practice and current scientific knowledge of individual species requirements and supported by an ecological assessment. Other legislation, including the Nature Conservation Act and EPBC Act may establish other requirements with which applicants must comply.		
PO3 Development within 500m of turtle nesting beaches is located, designed and operated to: a. protect the habitat values of the rookery for turtle breeding b. maintain a vegetated buffer adjacent to the beach c. ensure access to the beach nesting area is managed in a way that protects a turtle nesting area, and d. ensure lighting does not impact on the ecological and habitat values of turtle nesting areas and rookery.	**AO3.1** Development within 500m of a turtle nesting beach ensures any lighting: a. does not spill onto beach areas b. is on a structure no higher than 8.5m c. is directed away from the beach, and d. includes characteristic wavelengths that will not affect turtles.	The study area is located more than 500m from the coastline.
	AO3.2 Development is setback from and maintains at least a 200m wide vegetated buffer to turtle nesting beaches. The buffer is maintained in a natural state and is kept free from development.	The study area is located more than 500m from the coastline.
Wetland and waterway buffers		
PO4 An adequate buffer to a wetland in a wetland protection area is provided and maintained to: a. protect and enhance habitat values, connectivity and other ecological processes and values	**AO4** A development free buffer surrounding a wetland in a wetland protection area is provided and has a minimum width of: a. 200m where the wetland is located outside an urban area, or	There are no wetlands located within or adjacent to the study area.

Performance outcomes	Acceptable outcomes	Response
b. protect water quality and aquatic conditions c. maintain natural micro–climatic conditions d. maintain natural hydrological processes e. prevent mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding, and f. prevent loss or modification of chemical, physical or biological properties or functions of soil. Note—Any setbacks or areas required for bushfire management, safety, recreation, maintenance or any other purpose, are provided in addition to a vegetated buffer provided for ecological purposes.	b. 50m where the wetland is located within an urban area. Note—To avoid conflict, where a development requires multiple buffers to be established by this code to protect waterways, ecological corridors, wetlands or MSES, the greatest distances required by this code will prevail to the extent of any inconsistency.	
For all assessable development		
PO5 Alterations to natural landforms, hydrology and drainage patterns do not adversely impact on areas containing MSES.	No acceptable outcome is nominated.	The proposed works to construct the aquatic centre are considered unlike to impact on an areas of MSES. The aquatic centre is located greater than 50 m from the identified waterway and sediment and erosion management measures will be employed to avoid sediment impacts.
PO6 Development retains and enhances riparian vegetation along watercourses and drainage corridors, and vegetation along timbered ridgelines.	No acceptable outcome is nominated.	No disturbance of the watercourse mapped on the site is proposed. Following an options analysis the proposed aquatic centre has been proposed to be located near the crest of a low gently undulating rise.
PO7 Buffering, rehabilitation or restoration, protects and enhances MSES and their underlying ecological processes, habitat and biodiversity values by: a. using site appropriate and locally occurring native species	No acceptable outcome is nominated.	Landscaping of the proposed aquatic centre will utilise native species where appropriate. No rehabilitation or restoration is proposed.

Performance outcomes	Acceptable outcomes	Response
b. replicating as far as practicable, the species composition and structural components of healthy remnant vegetation and associated habitats, including understorey vegetation, and c. excluding environmental weeds, declared plants and other non–native plants likely to displace native flora or fauna species or degrade habitat. Note—To assist in demonstrating achievement of this performance outcome, an ecological assessment and rehabilitation plan is undertaken by the applicant.		
PO8 Degraded areas supporting MSES or other environmental values important to the maintenance of underlying ecological processes required to maintain biodiversity, are rehabilitated as near as is practical to the naturally occurring state of native plant species and ecological communities.	No acceptable outcome is nominated.	The vegetation within the portion of the study area outside of the proposed aquatic centre footprint is proposed to be retained and will continue to regenerate naturally.
PO9 Development: a. avoids the introduction of pest species (plant or animal) that pose a risk to the ecological integrity and biodiversity values of MSES, and b. includes appropriate pest management practices to control any existing threat of pest species in a way that provides for the long term ecological integrity of MSES.	No acceptable outcome is nominated.	A number of environmental weed species are present within the study area. To prevent the introduction of new species all earthmoving equipment should be thoroughly washed down prior to entry to the construction site.
Significant species, wildlife nesting and breeding areas		
PO10 Development avoids direct and indirect impacts on significant ecological communities and significant	No acceptable outcome is nominated.	The only significant species or community potentially present in the study area is the Koala. Impacts to the Koala are to be

Performance outcomes	Acceptable outcomes	Response
species and their habitats, including disturbance from the presence of vehicles, pedestrian use, increased exposure to domestic animals and noise and lighting impacts. Note—To assist in demonstrating achievement of this performance outcome, a detailed environmental and ecological assessment to identify any significant species or communities that may be impacted by development, is undertaken by applicants.		assessed under the EPBC Act. The White-throated Needletail may occasionally overfly the study area but is not considered to use the habitat present.
PO11 Areas of habitat that support a critical life cycle stage such as feeding, breeding or roosting or ecological function for threatened species, ecological communities or migratory species are protected and not impacted by development.	No acceptable outcome is nominated.	The only threatened species potentially present in the study area is the Koala. Impacts to the Koala are to be assessed under the EPBC Act. The White-throated Needletail may occasionally overfly the study area but is not considered to use the habitat present.
Ecological corridors		
PO12 Development protects ecological corridors, enhances ecological connectivity to habitats on and/or adjacent to the site. Ecological corridors and habitat linkages have dimensions and characteristics to support: a. ecological processes and functions that enable the natural change in distributions of species and provide connectivity between populations of species over long periods of time b. ecological responses to climate change c. connectivity between large tracts and patches of remnant vegetation, habitat areas and areas supporting MNES and MSES, and	**AO12.1** Development does not occur in an ecological corridor.	The study area essentially is at the dead end of native vegetation in the area with the urban areas of Tannum Sands location to the north, west and south and Boyne Island further west beyond the Boyne River. It is possible that the study area may be used as part of a stepping stone corridor by highly mobile fauna such as birds and bats to move between the areas of native vegetation to the east of the study area and native vegetation to the west of Boyne Island. However this is considered to be unlikely given that such movements would require fauna to cross more than a

Performance outcomes	Acceptable outcomes	Response
d. effective and unhindered day–to–day and seasonal movement of avian, terrestrial and aquatic fauna.		kilometre of urban area. Therefore, the study area is considered unlikely to play a substantial role in maintain habitat connectivity in the broader area.
	AO12.2 No acceptable solution is nominated where in an urban residential zone or centre zone. In all other zones including the Rural Zone, Environmental Management Zone, Conservation Zone, all Industry Zones, Emerging Community Zone and Limited Development Zone: Where an ecological corridor is intended to facilitate fauna movement, access or use of an area supporting MNES or MSES, the ecological corridor is maintained and restored to achieve a minimum width of 350m consisting of: a. a 250m wide core corridor to support avian species and most arboreal mammals, and b. a 50m wide vegetated buffer extending from the outside edges on both sides of the core corridor.	The location of the aquatic centre at the frontage with Coronation Drive will minimise fragmentation of the vegetation within the study area and help to maintain any small role the vegetation in the study area may play in providing landscape connectivity.
PO13 Isolated habitat areas are linked by a continuous corridor to provide effective ecological connectivity and to create additional linkages along waterways, wetlands, drainage lines, ridgelines, coastlines and other areas where possible.	**AO13** Development provides a continuous corridor having a minimum width of 100m linking areas of protected vegetation to each other and other vegetation areas off–site.	There is limited scope to increase habitat connectivity for the study area due to the existing urban development and roads that surround the study area. Within the study area approximately 8.2 ha of vegetation will be retained. The location of the aquatic centre at the frontage with Coronation Drive will minimise fragmentation of the vegetation within the study area and help to maintain any small role the vegetation in the study area may play in providing landscape connectivity.

Performance outcomes	Acceptable outcomes	Response
PO14 Development facilitates the unimpeded use and movement of terrestrial and aquatic fauna accessing the site or likely to use an ecological corridor as part of their normal life cycle by: a. ensuring that development (e.g. roads, pedestrian access, in–stream structures) during both construction and operation does not create barriers to the movement of fauna along or within ecological corridors b. providing wildlife movement infrastructure where necessary and directing fauna to locations where wildlife movement infrastructure has been provided to enable fauna to safely negotiate a development area, and c. separating fauna from potential hazards through the use of appropriate barriers, fencing and buffers.	No acceptable outcome is nominated.	The proposed development of the aquatic centre will maintain the existing level of connectivity to the vegetation to the east of Tannum Sands Road.
Monitoring		
PO15 During construction and operation of development, ongoing management, monitoring and maintenance is undertaken to ensure impacts on areas supporting MNES or MSES and their underlying ecological processes and biodiversity values are avoided or minimised. Note—Compliance with this requirement can be achieved by preparing a Monitoring and Remediation Plan in accordance with best practice. Where necessary, remedial action is identified and carried out on land managed by the entity carrying out the development.	No acceptable outcome is nominated.	A registered spotter catch will be required to be on site during all vegetation clearing operations to ensure that no Koalas are present during clearing operations and to monitor the vegetation clearing process to ensure impacts to fauna are minimised.
Environmental offsets		
PO16 Where it is not possible to avoid adverse impacts on MSES and development has minimised adverse	No acceptable outcome is nominated.	The only MSES potentially impacted by the proposed aquatic centre is the Koala. Impacts and any offset that may be required

Performance outcomes	Acceptable outcomes	Response
impacts to the greatest extent possible, development provides an offset for any significant residual impact in accordance with the Queensland Environmental Offset Policy 2014.		will be assessed and conditioned under the Commonwealth EPBC Act.
Wetland protection area		
PO17 Development is not carried out in a wetland in a wetland protection area, unless there are no feasible alternatives.	**AO17.1** Development is not carried out: a. in a wetland in a wetland protection area, or b. within an alternative mapped boundary of a wetland in a wetland protection area, as shown in a site assessment prepared in accordance with the Department of Environment and Heritage Protection Queensland Wetland Definition and Delineation Guidelines (or current version). OR **AO17.2** Where AO17.1 cannot be achieved, development is to comply with PO17 – PO26. OR **AO17.3** Where AO17.1 or AO17.2 cannot be complied with, an environmental offset as described in PO27, is provided.	There are no wetlands located within or adjacent to the study area
Wetland and waterway buffers		
PO18 An adequate buffer to a waterway is provided and maintained to: a. protect and enhance habitat values, connectivity and other ecological processes and values	No acceptable solution is nominated where in an urban residential zone or centre zone. **AO18** In all other zones including the Rural Zone, Environmental Management Zone, Conservation Zone, all Industry Zones, Industry Investigation Zone, Emerging Community Zone and Limited	

Performance outcomes	Acceptable outcomes	Response
b. protect water quality and aquatic conditions c. maintain natural micro–climatic conditions d. maintain natural hydrological processes e. prevent mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion or scalding, and f. prevent loss or modification of chemical, physical or biological properties or functions of soil. Note—Any setbacks or areas required for bushfire management, safety, recreation, maintenance or any other purpose, are provided in addition to a vegetated buffer provided for ecological purposes.	Development Zone: Other than where cropping for forestry for wood production, a vegetated and development free buffer is provided and maintained extending from the high bank of the waterway or plan position of a waterway (whichever is the greater) and with a minimum width of: a. stream order 1 or 2: 25m, or b. stream order 3 or 4: 50m, or c. stream order 5 and above: 100m. Note—Stream order is mapped on Fish habitat area mapping in OM.	
Wetland hydrology and stormwater management		
PO19 The existing surface water hydrological regime of the wetland protection area (including the area of the wetland) is enhanced or maintained. Note—The hydrological regime of surface waters includes: • peak flows • volume of flows • duration of flows • frequency of flows • seasonality of flows • water depth (seasonal average) • wetting and drying cycle.	**AO19.1** Development must: 1. provide a net ecological benefit and improvement to the environmental values and functioning of a wetland in a wetland protection area, or 2. rehabilitate the existing hydrological regime, or restore the natural hydrological regime of a wetland in a wetland protection area. OR **AO19.2** If the development cannot enhance existing values in accordance with AO19.1, development does not change the existing surface water hydrological regime of a wetland in a wetland protection area, including through channelisation, redirection or interruption of flows. OR	There are no wetlands located within or adjacent to the study area

Performance outcomes	Acceptable outcomes	Response
	AO19.3 If AO19.1 or AO19.2 cannot be complied with, the extent of any change to the existing surface water hydrological regime is minimised to ensure the wetland values and functioning are protected. The change is minimised if, at least: 1. there is no change to the reference high–flow duration and low–flow duration frequency curves, low–flow spells frequency curve and mean annual flow to, and from, the wetland 2. any relevant stream flows into the wetland comply with relevant environmental flow objectives (EFOs) of the applicable water resource plan under the *Water Act 2000* for the area 3. for development resulting in an increase to the velocity or volume of stormwater flows into the wetland – the collection and reuse of stormwater occurs in accordance with (a) and (b).	
PO20 The existing groundwater hydrological regime of the wetland protection area (including the area of the wetland) is enhanced or protected.	**AO20.1** The water table and hydrostatic pressure in the wetland protection area are returned to their natural state. OR **AO20.2** If AO20.1 cannot be complied with: 1. the water table and hydrostatic pressure within the wetland protection area is not lowered or raised outside the bounds of variability under pre–development conditions, and 2. the ingress of saline water into freshwater aquifers is prevented.	There are no wetlands located within or adjacent to the study area

Performance outcomes	Acceptable outcomes	Response
	Note—Groundwater modelling is recommended where groundwater hydrology for a wetland in a wetland protection area represents a significant environmental constraint for, and interference is proposed by, the proposed development.	
PO21 During construction and operation of development in a wetland in a wetland protection area: 1. the wetland is not used for stormwater treatment, and 2. the buffer and water quality values of the wetland are protected from stormwater impacts.	**AO21** Development does not result in any measurable change to the quantity or quality of stormwater entering a wetland in a wetland protection area during construction and operation. Note—Measurable Change is to be determined by comparing the overall development impact with existing baseline (pre–development) conditions, and should not exceed reference environmental values or be inconsistent with water quality objectives provided under the Environmental Protection (Water) Policy 2009, the Urban Stormwater Quality Planning Guidelines 2010, or other relevant supporting technical reference documents as outlined in the guidelines.	There are no wetlands located within or adjacent to the study area
Wetland ecological values		
PO22 Development involving the clearing of vegetation protects the biodiversity, ecological values and processes, and hydrological functioning of a wetland in a wetland protection area, including: 1. water quality values 2. aquatic habitat values 3. terrestrial habitat values 4. usage of the site by native wetland fauna species or communities.	**AO22** Vegetation clearing undertaken as a consequence of development does not occur in: 1. a wetland in a wetland protection area, or 2. a buffer area for a wetland as described in PO18.	There are no wetlands located within or adjacent to the study area
PO23 Development avoids land degradation in a wetland protection area, including:	**AO23.1** Development is not carried out in: 1. a wetland in a wetland protection area, or	There are no wetlands located within or adjacent to the study area

Performance outcomes	Acceptable outcomes	Response
1. mass soil movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding 2. loss or modification of chemical, physical or biological properties or functions of soils.	2. a buffer area for a wetland as described in PO18. OR **AO23.2** Based on the prevailing soil and slope characteristics for the development area, all reasonable and practical measures are implemented to establish development specific engineering designs and solutions for the horizontal and vertical alignment of infrastructure, so as to avoid land degradation in a wetland protection area. AND **AO23.3** Filling and excavation operations are carried out, and an erosion and sediment control plan is prepared, and implemented, to minimise land degradation in a wetland protection area.	
PO24 Development in a wetland protection area ensures that any existing ecological corridors are enhanced or protected and have dimensions and characteristics that will: 1. effectively link habitats on or adjacent to the site 2. facilitate the effective movement of terrestrial and aquatic fauna accessing or using a wetland as habitat.	**AO24.1** Development in a wetland protection area does not occur within an existing ecological corridor. OR **AO24.2** If AO24.1 cannot be complied with and an ecological corridor is required to facilitate fauna movement: 1. an alternative ecological corridor with an appropriate width is provided and maintained in accordance with the Wetland Rehabilitation Guidelines for the Great Barrier Reef Catchment, Department of Environment and Heritage, 2008, or 2. the design, construction and operation of development does not impede movement of fauna that may use, is likely to use or	There are no wetlands located within or adjacent to the study area

Performance outcomes	Acceptable outcomes	Response
	may move through a wetland in a wetland protection area as part of their normal life cycle.	
PO25 Development does not result in the introduction of non–native pest plants or animals that pose an increased risk to the ecological values, integrity and processes of a wetland in a wetland protection area. In particular: 1. pest dispersal prevention measures are provided in appropriate locations to manage the threat of pest species to a wetland in a wetland protection area, and 2. any pest dispersal prevention measures do not result in a barrier or hazard to the movement of wetland fauna in the wetland protection area.	**AO25.1** Existing non–native pest plants or animals are removed or their threat is controlled by adopting pest management practices that provide for the long–term function of a wetland in a wetland protection area. AND **AO25.2** Development does not result in the introduction of any non–native or pest species in a wetland in a wetland area.	There are no wetlands located within or adjacent to the study area
PO26 During construction and operation of development in a wetland protection area, wetland fauna are protected from impacts associated with noise, light or visual disturbance.	**AO26.1** Development in a wetland protection area does not result in noise, light or visual disturbance impacts on wetland fauna, during construction and operation. OR **AO26.2** Where AO26.1 cannot be complied with, an assessment of adverse impacts of the development in a wetland protection area on wetland fauna from the impacts of noise, light or visual disturbance is carried out by a qualified ecologist or equivalent, and recommendations for mitigation of these impacts are identified and implemented.	There are no wetlands located within or adjacent to the study area
Environmental offsets		
PO27	**AO27**	There are no wetlands located within or adjacent to the study area

Performance outcomes	Acceptable outcomes	Response
For development, where it is not possible to enhance existing values or avoid adverse effects or alternatively minimise adverse effects any remaining environmental impacts are offset in accordance with the Queensland Environmental Offset Policy 2014.	Where environmental offsets are required in this code, they must be provided in accordance with the Queensland Environmental Offset Policy 2014.	
Monitoring		
PO28 Development is monitored to ensure environmental values of a wetland in a wetland protection area are maintained.	**AO28.1** A monitoring plan for development construction is prepared and implemented to monitor the effects of development on the ecological and hydrological functioning of a wetland in a wetland protection area. AND **AO28.2** Remedial action is carried out on land managed by the entity carrying out the development, where monitoring determines that compliance with the acceptable outcomes is not achieving the relevant policy outcome.	There are no wetlands located within or adjacent to the study area

APPENDIX 8: BUSHFIRE MANAGEMENT ASSESSMENT

AP08

QUEENSLAND BUSHFIRE PLANNING

BUSHFIRE MANAGEMENT PLAN (BMP)

Property

Boyne Tannum Aquatic Recreation Centre
Lot 900 on SP152499

Prepared for: PSA Consulting Pty Ltd

December 2022 - V1

www.qldbushfireplanning.com.au

Disclaimer

This document has been prepared for the benefit of PSA Consulting Pty Ltd. This report is prepared for the benefit of the named client only. No third party may rely upon any advice or work done by Queensland Bushfire Planning (QBP) in relation to the services, including this report, except to the extent expressly agreed to in writing by QBP.

It is acknowledged and agreed that the site may be subject to a degree of bushfire hazard. The client acknowledges and agrees that QBP has not created or contributed to the creation of this hazard and the client indemnifies QBP for claims arising out of or result from a bushfire event except to the extent attributable to the negligence of QBP.

The client agrees that QBP shall have no liability in respect of any damage or loss incurred as a result of bushfire. Compliance with this report shall be the responsibility of the client and/or the land-owners. This disclaimer shall apply notwithstanding the report may be made available to the relevant Local Government Authority and other persons for an application for permission or approval to fulfill a legal requirement.

GLOSSARY OF TERMS AND ABBREVIATIONS

4WD	Four wheel drive
APZ	Asset Protection Zone - An area between an asset and a bushfire hazard where the bushfire fuel hazard has been reduced significantly to reduce the likely intensity of the any bushfire attack so that fire suppression and asset protection activities may be carried out.
AS3959	Australian Standard 3959-2018 - Construction of Buildings in Bushfire-prone Areas
Asset	Anything valued by the community that may be at risk of harm from bushfire, including people, house, crops, heritage buildings and places, infrastructure, the environment, businesses and forest resources.
BAL	Bushfire Attack Level as defined in AS3959 - A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire.
Bushfire attack	Attack by burning debris, radiant heat or flame generated by bushfire which might result in ignition and subsequent destruction of the building.
Bushfire catchment	The geographical area surrounding a community which a bushfire ignition is likely to impact on assets valued by the community.
Bushfire hazard area	An area where the combination of fuel load, fuel arrangement and topography under particular climatic and weather conditions has the potential to sustain a bushfire of sufficient severity to pose a risk to people, property or the environment. Bushfire hazards are variable in their severity with severity levels usually measured in terms of fire intensity (kW/m2) arising from the hazard.
Bushfire management	All activities directed to the prevention, detection, damage mitigation and suppression of bushfires and recovery after bushfire events. It includes bushfire policy, administration, law enforcement, community education, training of fire fighters, planning, communication systems, equipment, research, and the multitude of field operations undertaken by land managers and emergency service personnel relating to bushfire control and use of fire to meet land management goals and objectives.

Bushfire-prone area	An area that can support bushfire or is likely to be subject to bushfire attack due to its proximity to a bushfire hazard area.
Ember attack	Attack by smouldering or flaming windborne debris that is capable of entering or accumulating around a building and may ignite the building and other combustible materials and debris (eg garden mulch, pine fencing).
Emergency warning	An emergency warning is a message signalling an imminent hazard, which may include advice on protective measures. Emergency warnings in relation to bushfires are issued by QFES and are used to inform residents of threat to properties, time to impact, the direction and strength of the fire and of the steps residents must to take to survive. There are three National bushfire warning levels defined as follows: • ADVICE: indicates a fire or other emergency has started, however there is no immediate threat. • WATCH AND ACT: there is a heightened level of threat, you need to be aware of your situation and take action to be prepared and protect yourself and your family. • EMERGENCY WARNING: you are in danger.
Environment	The term environment includes: • Ecosystems and their constituent parts, including people and communities. • Natural and physical resources. • The qualities and characteristics of locations, places and areas. • Heritage value of places. • The social, economic and cultural aspects of a thing mentioned above.
FFDI	Forest Fire Danger Index (see also FDR) - A relative number denoting an evaluation if the fire rate of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed. The numbers range from 1 to 100.
FDR	Fire Danger Rating - A relative class denoting an evaluation of rate of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed indicating the relative evaluation of the fire danger. Ratings are low-moderate (FDI 0-11), high (FDI 12-24), very high (FDI 25-49), severe (FDI 50-74), extreme (FDI 75-99), catastrophic (FDI 100+).
Fine fuel	Fuels such as grass, leaves, bark and twigs (dead plant material less than 6mm and live plant material less than 3mm in diameter) that ignite readily and are burnt readily when dry.

Fire control line	A natural (such as a creek line) or constructed barrier (such as trail or mineral earth break), or treated fire edge used in fire suppression and prescribed burning to limit the spread of the fire.
Fire regime	The history of fire in a particular vegetation type or area including the frequency, intensity and season of burning. It may also include proposals for the use of fire in a given area.
Fuel	Any material such as grass, leaf litter, and live vegetation which can be ignited and sustains a bushfire. Fuel is usually measured in tonnes per hectare.
Fuel layer	The layering of fuels will influence fire behaviour.The five main fuel layers consist of surface fuel, near surface fuel, elevated fuel, bark fuel and canopy fuel.
GIS	Geographic Information System
LGA	Local Government Area
QFES	Queensland Fire and Emergency Services
Regional ecosystem	A grouping of vegetation classes with common ecological requirements for fire and common fire behaviour characteristics.
Residual Risk	The risk of adverse impacts from a bushfire after implementation of risk mitigation/management measures.
Risk	The likelihood of a bushfire igniting and developing to the point that it will threaten an asset and the resultant nature and magnitude of the social, economic and environmental consequences to the community or the assets they value.
Risk mitigation/management	A systematic process that provides a range of treatments which are designed to reduce bushfire risk and thereby contribute to the wellbeing of communities and the environment which may suffer the adverse impacts of bushfire.
ROS	Rate Of Spread
SPP Interactive Mapping System	The State Planning Policy (SPP) Interactive Mapping System, as amended from time to time, published by DLGIP and located at https://spp.dsdip.esriaustraliaonline.com.au/geoviewer/map/planmaking
Unacceptable risk	A situation where people or property are exposed to a predictable hazard event that may result in serious injury to, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation.

VHC	Vegetation Hazard Class (VHC) - based on the available bushfire fuel load typically associated with a particular vegetation type.
Water point	Any natural or constructed supply of water that is readily available for fire control operations.
Wildfire	Another term for a bushfire.

EXECUTIVE SUMMARY

Queensland Bushfire Planning has been engaged on behalf of PSA Consulting Pty Ltd to conduct a site-based Bushfire Hazard Assessment in relation to a proposed Boyne Tannum Aquatic Recreational Centre (BTARC)development at Lot 900 on SP152499. The BTARC facility is to be a contemporary community aquatic centre facility with the recreational functions and capability to host Swimming Australia local and regional events. The site is captured by the State Planning Policy Natural Hazards and Resilience - *Bushfire Prone Area* mapping and in accordance with the provisions of the Gladstone Regional Council Planning Scheme 2017 V2 - Bushfire Hazard Overlay Code, a detailed Bushfire Management Plan has been prepared. This report includes a number of recommendations regarding bushfire risk mitigation in accordance with AS3959-2018 and Gladstone Regional Council Planning Scheme 2017 V2.

As detailed in Section 5 the bushfire hazard and risk management measures that have been incorporated into the design of the proposed development, Boyne Tannum Aquatic Recreation Centre at Lot 900 on SP152499, combined with the implementation of the additional recommended measures during the construction and occupational phase of the development should ensure compliance with the Gladstone Regional Council Planning Scheme 2017 V2 - Bushfire Hazard Overlay Code.

The designed purpose of the BTARC will minimise exposure of people and property to the impacts of any bushfire event occurring on Lot 900 on SP152499. A fire event will be the result of localised, point ignition and not a large fire front moving onto Lot 900 on SP152499. The hardstand /parking areas and designed recreational spaces provide separation of infrastructure from the impact of radiant heat. The development and implementation of a specific Emergency Response Plan will address all risk factors on and about the BTARC.

In conclusion, the Boyne Tannum Aquatic Recreational Centre (BTARC) development at Lot 900 on SP152499 is a development associated with an acceptable level of risk with regards to people or property being exposed to harm in the event of a bushfire.

Recommendation
1. Ingress and egress for users and emergency services will be via constructed direct access to Coronation Drive.
2. Reticulated water will be provided to the reconfiguration to meet the required standards
3. Proposed buildings will be constructed to meet the requirements of the Australian Standard AS3959- 2018 - *Construction of buildings in bushfire prone areas.*
4. The vegetation on Boyne Tannum Aquatic Recreation Centre will be maintained in managed low hazard state.
5. Fencing on Boyne Tannum Aquatic Recreation Centre will be constructed of non – combustible materials.
6. An Emergency Management Plan will be developed for all occupants to inform them of the bushfire risks and their roles and responsibilities for prevention, preparedness and response to any fire event.

1. INTRODUCTION

This Bushfire Hazard Assessment (BHA) Report has been prepared on behalf of PSA Consulting Pty Ltd for the Boyne Tannum Aquatic Recreational Centre (BTARC) development at Lot 900 on SP152499. The focus of this Report refers to the statutory planning and building requirements as they may apply, pursuant to all relevant policies, standards and regulation, along with end-user consideration. In addition, this report seeks to ensure fire risk and evacuation for adjoining and nearby properties is not inadvertently adversely impacted. This assessment report aims to mitigate the risk to life and property from bushfire threat and the impact of bushfire attack which includes:

- Direct flame contact;
- Ember and firebrand attack;
- Radiant heat; and
- Fire-driven wind.

This Report provides:

- In Section 2 a description of the Boyne Tannum Aquatic Recreational Centre (BTARC) development.
- In Section 3 an assessment of the bushfire hazards and risks that will be present within the Boyne Tannum Aquatic Recreational Centre (BTARC) development pre and post completion.
- In Section 4 details concerning the bushfire hazard and risk management measures that have been incorporated into the Boyne Tannum Aquatic Recreational Centre (BTARC) development and additional measures that are recommended for implementation during the construction and occupational phases of the development.
- In Section 5 assessment of the level of compliance of Boyne Tannum Aquatic Recreational Centre (BTARC) development against the requirements of the Gladstone Regional Council Planning Scheme 2017 V2 - Bushfire Hazard Overlay Code.

This assessment does not seek to remove the threat of any bushfire risk, but provide detailed siting, layout, building and/or servicing information to assist the ability of the owner(s) to manage the potential threat of this risk. This assessment report is prepared in accordance with best practice industry standards as applicable in Queensland and pursuant to both State and local government bushfire hazard policies and guidelines.

1.1 Bushfire Regulatory Framework

1.1.1 State Planning Policy (SPP)

The SPP identifies the Queensland Government's policies about matters of state interest in land use planning and development (DILGP, July 2017). The SPP is a broad and comprehensive statutory planning instrument. It sits above regional plans, standard planning scheme provisions and local government planning schemes within the hierarchy of planning instruments outlined in the Planning Act 2016.

The SPP is supported by the following guidance material:

- The SPP state interest guidance material - Natural hazards, risk and resilience – Bushfire ('SPP guidance') (DSDMIP, 2019), which provides further context to the SPP and explains how the SPP policies can be applied, in particular for local government when making or amending local planning instruments. The SPP guidance is also intended to assist assessment managers and practitioners in applying the SPP assessment benchmarks when state interests have not been integrated into the local planning scheme (where applicable).
- The 'Bushfire Resilient Communities – Technical Reference Guide for the State Planning Policy State Interest - Natural Hazards, Risk and Resilience – Bushfire ('BRC technical document') (QFES, 2019), which provides technical guidance and policy positions of the Queensland Fire and Emergency Services (QFES). It includes procedures for undertaking a bushfire hazard assessment (BHA), calculating asset protection zones and preparing a Bushfire Management Plan.

1.1.2 Gladstone Regional Council Planning Scheme 2017

The Gladstone Regional Council Planning Scheme 2017 V2– A Bushfire Management Plan is required for any development located on land where the bushfire hazard is greater than 'low'. To demonstrate compliance with bushfire statutory requirements, this report has been developed in accordance with this planning scheme.

The purpose of a Bushfire management plan is to:

1. Confirm bushfire hazard exposure.
2. Direct where on a site development should be located to minimise exposure for people, property and buildings to bushfire hazard.
3. Determine measures to be utilised to reduce bushfire hazard.
4. Determine measures to be utilised to mitigate any remaining bushfire hazard.

A Bushfire Management Plan is required for:

1. Accepted development (subject to requirements) and assessable development applications for which the Bushfire hazard overlay code is identified in the assessment benchmarks for assessable development and requirements for accepted development outcomes column in Table 8.2.4.3 - Accepted development subject to requirements and assessable development.
2. Development not located in a low bushfire hazard area.

1.1.3 AS3959:2018 Construction of Buildings in Bushfire Prone Area

The Australian Standard AS3959:2018 Construction of Buildings in Bushfire-Prone Areas (Standards Australia, 2009) specifies the requirements for the construction of buildings in bushfire-prone areas in order to improve their resistance to bushfire attack. AS3959:2018 applies to those areas where a regulated map (i.e. a planning scheme overlay map) identifies an area as a bushfire prone area (or similar), requiring calculation of Bushfire Attack Level (BAL) in accordance with a methodology outlined in the standard. AS3959:2018 prescribes the construction details for buildings depending on the calculated BAL. The detailed requirements relating to construction methods and materials are typically dealt with as part of building design and enabled via private certification in accordance with the Building Code of Australia.

2. SITE DESCRIPTION AND DETAILS

2.1 Overview

The site is described as Lot 900 on SP152499 within Gladstone Regional Council (Figure 1).

Figure 1

Lot 900 on SP152499 has an area of 99250 square metres and is aligned north-south with a northwesterly aspect (Figure 2).

Figure 2

Lot 900 on SP152499 is currently zoned Emerging Community (Figure 3).

Figure 3

2.2 Proposed Development

The proposed development is the Boyne Tannum Aquatic Recreational Centre (BTARC) (Figure 4).

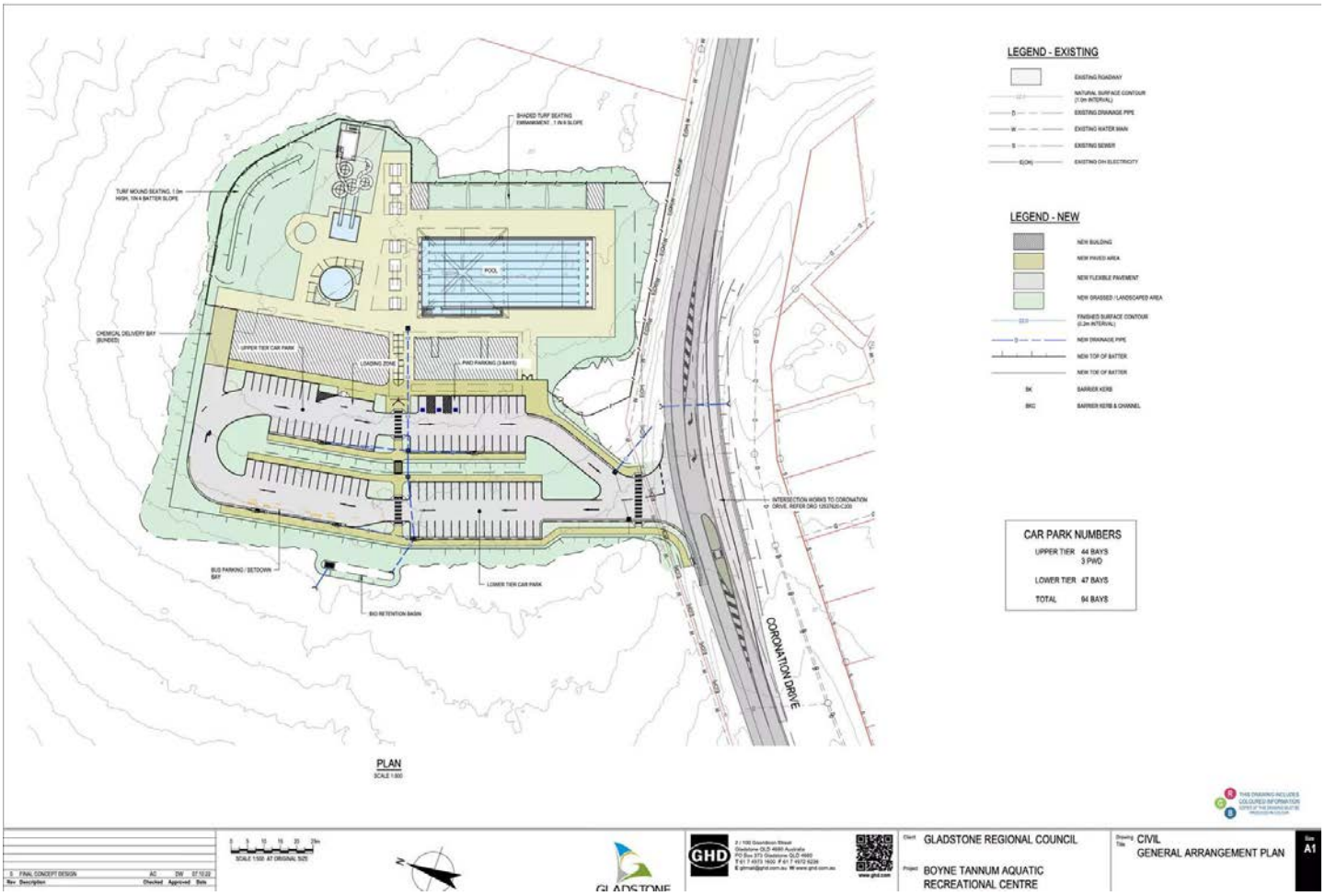


Figure 4

3. BUSHFIRE HAZARD AND RISK ASSESSMENT

3.1 Overview

Gladstone Regional Council is situated in Central Queensland, an area characterised by a mild sub-tropical costal climate which does not normally experience extended periods of server fire weather that are frequently experienced in southern Australia. The Central Queensland region has a sub-tropical climate with hot, moist summers and warm, dry winters, with occasional frost in the south. The average annual temperature is 21°C. Summer average temperature is 27°C, autumn is 22°C, winter 15°C and spring is 22°C. Annual and seasonal average rainfall are variable, affected by local factors such as topography and vegetation, and broader scale weather patterns, such as the El Niño–Southern Oscillation. The greatest rainfall occurs in summer, averaging 277mm per year. The number of days each year characterised by weather conditions conducive to the ignition and rapid spread of a high intensity bushfire are limited. The Central Queensland fire season (when more severe bushfires normally occur) is generally recognised as August to December.

Consistent with the relatively low frequency of high risk bushfires in Central Queensland compared to southern states, the number of lives and houses lost as a result of bushfire is relatively low. Not withstanding, bushfires still do frequently occur in Central Queensland and present a risk that needs to be considered as part of a comprehensive approach to land use planning and development.

3.2 Bushfire Hazard Assessment

3.2.1 Gladstone Planning Scheme Bushfire Risk Map

Figure 5 shows the bushfire hazard overlay mapping in the Gladstone Planning Scheme.

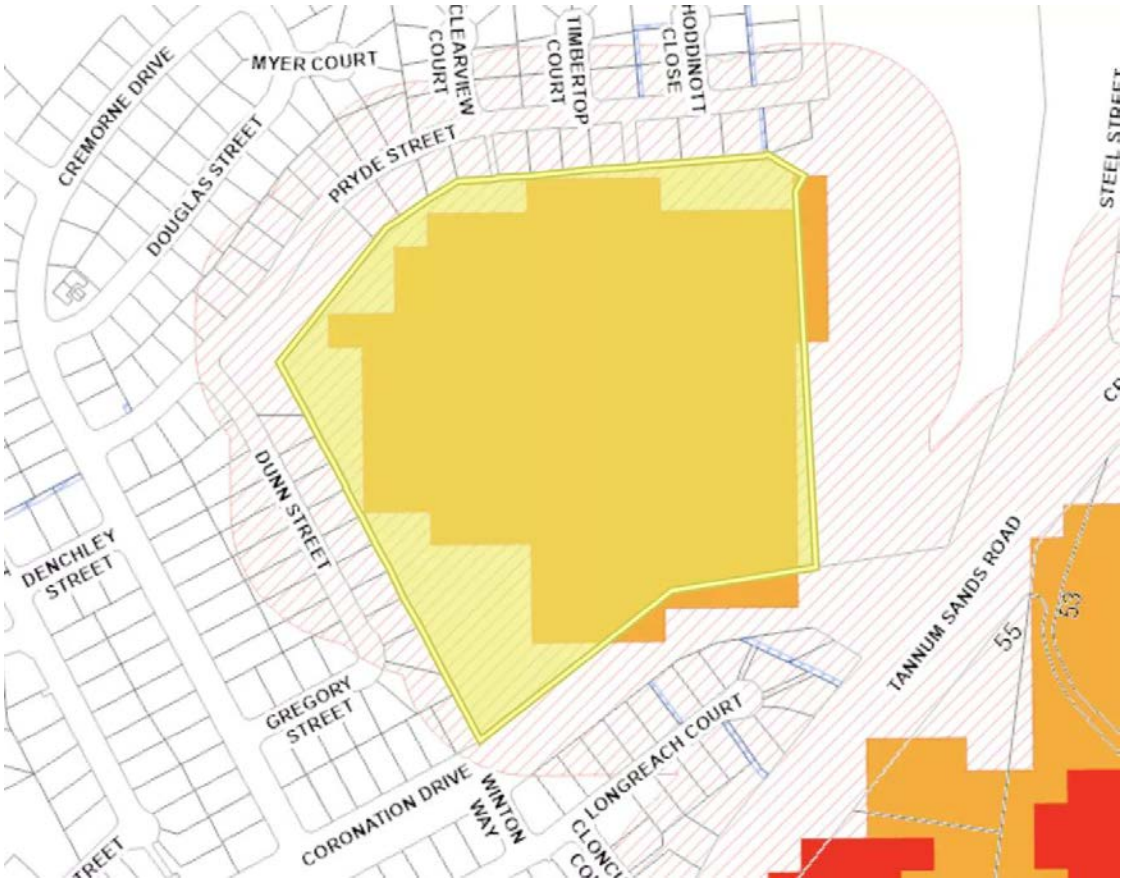


Figure 5

3.2.2 SPP Natural Hazard Mapping

The State Government Single State Planning Policy (SPP) released in 2017, includes mapping that is an outcome of the new bushfire hazard mapping methodology developed by the CSIRO and the Queensland Government. The new Bushfire Prone Area mapping was found to have an average reliability of 85%. The new methodology provides a major improvement in Bushfire hazard mapping. The new modified approach calculates potential fire line intensity using total fuel loads, landscape slope and fire weather severity. A default 100-metre buffer was determined from analysis of heat and radiation decay curves and research that indicates 80% of housing loss and 80% of life loss occurred within 100 metres of bushland.

The subject site is identified on the State Planning Policy Natural Hazards Risk and Resilience mapping as being within potential bushfire impact zone, requiring the bushfire hazard impacts be addressed (Figure 6).

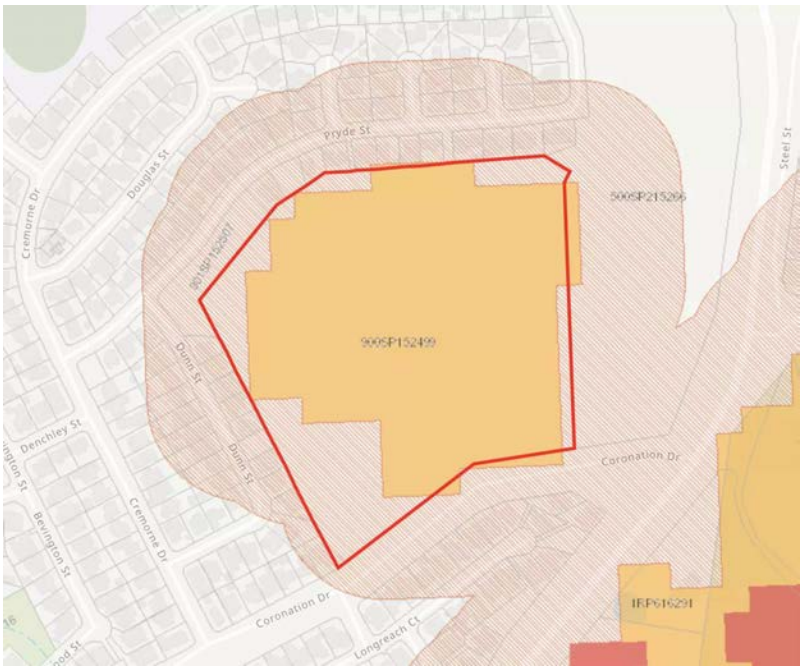
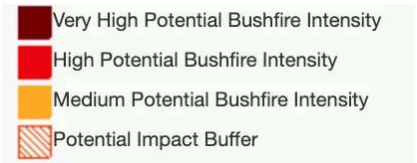


Figure 6



3.3 Site Assessment

The site specific assessment of the bushfire hazard classification for the development at Lot 900 on SP152499 and immediate locality has been completed based on a review of aerial imagery, topographic data, available vegetation mapping and a site inspection review was conducted in November 2022. The site review was conducted to confirm and record the relevant information to determine the bushfire hazard in accordance with the requirements of the Gladstone Regional Council Planning Scheme 2017 V2. These assessments account for changes that will occur to the extent and nature of the vegetation types as a result of the proposed development. The site specific assessments were based on the methodology specified in Australian Standard AS3959:2018 - Construction of Building in Bushfire Prone Areas.

The classification of an area's Potential Bushfire Intensity takes into account three key variables:

- Total Fuel Load - primarily a function of the vegetation type(s) in an area.
- McArthur Forest Fire Danger Index (FFDI) - an index that considers variability in fire intensity associated with a range of weather variable including recent precipitation, current wind speed, relative humidity and temperature.
- Slope - an important variable controlling the rate of fire spread and fuel consumption.

3.3.1 Pre Development Vegetation

Table 1 shows the original vegetation on and about the site identified using the *Public Safety Business Agency (PSBA) State-wide Bushfire Hazard (Bushfire Prone Area)* mapping.

VHC Description	Regional Ecosystem (RE)	Site Specific Assessment of Presence	Potential Fuel Load (t/Ha) Surface	Potential Fuel Load (t/Ha) Total
1. VHC: 10.2 (Photo 1)	12.11.6 Corymbia citriodora subsp. variegata, Eucalyptus crebra woodland on metamorphics and interbedded volcanics	Remnant vegetation present on Lot 900 and the adjoining Lot 500 on SP215266	14.0	18.0

Table 1

Photo 1

3.3.2 Classified Vegetation

Australian Standard, *Construction of Buildings in Bushfire Prone Areas* (AS 3959–2018*)* requires any classified vegetation within 100 metres of the proposed works must be assessed. Table 2 shows the vegetation on and about the site identified using the *Public Safety Business Agency (PSBA) State-wide Bushfire Hazard (Bushfire Prone Area)* mapping

VHC Description	Regional Ecosystem (RE)	Site Specific Assessment of Presence	Potential Fuel Load (t/Ha) Surface	Potential Fuel Load (t/Ha) Total
1. VHC: 10.2 (Photo 1)	12.11.6. Corymbia citriodora subsp. variegata, Eucalyptus crebra woodland on metamorphics and interbedded volcanics	Remnant vegetation present on Lot 900	14.0	18.0
1. VHC: 10.2 (Photo 2)	12.11.6 Non - Remnant Corymbia citriodora subsp. variegata, Eucalyptus crebra woodland on metamorphics and interbedded volcanics	Non - remnant present on adjoining Lot 500 on SP215266	17	18.0

Table 2

Photo 2

Based on the above, the Potential Fuel Loads available within and adjacent to Lot 900 on SP152499 range from:

- a minimum of 14 tonnes/Ha associated with existing and proposed fuel load: to
- a maximum of 18 tonnes/Ha associated with ares of remnant vegetation located within 100m of the development.

3.3.3 Forest Fire Danger Index

For land use planning purposes in Queensland the 1:20 year Forest Fire Danger Index, adjusted to reflect the expected climate in the year 2050, has been adopted as the design fire weather conditions. The FFDI for a 1:20 year is equivalent to a 5% annual exceedance probability (ie. 5% chance of occurring in any given year) and integrates the combined effect of a range of weather variables including long term dryness, recent precipitation, current wind speed, relative humidity and temperature.

The QFES Redi-Map Portal provides more refined mapping of FFDI (1 in 20 years) index values. Utilising this mapping the applicable FFDI for the development at Boyne Tannum Aquatic Recreation Centre has resulted in an FFDI for the development of 56. An FFDI of 56 falls within the severe Fire Danger Rating (FDR) according to the FDR system developed by Australasian Fire Authorities Council (AFAC) and summarised in Table 3.

Fire Danger Rating	AFAC Description of Likely Fire Behaviour and Consequence
Catastrophic FFDI > 100	Fires will be uncontrollable, unpredictable and fast moving. These are the worst conditions for a bush or grass fire. If a fire starts and takes hold, it will be extremely difficult to control. It will take significant fire fighting resources and cooler conditions to bring it under control. Spot fires will start well ahead of the main fire and cause rapid spread of the fire. Embers will come from many directions. Homes are not designed or constructed to withstand fires in these conditions. The safest place to be is away from bushfire prone areas.
Extreme **FFDI 75-99**	Fires will be uncontrollable, unpredictable and fast moving. These are very hot, dry and windy conditions for a bush or grass fire. If a fire starts and takes hold, it will be unpredictable, move very fast. It will be very difficult for fire fighters to bring under control. Spot fires will start and move quickly. Embers may come from many directions. Homes that are prepared to the highest level, have been constructed to bushfire protection levels and are actively defended, may provide safety. You must be prepared physically and mentally to defend in these conditions. The safest place to be is away from bushfire prone areas.

Fire Danger Rating	AFAC Description of Likely Fire Behaviour and Consequence
Severe **FFDI 50-74**	Fires will be uncontrollable and move quickly .These are hot, dry and possibly windy conditions for a bush or grass fire. If a fire starts and takes hold, it will be hard for fire fighters to bring under control. Well-prepared homes that are actively defended can provide safety. You must be prepared physically and mentally to defend in these conditions.
Very High **FFDI 25-49**	Fires Can be difficult to control. Flames may burn into the tree tops. Theres is a chance people may die or be injured. Some homes and businesses may be damaged or destroyed. Well prepared and actively defended house can offer safety during a fire. Embers may be blown ahead of a fire. Spot fires may occur up to 2km ahead of the fire. Leaving is the safest option for your survival. Your home will only offer safety if it and you are well prepared and you can actively defend during a fire.
High **FFDI 12-24**	Fires can be controlled. Loss of life is highly unlikely and damage to property will be limited. Well prepared and actively defended houses can offer safety during a fire. Embers may be blown ahead of the fire. Spot fires can occur close to the main fire. Know where to get more information and monitor the situation for any changes.
Low-Moderate **FFDI <12**	Fires can be easily controlled. Little or no risk to life and property. Know where to get more information and monitor the situation for any changes

Table 3

Note: An FFDI of 56 specified for use in the SPP for land use planning purpose is higher than the FFDI of 40 specified in AS3959-2018 for all of Queensland for building design and approval purposes.

3.3.4 Slope Assessment

From a bushfire hazard perspective slope of the land under the bushfire prone vegetation can greatly influence fire behaviour. This slope is referred to as the **effective slope**. If the potentially hazardous vegetation is located upslope of the asset(s) the contribution that slope makes towards the intensity and rate of spread of the fire is negligible. **Site slope** is the gradient of the land between retained vegetation and adjoining assets. The site slope influences the 'view factor' of the flame geometries in Bushfire Attack Level models.

Where potentially hazardous vegetation is located downslope of the asset(s) the effective slope gradient of the vegetated land will have significant influence on bushfire intensity and rate of spread. Typically, for each 18-20% (or 10 degrees) increase in slope gradient the rate of forward spread and intensity of a bushfire will double for a fire moving up the slope towards an asset. Similarly if the fire is moving down the slope the rate of spread will decrease by approximately double for each 18-20% (or 10 degrees) increase in slope gradient. As the rate of spread of a bushfire increase so does its intensity.

The effective and site slope for the proposed development at Boyne Tannum Aquatic Recreation Centre has been calculated from Gladstone Regional Council Online mapping System as 15 degree effective slope and 1 degrees site slope.

NOTE: As fire travels slower down a hill, all classified vegetation that is upslope will assume a value of 0 degrees (i.e. flat land) *(AS3959:2018)*.

3.4 Bushfire Risk Assessment

3.4.1 Risk Classification

With reference to AS/NZS ISO 31000 Risk Management - Principles and Guidelines, The bushfire risk profile of an asset may be defined as "*the chance of something happening that will have an impact on objectives*" and can be qualified in terms of:

- **Likelihood:** the frequency with which it is expected a bushfire of a particular level of intensity will threaten an asset via smoke, embers, radiant heat or flame attack. This can be influenced by local environmental factors, fuel biomass and structure, density of potential ignition sources, fire management and intervention capability etc. , all of which can vary over time due to the influence of resource availability, weather and climate variability.
- **Consequences:** The nature and significance of the potential adverse outcomes for an asset exposed to a certain intensity of bushfire attack (eg. health effects, damage to structures, economic loss, interference with ecosystem processes, loss of biodiversity). This can be influenced by the vulnerability and resilience of the asset to bushfire exposure, the social, economic and environmental values of the asset, post fire recovery and prospects, costs and timeframes.

Assessing the risks to people and property posed by bushfires requires an understanding of the tolerances of people and property to different levels of bushfire attack, in particular attack by flames and radiant heat. For people there is generally no safe level of direct flame exposure and radiant heat is recognised as the biggest killer in a bushfire. Radiant heat levels increase with the increase in the proximity and intensity of bushfire.

The vulnerability of buildings and structures to bushfire attack is largely determined by:

- The material used in their construction.
- The severity and duration of the exposure to radiant heat or flame attack.

For land use planning purposes a maximum radiant heat flux exposure of 29 kW/m2 for residential dwellings on newly created lots is increasingly being recognised as the benchmark for an acceptable level of risk exposure. In this respect the building setback distance needed to achieve a 29 kW/m2 heat flux exposure:

- Reduces potential exposure to bushfire attack, particularly direct flame contact.
- Reduces the likelihood of piloted ignition due to radiant heat exposure.
- Provides opportunities for emergency access and operational space for firefighters before the arrival of a bushfire,
- Improves consistency between planning and building outcomes, thereby reducing the potential for conflicts between planning and building approvals.
- Avoids duplication and regulatory burden on home owners.

3.4.2 Bushfire Behaviour and Risk Exposure Modelling

For land use planning purposes, an important element of a "fit for purpose" method of assessing whether or not a proposed development provides a tolerable or acceptable level of bushfire risk is to consider likely bushfire behaviour and consequences for future residents, QFES personnel and built infrastructure under a design bushfire event. One method for assessing bushfire risk exposure levels examining the likely levels of flame, radiant heat and ember attack that people and property would be exposed to under a design fire event using the Australian Standard AS3959-2018: Construction of buildings in Bushfire Prone Areas - Bushfire Attack Level Method 2. This approach involves:

- **Step 1**: Determine the relevant FDI.
- **Step 2:** Determine the vegetation classification, fuel loads.
- **Step 3**: Determine the effective slope in degrees under the classified vegetation.
- **Step 4**: Determine the slope in degrees of the land between the site and the classified vegetation.
- **Step 5**: Determine the distance of the site from classified vegetation.
- **Step 6**: Determine the BAL rating using Method 2.

For the purposes of this assessment the relevant FFDI, classified vegetation types and slope characteristics used in this assessment are detailed in Section 3.3.2 and 3.3.4 of this Report.

3.4.3 Assessment of Bushfire Hazard

Australian Standard - *Construction of Buildings in Bushfire Prone Areas (AS 3959–2018)* requires that any classified vegetation within 100 metres of the proposed works must be assessed. Figure 9 shows the extent of the 100-metre separation zone (BAL Impact Zone).

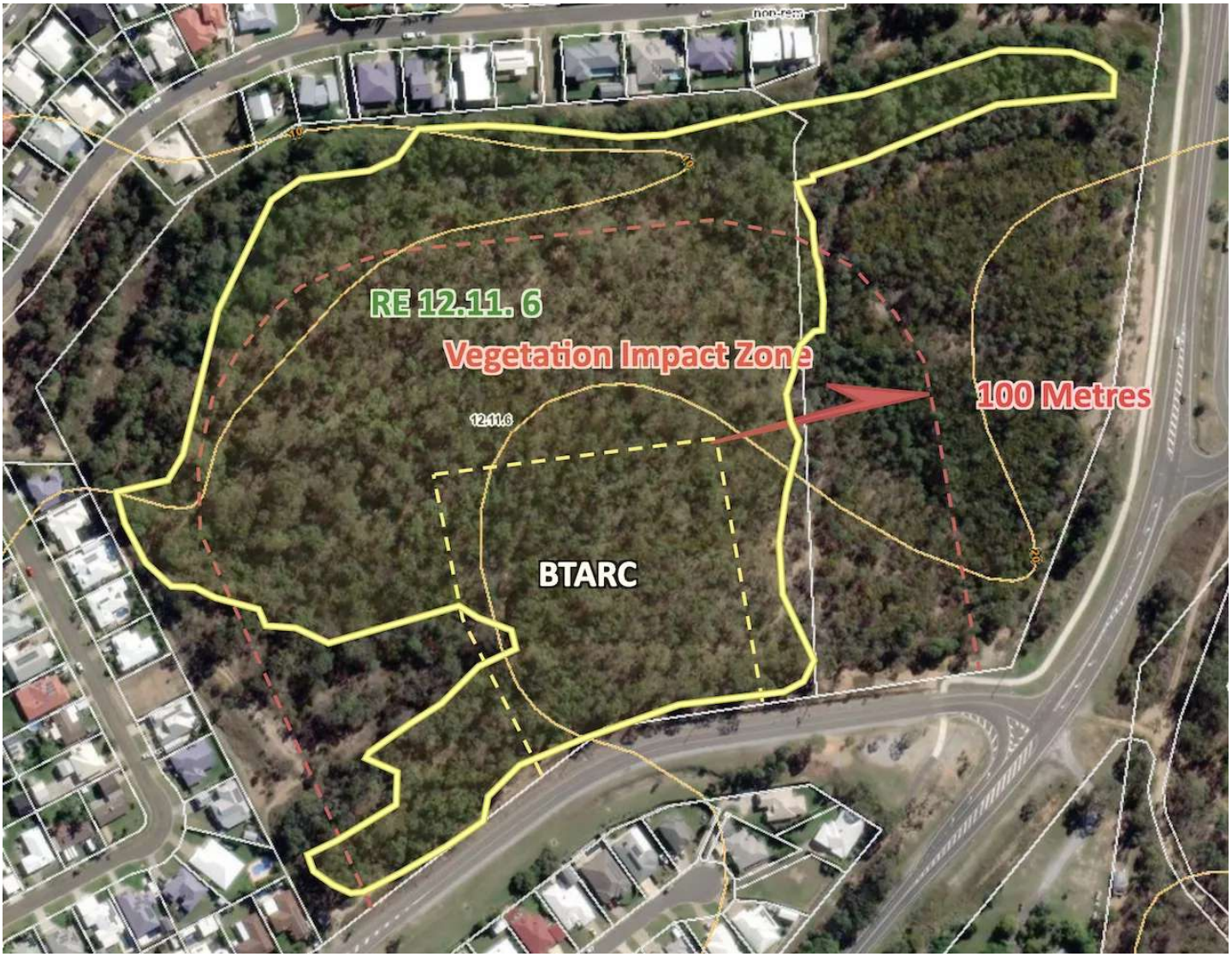


Figure 9

The classified vegetation to the north and west will impact the BTARC site. The vegetation to the east is poor quality regrowth and not mapped as potential bushfire hazard. The Radiant Heat Flux Exposure (kW/m2) as a function of distance as calculated in Table 4 is shown in Figure 10 and 11.

Figure 10 (BAL Impact Zone)

Figure 11 (BAL Impact Zone)

The classified vegetation to the north and west will impact the BTARC site. The vegetation to the east is poor quality regrowth and not mapped as potential bushfire hazard.

Calculations using AS 3959-2018, in accordance with Appendix B - *Detailed Method for Determining the Bushfire Attack Level (BAL) – Method 2 (Normative)*, indicate that at a separation distances as shown in Table 4 structures located on the proposed site will be exposed to a radiant heat flux as a function of distance equating to a Bushfire Attack Level (BAL) of as indicated in Table 4. Table 5 describes the six (6) Bushfire Attack Levels.

Minimum distance to < 40 kW/m²	8.4 m
Minimum distance to < 29 kW/m²	11.4 m
Minimum distance to < 19 kW/m²	16.9 m
Minimum distance to < 12.5 kW/m²	24.5 m

Table 4

Bushfire Attack Level (BAL)	Radiant Heat Exposure (AS3959)	Description of Predicted Bushfire Attack and Levels of Exposure
BAL - Low	Insignificant	The risk is very low, radiant heat on the building is insignificant to warrant specific construction requirements. However, ember attack may still occur.
BAL 12.5	0 to 12.5kW/m2	Primarily risk of ember attack. Risk of radiant heat is considered low.
BAL 19	12.5 to 19kW/m2	Risk is considered moderate with increasing levels of ember attack and burning debris ignited by wind borne embers. Increasing likelihood of exposure to radiant heat.
BAL 29	19 to 29kW/m2	Risk is considered to be high. Increasing levels of ember attack and burning debris ignited by wind borne embers. Increasing likelihood of exposure to radiant heat.
BAL 40	29 to 40kW/m2	Risk is considered to be very high. Increasing levels of ember attack and burning debris ignited by wind borne embers. Increasing likelihood of exposure to radiant heat and some direct exposure to flames possible.
BAL FZ	40kW/m2 plus (flame contact)	Risk is considered to be extreme. Direct exposure to flame from the fire front is likely in addition to high levels of radiant heat exposure and ember attack.

Table 5

4. BUSHFIRE HAZARD AND RISK MITIGATION

Figure 11 illustrates that effective protection against bushfire can only be achieved by the integration of multiple measures. Removing the bushland (hazard) will remove the risk but this option is neither necessarily possible nor desirable. An acceptable level of protection of life and property can be achieved while still retaining and protecting biodiversity and the natural values of the bushland.

Figure 11

The appropriate mitigation and management of bushfire hazards and risks involves the integration of a combination of bushfire hazard mitigation measures during the design, construction and operational phase of any development, including:

- Ensuring development design, including the layout of roads and driveways and the location, size and orientation of residential lots and buildings, is responsive to bushfire hazards;
- Appropriate firefighting and management infrastructure is provided, including an adequate and accessible water supply, fire breaks and maintenance/access trails;
- Specifications and materials for building design and construction are in accordance with AS3959-2018 Construction of Buildings in Bushfire Prone Areas;
- Management of potentially hazardous vegetation taking into account the conservation values of that vegetation and the important role fire plays in the functioning of many Australian ecosystems;
- Landscape design and property maintenance requirements;
- Community awareness, education and training; and
- Identification of parties to be responsible for specific bushfire management tasks and actions.

The design of the Boyne Tannum Aquatic Recreational Centre (BTARC) development at Boyne Tannum Aquatic Recreation Centre has been informed by the above. The following sections provide detail concerning some of the key design elements which have been incorporated into the design of the development to ensure an acceptable level of risk to human safety and property is maintained in the event of a bushfire occurring in the general locality. Where appropriate, details concerning measures that need to be taken during construction and occupational phases of the development are also provided.

4.1 Access and Evacuation

The intent of design requirements for roads is to provide safe egress for residents and access for attending firefighting vehicles. A road system that is compliant with guideline measures provides fire services with easier access to buildings, a safe retreat for firefighters and residents, and can provide a fire control line where hazard reduction and back burning can take place. In determining safe access to a site, consideration is given to the fire brigade vehicles which are required to access public and private roads. Given the size of these vehicles and the poor visibility in which they often operate, roads need to be designed to specific requirements, including road width, grade, cross-fall, weight capacity, passing bays and turnaround areas, all of which may vary depending on whether it is a perimeter, access, cul-de-sac or battle-axe road type.

Ultimately egress and ingress to the Boyne Tannum Aquatic Recreational Centre (BTARC) development will be via constructed direct access to Coronation Drive. There is likely to be substantial warning of a major bushfire front approaching the development allowing the implementation of the BTARC Emergency Response Plan.

4.2 Water Supply

Providing a sufficient water supply provides firefighters and residents with the appropriate levels of water to undertake building defense. There are two options in which a site can be supplied with a sufficient water supply; from either reticulated water accessible via a hydrant, or a dedicated static water supply. Reticulated water will be supplied to the development meeting the required statutory standards.

4.3 Building Design and Construction

Buildings within the Boyne Tannum Aquatic Recreational Centre (BTARC) development situated within 100metres of areas of hazardous vegetation (ie. bushfire prone vegetation with the capacity to support bushfires with an intensity of 4000kW/m2 or greater under design fire weather conditions) need to be designed and constructed in accordance with AS3959-2018: *Construction of Buildings in Bushfire Prone Areas.*

4.4 Vegetation Management

The bushfire severity potential of an area can be substantially reduced by managing vegetation in a manner that reduces or removes potential bushfire fuel loads. This includes management of areas that are intended to provide a conservation function. The failure to manage vegetation fuel loads in conservation reserves can result in high intensity wildfires that have adverse ecological impacts for the reserve as well as creating an unnecessary hazard for adjacent urban areas.

Onsite vegetation and landscape management are important to maintaining low hazard conditions by:

- Limiting fuel accumulation;
- Reducing connectivity of fuels;
- Establishing and maintaining defendable space;
- Appropriate landscaping; and
- The proposed lot size of the development will constrain the development of any additional bushfire hazard.

Clearing - The site will be cleared to facilitate the proposed development.

4.5 Residential Landscape Design

Inappropriate landscape design in bushfire prone areas (ie. any land within 100m of bushfire prone vegetation) may expose a dwelling to increased levels of ember attack, radiant heat and flame contact. Well designed and maintained landscaping with appropriate plant species can actually help protect houses by:

- Reducing the amount of radiant heat received by a house;
- Reducing the chance of direct flame contact with the house;
- Deflecting and filtering embers; and
- Reducing flammable landscaping materials within the defendable space.

All vegetation material can burn under the influence of a bushfire, therefore landscape designs in bushfire prone areas should give careful consideration to:

- Species selection;
- Species planting proximity to assets and access paths relative to their flammability.
- Avoidance of both horizontal and vertical continuity of vegetation.

In general "mesic" plant species that have a higher leaf moisture content, less bark and a lower rate of leaf drop will assist with reducing available bushfire fuel loads thereby assisting in reducing the likelihood and severity of bushfire attack. The use of mesic plant species in combination with the following guidelines form the basis for a low risk landscape design in bushfire prone areas:

- Establish and maintain lawn or paved areas such as paths and/or pebble garden with herbs near to structures.
- Maintain cleared areas around all driveways, pathways, and roadways that may be need to used as access/egress route during a bushfire.
- Plant trees at least 5m from any structure to allow clear access and minimise canopy overhang of roofs and associated accumulation of leaf litter.
- Space trees and shrubs to avoid the creation of continuous canopy that may carry fire.
- Prune lower limbs of trees to height of 2m above ground level.
- Avoid using confers, paperbarks (ie. Melaleuca species), stringy bark and ribbon bark eucalyptus in landscape planting.
- Avoid using organic mulch with preference given to non-flammable mulches such as scoria (light weight volcanic stone), pebbles, recycled crushed bricks.
- Regularly water landscape plantings to maintain plant health and moisture levels.

4.5 Fencing

Fencing materials have the capacity to contribute to fire spread and intensity. It is recommended that non-combustible fencing materials should be used.

4.6 Community Awareness

Property owners are responsible for developing their own knowledge and understanding of the level of bushfire risk specific to their respective properties. A Emergency Response Plan is required and must take account of matters such as, if any occupants require special assistance (i.e. infants, the elderly or the ill), evacuation routes available, evacuation destinations, property maintenance and preparation. Planning ahead of any perceived bushfire event is essential.

The warning systems now implemented by Emergency Services and Local Authorities provide timely information and advice to occupants. Understanding what to do in the event of bushfire emergency is critical. Prior knowledge as to the steps to take during the lead up to a fire event, during the passage of bushfire, and what to do immediately after the fire front has passed is critical.

5. COMPLIANCE ASSESSMENT

Bushfire Hazard Overlay Code - Gladstone Regional Council Planning Scheme 2017 V2 (Section 8.2.4)

Performance Outcomes	Acceptable Outcomes	Compliance
PO1 Development maintains the safety of people and property by not exposing them to an unacceptable risk from bushfire.	**AO1** No acceptable outcome is nominated.	The design and layout of the BTARC provides suitable low hazard areas.
PO2 Development does not result in a higher concentration of people living, working or congregating in a high or very high bushfire hazard area unless it can be demonstrated: 1. there is an overriding community need in the public interest, and 2. no other site is suitable and reasonably available.	**AO2** The following uses are not located on land within a confirmed medium, high or very high bushfire hazard area: 1. child care facility 2. community care centre 3. educational establishment 4. hostel 5. hospital 6. multiple dwelling 7. non–resident workforce accommodation 8. residential care facility 9. retirement facility 10. shopping centre 11. short–term accommodation 12. tourist attraction 13. tourist park.	The aquatic centre site provides a suitable location for this facility. A risk assessment prepared by GHD Pty Ltd (GHD) records injury or facility damage due to bushfire as medium.. The risk will mitigated by facility design standards to reflect bushfire design requirements.

Performance Outcomes	Acceptable Outcomes	Compliance
PO3 Development in areas with a reticulated water supply has adequate flow and pressure for fire–fighting purposes at all times.	**AO3** The water supply network has a minimum sustained pressure and flow of at least 10L per second at 200kPa.	The proposed development will provide adequate flow and pressure (20 l/sec @ feed performance). Fire pumps and/or water storage will be established if required.
PO4 Development in areas without a reticulated water supply has an appropriate dedicated water supply for fire–fighting purposes that are safely located and freely accessible for fire–fighting purposes at all times.	**AO4** Development involving a gross floor area greater than 50m2 where a reticulated water supply is not available is: 1. provided with an easily accessible fire resistant on–site water storage of not less than 5,000L (e.g. concrete tank with fire brigade fittings, in–ground swimming pool, dam fed by a permanent water source) that is within 100m of each class 1, 2, 3, or 4 building, and 2. has a hard standing area allowing a heavy rigid fire appliance safe access to within 6m of the storage facility. **AO4.2** The location of water supplies is readily identifiable from the street frontage with clear signage directing firefighters to its access point.	Not Applicable

Performance Outcomes	Acceptable Outcomes	Compliance
PO5 Roads and fire access trails are designed and constructed to: 1. enable efficient access to buildings and structures for fire–fighting purposes for emergency services, and 2. swift evacuation in emergency situations.	**AO5** Roads and fire access trails are designed and constructed to: 1. separate the development from the hazardous vegetation 2. have a maximum gradient of 12.5% 3. a minimum cleared width of 6m and a minimum formed width of 4m 4. have adequate drainage and erosion control devices 5. provides passing and turning areas for fire–fighting appliances at intervals of not less than 200m 6. have a vehicular access at each end to roads or a bushfire trail 7. not involve any cul–de–sac 8. have gates locked with a system authorised by QFES, and 9. have suitable arrangements in place to ensure maintenance in perpetuity. **AO5.2** Development has direct access to an evacuation route with a potential fire intensity exposure no greater than 2kw/m2.	No fire access trails to be established. Constructed access to Coronation Drive

Performance Outcomes	Acceptable Outcomes	Compliance
	AO5.3 Development incorporates an area of managed vegetation that separates lot boundaries from hazardous vegetation by a distance of: 1. 20m to a high or very high bushfire risk area, or 2. 10m to a medium risk bushfire area and includes a fire access trail.	The proposed development will be bounded by grassed/landscaped and hardstand/parking areas on the northern, southern and western extent.
PO6 Development provides for adequate fire breaks that minimise bushfire hazard by: 1. separating hazardous vegetation from development areas, and 2. facilitating access for firefighting and emergency vehicles.	No acceptable outcome is nominated.	Fire breaks (trails) not required.
PO7 The potential for the release of hazardous materials as a result of a bushfire event is avoided.	**AO7** Development involving the production or storage of hazardous materials in bulk: 1. is not located within a high or very high bushfire hazard area, or 2. complies with a site specific bushfire management plan	No production or storage of bulk hazardous materials.

Performance Outcomes	Acceptable Outcomes	Compliance
PO8 Additional lots avoid the risk of bushfire hazard to personal and property safety and increased risk of damage to assets.	**AO8** New residential lots (including rear lots) do not occur in a bushfire hazard area.	Not applicable
PO9 Development for community infrastructure is located, designed and sited to: 1. protect the safety of people during a bushfire 2. not increase the exposure of people to the risk from a bushfire event, and 3. function effectively during and immediately after bushfire event	No acceptable outcome is nominated.	The risk will mitigated by facility design standards to reflect bushfire design requirements. An Emergency Procedures Manual will be developed for the management of emergency operational response. The plan will inform staff and visitors of their roles and responsibilities in the event of any emergency.

QUEENSLAND BUSHFIRE PLANNING

APPENDIX 1

POTENTIAL BUSHFIRE ATTACK LEVEL

The Australian Standard, Construction of Buildings in Bushfire Prone Areas (AS 3959-2018) provides a suitable methodology for identifying assessable vegetation and determining the requirements for the construction of buildings in order to improve their resistance to bushfire attack from burning embers, radiant heat, flame contact and a combination of the three attack forms.

Determination of BAL

Step 1. Relevant Fire Danger Index

The PSBA bushfire hazard mapping identifies the FFDI as 56.

Step 2. Vegetation Classification - Fuel Loads

The vegetation type was classified as Spotted gum dominated woodlands. Available fuel weights were derived from *PSBA State – Wide Bushfire Hazard (Bushfire Prone Area) Mapping. Fuel weight was determined as: 18 tonne/hectare.*

Fuel weights were determined as:

- 14 tonne/hectare surface fuels
- 3.0 tonne/hectare near surface fuels
- 1.0 tonne/hectare elevated fuels
- 0.0 tonne/hectare bark fuels
- Total fuel weight = *18 tonne/hectare.*

Step 3. Determine the effective slope in degrees under the classified vegetation

The classified vegetation is downslope at 15 degrees, calculated using a Nikon Forestry Pro Range Finder and Inclinometer.

Step 4. Determine the slope in degrees of the land between the site and the classified vegetation

The slope between the site and the classified vegetation is with an average slope of 1 degrees.

Step 5. Determine the distance of the site from classified vegetation

Distance is calculated from the closest edge of the classified vegetation. Classified vegetation under AS 3959-2018 does not include low threat vegetation. The distance to the classified vegetation was calculated using a Nikon Forestry Pro Range Finder and Inclinometer at 0 - 100 metres.

Step 6. Calculations

Effective slope (°) - 15

Site slope (°) - 1

Distance (m) - 0 - 100

Vegetation classification — Spotted gum dominated woodlands

Forest Fire Danger Index (FFDI) – 56

Surface fuel load (t/ha) – 14

Overall fuel load (t/ha) – *18*

Heat of combustion (kj/kg) – 18 600

Flame temperature (K) – 1 090

Outcomes

Intensity (kW/m2) – 11 530

Radiant heat flux (kW/m2) – as a function of distance

Bushfire Attack Level (BAL) - as indicated in Table 4

QUEENSLAND BUSHFIRE PLANNING

APPENDIX 2

About the Report Author

This Report was prepared by Bushfire Specialist Bernard Trembath. Bernard has extensive practical knowledge and experience in bushfire planning and management and an intimate working knowledge of Queensland vegetation and climate, particularly in relation to fire prediction and behaviour.

Prior to establishing Queensland Bushfire Planning in 2014, Bernard was the Regional Manager Rural Operations, Brisbane Region, for Queensland Fire and Emergency Services (QFES). As Regional Manager, Bernard was responsible for bushfire mitigation within the Brisbane Region, working with Local Governments and many other organisations to help reduce the impacts of bushfires. Bernard was also the QFES bushfire planning specialist, providing specialist bushfire planning and management advice on behalf of QFES.
Since 2014, Bernard has provided his specialist bushfire planning knowledge to advise and assist a large number of individuals, companies and government agencies. His happy clients include:

APPENDIX 9: NOISE IMPACT ASSESSMENT

AP09

BOYNE TANNUM AQUATIC CENTRE

Lot 900 on SP152499, Tannum Sands

Noise Impact Assessment

PSA Consulting

Date
20 December 2022

Report
227401.0166.R01V01

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CONTENTS

APPENDICES

1. INTRODUCTION

Trinity Consultants Australia (Trinity) was commissioned by PSA Consulting to provide a noise impact assessment for the proposed new aquatic recreation centre along Coronation Drive, Tannum Sands (Lot 900 on SP152499, Tannum Sands.

The aquatic recreational centre will provide a swimming pool and various other water based recreational activities that are desired by the broader community in the area. The facility is projected to service a broad array of patrons, increase economic opportunities by providing a tourist spot in the area and enhancing the health and fitness of the community. The proposed concept design was approved by the Gladstone Regional Council on 15 March 2022.

As part of the design development phase, the noise impact of the aquatic recreation centre on nearby premises needs to be assessed to ensure that the acoustic amenity of nearby residences is not impeded.

The purpose of this report is as follows:

- Outline the relevant project noise criteria.
- Present the results of noise monitoring.
- Predict and assess the noise emissions from the development.
- Describe noise mitigation requirements, if any.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A**.

2. STUDY AREA DESCRIPTION

The proposed development is to be located along Coronation Drive, immediately west of the Tannum Sands Road intersection in Tannum Sands. The subject site is properly described as Lot 900 on SP152499. The site location is shown in **Figure 2.1** (source: Queensland Globe).

Figure 2.1: Site Location

The site is currently vacant, and generally consists of forested land.

The proposed development site is surrounded by the following uses (refer **Figure 2.1**):

- Residential houses (Receptor Group RG1) to the north.
- Residential houses (RG2) to the west.
- Residential houses (RG3) to the south, on the opposite side of Coronation Drive.
- Empty vacant lot to the east. Beyond this lot, retail businesses, police station and residential units can be found on the opposite side of Tannum Sands Road.

Location A refers to the location where the noise logger was placed to undertake noise monitoring of the site.

3. PROPOSED DEVELOPMENT

The proposed development includes the following components:

- Heated 50 metre swimming pool
- Water slide
- Children splash pool/play area
- Turf mound seating/amphitheatre
- Marquee area
- Car spaces, 47 spaces on the lower tier and 47 spaces on the upper tier (total of 91 standard plus 3 disability parking spaces)
- Building for ancillary spaces including administration space for reception and staff room, chemical delivery bunded area, chemical storage area and pool pumps spaces.
- Building for amenities including club room, toilets and change rooms and air-conditioning plant room.

The proposed building plans are included in **Appendix B**.

As an estimate, the site is expected to be used by 120 patrons during busy summer weekends during day time periods. Furthermore, it has been assumed that the site will be used by 40 patrons during a typical day and 20 patrons during a typical early morning and afternoon/evening. It is noted that larger scale events (e.g. swimming carnivals) may be held throughout the year on an infrequent basis (e.g. less than 4 times a year). These events will attract a larger number of people compared to typical daily operations.

The proposed hours of operation are 7 days a week, 5:30 AM to 8:00 PM. As per the Environmental Protection (Noise) Policy (2019), the operation time periods are defined within the day, evening and night period as follows:

- 5:30 AM to 7:00 AM: Night time period.
- 7:00 AM to 6:00 PM: Day time period.
- 6:00 PM to 8:00 PM: Evening time period.

The proposed development has the potential to create noise impacts on nearby residences due to amplified music, mechanical plant, patrons, onsite activities and onsite carpark vehicles traffic. These potential impacts are required to be considered in the project design. If predicted noise emission levels are compliant at these receivers then it is considered that all noise levels other receivers (located further away) are compliant.

4. NOISE MEASUREMENTS

4.1 Overview

Acoustic measurements consisted of an attended noise measurement and noise logging. The noise measurement location is shown in **Figure 2.1** and are described as follows:

- Location A: Located behind 32 Pryde Street, Tannum.

The noise monitoring was undertaken in general accordance with Australian Standard AS1055 Acoustics – Description and measurement of environmental noise and the DES (Department of Environment and Science) Noise Measurement Manual.

4.2 Attended Noise Measurement

An attended noise measurement was undertaken at Location A. The measurement was undertaken on Monday 31/10/2022 using a field and laboratory calibrated Larson David LD831 sound level meter. The microphone height was approximately 1.5m above natural ground level and was located at 1m from a façade.

Weather during the time of monitoring was fine, 10% cloud cover, with a slight breeze from the north-east at approximately 1 to 6 m/s.

The measured noise levels are summarised in **Table 4.1**.

Table 4.1: Attended Noise Measurement Results

Location	Date, Time and Duration	Results and Notes
A	1:00 pm 31/10/2022 15 minutes	Statistical noise levels: L_{eq} 55, L_{10} 51 dBA, L50 47 dBA, L_{90} 44 dBA Noise from insects dominant around 2 to 4 kHz Bird noise dominant around 1k to 2kHz – 43 dBA to 50 dBA Police siren – 49 to 51 dBA dBA Dog barks – 52 to 58 dBA Wind – 44 to 47 dBA Traffic on Pryde Street – 44 to 52 dBA

Note: * The reported noise levels, excluding the statistical noise levels, are the instantaneous levels read from the sound level meter, and generally represent the range in noise levels or maximum noise levels for a particular noise source.

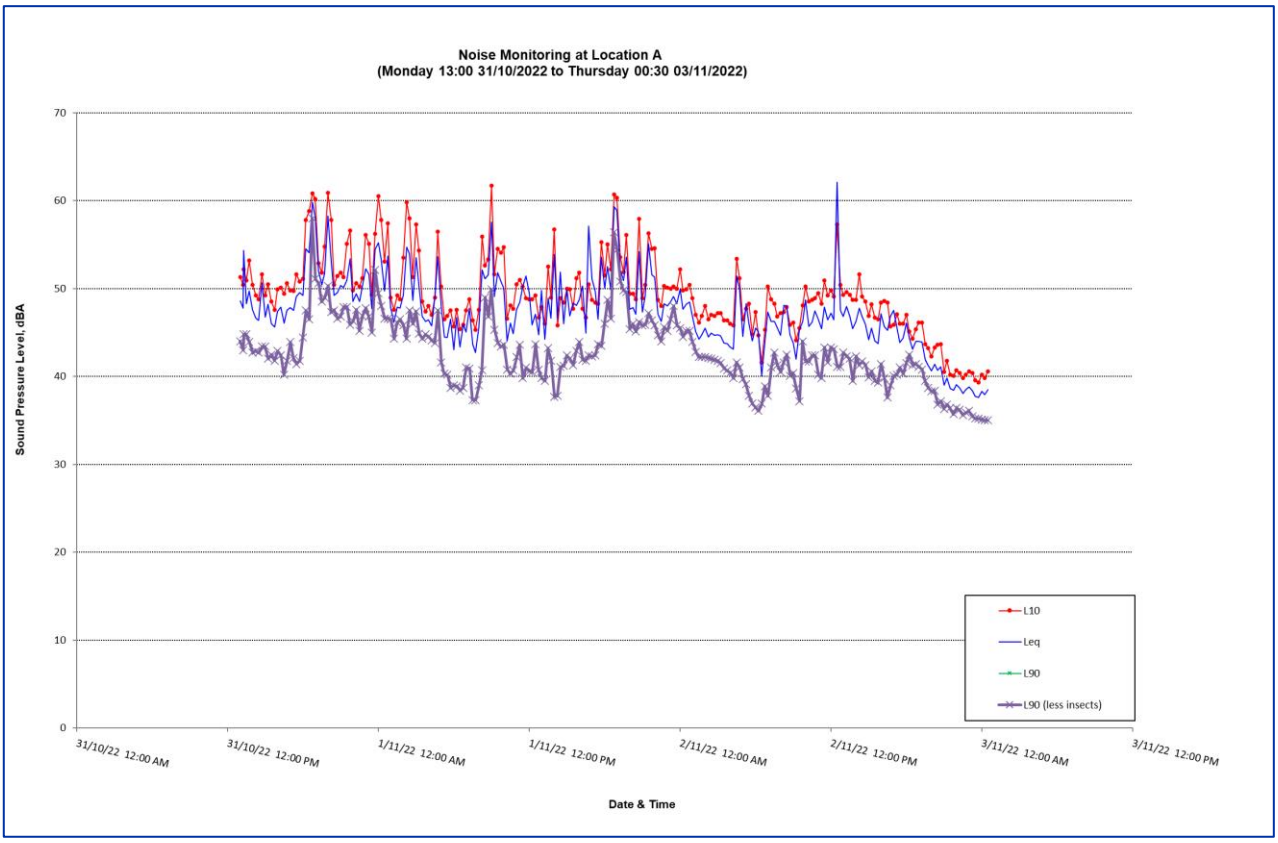
4.3 Noise Logging

Noise logging was undertaken at Location A. Logging was undertaken from Monday 31/10/2022 to Thursday 03/11/2022 using a field and laboratory calibrated Larson Davis LD831/C environmental noise logger. It is noted that the noise logger remained on site for a week, however, due to an equipment error, only 3 days of data was recorded.

Data from the Department of Environment and Science Boyne Island station (2.4 km north-west of the site) indicates that winds were below 5 m/s for the duration of the monitoring. The DES Boyne Island station does not measure rainfall. The next nearest station is located in South Gladstone, which indicates 22.8 mm of rain from 11 pm 31/10/2022 to 2 am 1/11/2022. Monitoring data for this period has been excluded from the analysis.

The measured noise levels are shown in **Figure 4.1**.

Figure 4.1: Graph of Noise Logging Results at Location A



From the noise logging the statistical results have been summarised in Table 4.2.

Table 4.2: Statistical Noise Levels at Location A

Parameter	Noise Levels dBA [Maximum-Top 10%-(Average)-Bottom 10%-Minimum]		
	Day	Evening	Night
L_{max}	83, 74, (65), 57, 55	74, 64, (57), 51, 45	76, 69, (57), 49, 44
L_1	78, 62, (55), 51, 47	63, 61, (53), 46, 42	64, 59, (52), 44, 41
L_{10}	62, 53, (49), 46, 44	61, 59, (51), 43, 40	61, 56, (48), 41, 39
L_{eq}	62, 51, (48), 45, 42	60, 56, (49), 41, 38	55, 52, (46), 39, 38
L_{90}	50, 44, (42), 39, 37	58, 51, (45), 37, 36	52, 47, (42), 36, 35
L_{eq} (less insects)	62, 50, (45), 41, 39	50, 48, (42), 38, 31	50, 45, (39), 32, 27
L_{90} (less insects)	47, 41, (39), 37, 34	49, 45, (37), 28, 23	42, 37, (31), 23, 21

4.4 Background Noise Levels

The background noise levels were filtered for insect noise and were calculated using the lowest 10th percentile method. The background noise levels are shown in **Table 4.3**. It is noted that normally the median of the lowest 10th percentile L_{A90} noise levels are used to derive the Rating Background Level (RBL). However, as only 3 days of data was recorded, the lowest background level of the 3 days was adopted.

When using background plus criteria, it is customary to use a minimum background noise level. Currently, the Queensland Department of Environment and Science documents adopt the following lowest background levels for the purpose of deriving noise criteria:

- QLD Model Mining Conditions (7 March 2017) – 30 dBA for day/evening/night
- QLD Streamlined model conditions for petroleum activities (5 May 2016):
  - Day (7am to 6pm): 35 dBA
  - Evening (6pm to 10pm): 30 dBA
  - Night (10pm to 6am): 25 dBA
  - Morning (6am to 7am): 30 dBA.
- Draft Planning for Noise Control Guideline (2013 review) – 30 dBA.

The above minimum background levels have been considered in conjunction with the noise monitoring data when deriving noise criteria. Based on the above information, the minimum background levels adopted for the morning, day, evening and night periods in Queensland are 30 dB(A), 30-35 dB(A), 30 dB(A) and 25 dB(A), respectively. Therefore, given the lowest measured background levels are below these values, background levels of 30/35/30/25 have been adopted for the assessment.

Table 4.3: Background Noise Levels at Location A

Period	Assessment Background Noise Level (ABL) L_{90} dBA	ABL L_{90} dBA (insect filtered)	Adopted Background Noise Level L_{90} dBA
Day (7am to 6pm)	42, 39, 39	37, 37	37
Evening (6pm to 10pm)	46, 46, 36	35, 32, 24	30 (min adopted in Queensland)
Night (10pm to 7am)	39, 37	27, 28	27

5. NOISE CRITERIA

5.1 Overview

The site is located within the Gladstone Regional Council area and therefore is required to comply with the requirements of the Gladstone Regional Council Planning Scheme (Version 2) Development and Overlay Codes. Other criteria to be considered include those found in the Environmental Protection Act (1994) and Environmental Protection (Noise) Policy (2019).

5.2 Gladstone Regional Council

5.2.1 Planning Scheme

The Gladstone Regional Council (GRC) Planning Scheme (Version 2) classifies Lot 900 SP152499 as Emerging Communities and the surrounding residential dwellings as Low Density Residential.

Table 5.1: Emerging Communities Performance and Acceptable Outcomes (Partial Copy Table 6.2.19.3.1)

Performance Outcomes	Acceptable Outcomes
PO8 Development maintains a high level of amenity within the site and minimises impacts on surrounding areas, having regard to: a) noise b) traffic and parking c) visual impact d) signage e) odour and emissions, and f) lighting. Note—Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance criterion.	No acceptable outcome is nominated.

The performance outcomes of the Development Design code (Section 9.3.2) also apply to the development, as shown in **Table 5.2.** The relevant acceptable outcome refers to the Environmental Protection (Noise) Policy, which is discussed in the following section.

Table 5.2: Development Design Code Performance and Acceptable Outcomes (Partial Copy Table 9.3.2.3.1)

Performance Outcomes	Acceptable Outcomes
PO16 Development prevents or minimises the generation of any noise or vibration so that: 1. nuisance is not caused to adjoining premises or other nearby sensitive land uses, and 2. desired ambient noise levels in residential areas are not exceeded.	**AO16** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008, as amended. Note—To achieve compliance, development is planned, designed and managed to ensure emissions from activities to achieve the appropriate acoustic objectives (measured at the receptor dB(A)).

5.3 Environmental Protection (Noise) Policy

5.3.1 Overview

In respect of the acoustic environment, the object of the Environmental Protection Act is achieved by the Environmental Protection (Noise) Policy 2019 (EPP (Noise)). This policy identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

5.3.2 Acoustic Quality Objectives

The EPP (Noise) contains a range of acoustic quality objectives for a range of receptors. The objectives are in the form of noise levels, and are defined for various periods of the day, and use a number of acoustic parameters. The objectives are not target levels but rather maximum levels.

Schedule 1 of the EPP(Noise) includes the following acoustic quality objectives to be met at residential dwellings:

- Outdoors
  - Daytime and Evening: 50 dBA $L_{Aeq,adj,1hr}$, 55 dBA $L_{A10,adj,1hr}$ and 65 dBA $L_{A1,adj,1hr}$
- Indoors
  - Daytime and Evening: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$
  - Night: 30 dBA $L_{Aeq,adj,1hr}$, 35 dBA $L_{A10,adj,1hr}$ and 40 dBA $L_{A1,adj,1hr}$

In the DEHP EcoAccess Guideline "Planning For Noise Control" documentation it is proposed that the noise reduction provided by a typical residential building façade is 7 dBA assuming open windows. That is, with an external noise source, a 7 dBA reduction in noise levels from outside a house to inside a house is expected when windows are fully open. Thus the indoor noise objectives noted above could be converted to the following external objectives (with windows open):

- Daytime and Evening: 42 dBA $L_{Aeq,adj,1hr}$, 47 dBA $L_{A10,adj,1hr}$ and 52 dBA $L_{A1,adj,1hr}$
- Night: 37 dBA $L_{Aeq,adj,1hr}$, 42 dBA $L_{A10,adj,1hr}$ and 47 dBA $L_{A1,adj,1hr}$

A sensitive receptor is defined as "an area or place where noise is measured".

Given the outdoor objectives within the EPP(Noise) are higher than the calculated external objective (with windows open), that the use of the outdoor objectives may require residents (or other sensitive uses) to close their windows and doors to achieve an acceptable indoor amenity.

The EPP(Noise) states that the objectives are intended to be progressively achieved over the long term. However, as this project involves the introduction of new noise sources it would seem reasonable that the acoustic quality objectives are achieved upon commencement of operation of the project, and this may be the intent of the policy. Therefore, consideration to achieving these acoustic quality objectives will be included in the design noise limits for the project.

It is noted that the acoustic quality objectives do not take into consideration the existing noise environment and therefore it is considered that they do not necessarily protect or enhance the acoustic amenity of the area surrounding the site as required by the EPP(Noise). Therefore, it is considered that the objectives should not be used as the sole noise limits for a development, and reference should also be made to noise limits which are determined with consideration for the existing noise environment.

5.3.3 Background Creep

It is noted that the acoustic quality objectives do not take into consideration the existing noise environment and therefore it is considered that they do not necessarily protect or enhance the acoustic amenity of the area surrounding the site as required by the EPP(Noise). Therefore, it is considered that the objectives should not

be used as the sole noise limits for a development, and reference should also be made to noise limits which are determined with consideration for the existing noise environment.

The EPP(Noise) identifies that background creep is to be prevented or minimised. Background creep is defined as a gradual increase in the total amount of background noise in the area of place as measured under the document called the 'Noise measurement manual'.

The EPP Noise (2019) does not specifically define background creep criteria, however, it is noted that the 2008 version specified a Background Plus 5 dBA limit for variable noise. The EP Act 1994 and various DES guidelines also reference a Background Plus approach (+ 5 dB during the day and evening, and + 3 dB during the night period).

5.4 Noise Limits

The project noise limits can be determined based on the Background Plus criteria method and the noise monitoring results in **Section 4**. The noise limits are calculated as shown in **Table 5.3**. These Background Plus limits are noted to be more stringent than the EPP Noise acoustic quality objectives.

Table 5.3: Noise Limits

Period	Rating Background Noise Level RBL L_{90} dBA	Noise Limits $L_{Aeq,adj,T}$ dBA
Day (7am to 6pm)	37	42
Evening (6pm to 10pm)	30	35
Night (10pm to 7am)	27	30

6. NOISE MODELLING

6.1 Overview

For the purposes of assessing impacts associated with noise emissions from the proposed development, noise modelling of key noise sources from the subject site was completed using a proprietary computer modelling software SoundPLAN v8.2.

SoundPLAN incorporates the influence of meteorology, existing terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receiver locations. The prediction method incorporated into SoundPLAN is in accordance with ISO Standard 9613-2 (1996) Acoustics – Attenuation of sound during propagation outdoors.

The following sections discuss the inputs, assumptions and results of the noise modelling

6.2 Modelled Scenarios

Three noise modelling scenarios have been considered:

- Scenario 1 – typical day-to-day operations as outlined in **Figure 6.1** - up to 40 patrons are assumed for the day period (i.e. 7.00 am to 6:00 pm), only general public to use the pool and facilities, a car park traffic of 20 cars per hour.
- Scenario 2 – typical early morning or evening operations as outlined in **Figure 6.2** - up to 20 patrons assumed for early morning (night) (5:30 am to 7:00 am) and evening (6:00 pm to 8:00 pm) period, only general public to use the pool and facilities, a car park traffic of 10 cars per hour.
- Scenario 3 – busy summer weekend day time operations as outlined in **Figure 6.3** - up to 120 patrons are assumed for day period (i.e. 7.00 am to 6:00 pm), only general public to use the pool and facilities, a car park traffic of 60 cars per hour.

Modelling of larger events such as a swimming carnival have not been specifically modelled. It is not expected that such infrequent events should define mitigation for the site. Rather, noise from such events can be addressed through a noise management plan.

Figure 6.1: Modelled Noise Sources Locations – Typical Day-to-Day Operation

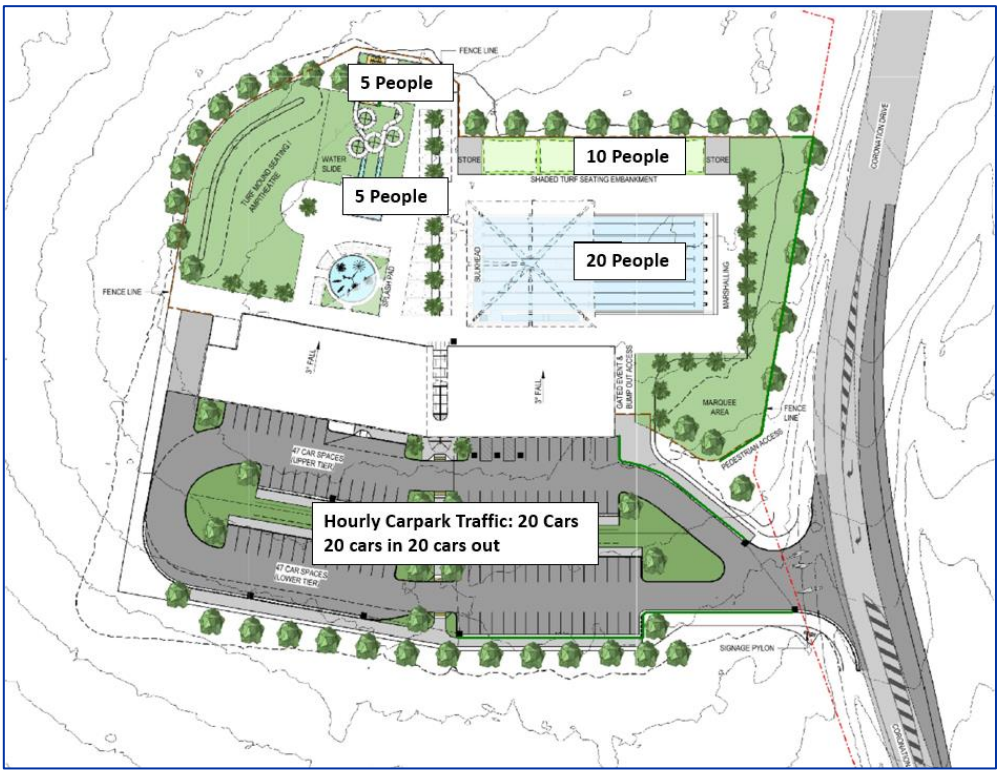


Figure 6.2: Modelled Noise Sources Locations – Typical Early Morning or Evening Operation

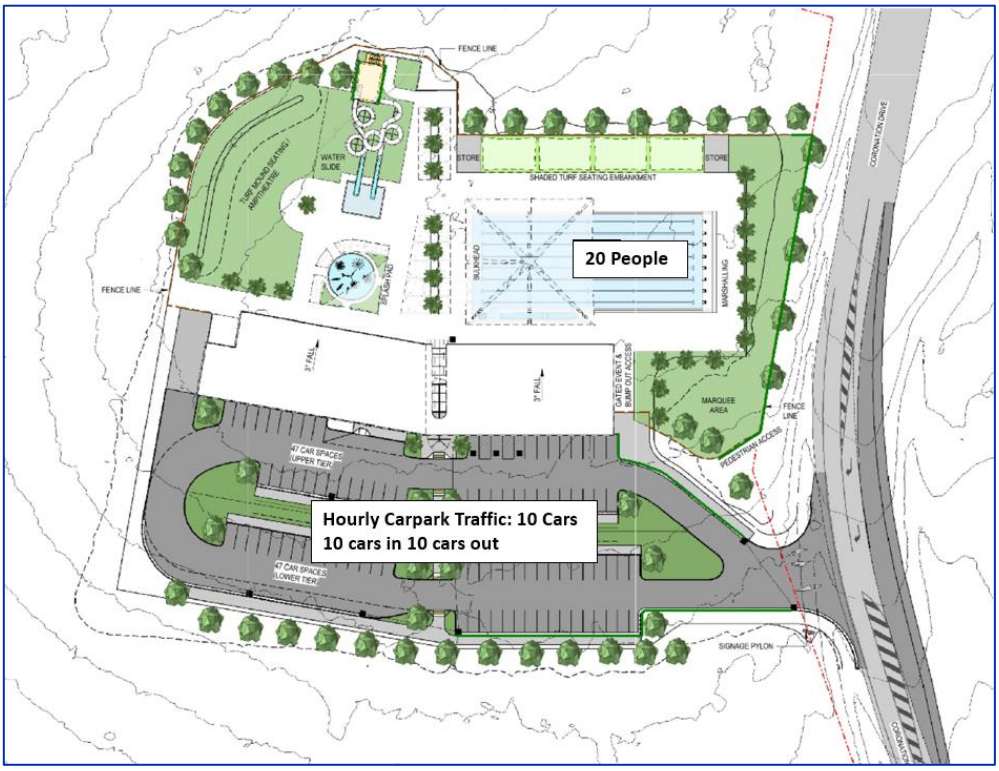
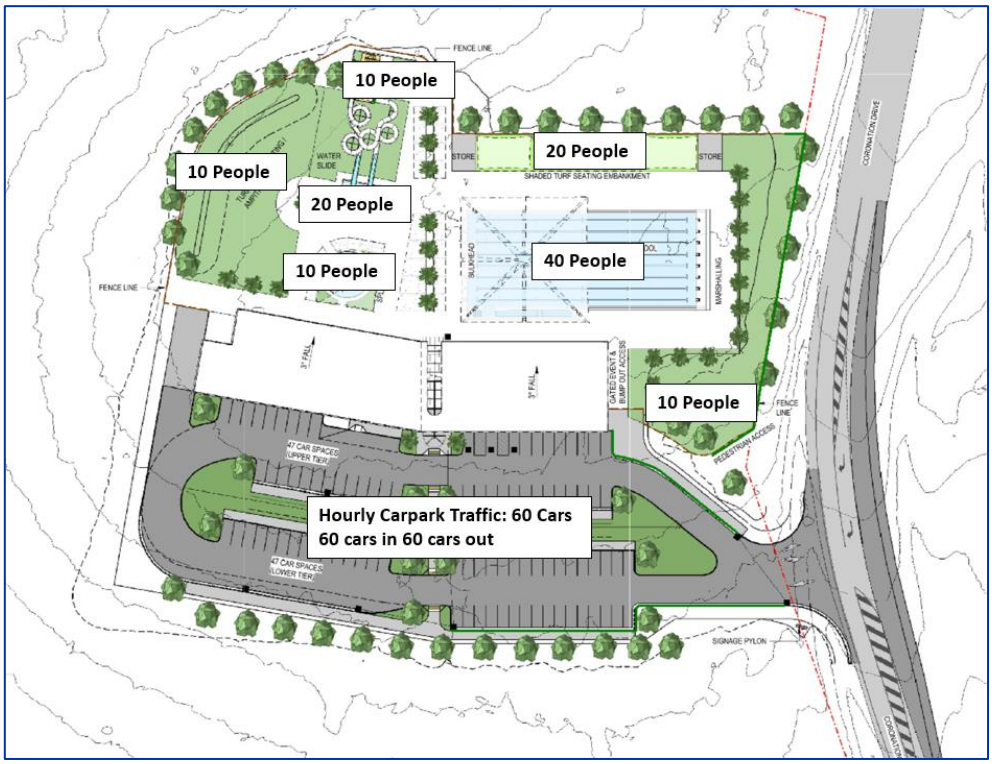


Figure 6.3: Modelled Noise Sources Locations – Busy Summer Weekend Day Operation



6.3 Assumptions and Input Data

The following assumptions were made in constructing the 3D noise model:

- All predictions have been undertaken in accordance with ISO Standard 9613-2 (1996) Acoustics – Attenuation of sound during propagation outdoors. ISO 9613-2 predictions are relevant for light to moderate downwind conditions (1 to 5 m/s) or a well-developed moderate ground-based temperature inversion (e.g. clear, calm night)
- Terrain data for the development and the surrounding area was obtained from Queensland Spatial.
- Receiver heights were modelled at 1.8m from the FFL of the ground floor of nearby buildings.
- Noise source data for each noise source were obtained from Trinity's library of noise source data.

The locations of the noise sources and receivers can be found in **Figure 6.4**.

Figure 6.4: Noise Source and Receiver Locations

The noise source data used in the model are included in **Table 6.1**.

Table 6.1: L_{Aeq} Noise Source Data

Noise Source	Octave Band Noise Data dBA								Overall Noise Level dBA
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Patron Noise									
5 Patrons	57.2	63.9	70.6	73.5	69.8	65.2	60.2	54.0	74.5
10 Patrons	61.7	68.4	75.1	78.0	74.3	69.7	64.7	58.5	79.0
20 Patrons	63.7	70.4	77.1	80.0	76.3	71.7	66.7	60.5	81.0
40 Patrons	66.7	73.4	80.1	83.0	79.3	74.7	69.7	63.5	84.0

Noise Source	Octave Band Noise Data dBA								Overall Noise Level dBA
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Slide 2x	65.4	72.1	78.8	81.7	78.0	73.4	68.4	62.2	82.7
Carpark									
1 car per lot per hour	30.5	40.5	51.5	51.5	51.5	51.5	45.5	40.5	57.9
Carpark Traffic 10 in 10 out	92.7	92.6	96.1	90.7	87.5	86.3	80.5	75.5	93.9
Carpark Traffic 20 in 20 out	95.8	95.7	99.2	93.8	90.6	89.4	83.6	78.6	97.0
Carpark Traffic 60 in 60 out	100.5	100.4	103.9	98.5	95.3	94.1	88.3	83.3	101.7

6.4 Noise Level Results

The predicted noise levels for the different modelling scenarios are listed in . As indicated previously, the relevant assessment time periods are defined as follows:

- 5:30 AM to 7:00 AM: Night time period.
- 7:00 AM to 6:00 PM: Day time period.
- 6:00 PM to 8:00 PM: Evening time period.

Furthermore, as per **Section 6.2**, Scenario 1 and 2 refer to typical operations and Scenario 3 refers to busy summer weekend days.

Table 6.2: Predicted Noise Levels

Receiver	Worst Case Day L_{eq},dB(A)	Typical Day L_{eq}, dB(A)	Evening L_{eq} dB(A) 6PM to 8PM	Early Morning L_{eq} dB(A) 5AM to 7AM
Noise Sources	120 Patron, 60 cars	40 Patron, 20 cars	20 Patron, 10 cars	20 Patron, 10 cars
Limit	**42**	**42**	**35**	**32**
R01 - 33 Longreach Court	36	29	28	28
R02 - 31 Longreach Court	36	32	29	29
R03 - 29 Longreach Court	36	32	29	29
R04 - 27 Longreach Court	36	31	28	28
R05 - 25 Longreach Court	34	30	27	27
R05 - 25 Longreach Court	34	30	27	27
R06 - 23 Longreach Court	33	29	26	26
R07 - 21 Longreach Court	32	28	25	25
R08 - 19 Longreach Court	31	26	23	23
R09 - 2 Dunn St	32	27	24	24
R10 - 4 Dunn St	31	27	24	24
R11 - 6 Dunn St	31	27	23	23
R12 - 10 Dunn St	30	25	22	22
R13 - 12 Dunn St	30	25	22	22

Receiver	Worst Case Day L_{eq}, dB(A)	Typical Day L_{eq}, dB(A)	Evening L_{eq} dB(A) 6PM to 8PM	Early Morning L_{eq} dB(A) 5AM to 7AM
R14 - 14 Dunn St	29	24	21	21
R15 - 16 Dunn St	28	24	20	20
R16 - 18 Dunn St	28	23	20	20
R17 - 32 Pryde St	27	23	17	17
R18 - 34 Pryde St	27	23	18	18
R19 - 36 Pryde St	28	23	19	19
R20 - 38 Pryde St	27	23	18	18
R21 - 40 Pryde St	27	23	18	18
R22 - 42 Pryde St	27	23	18	18
R23 - 42 Pryde St	27	23	18	18
R24 - 46 Pryde St	27	23	18	18
R25 - 48 Pryde St	26	22	17	17
R26 - 30 Pryde St	27	22	17	17
R27 - 26 Pryde St	27	22	18	18
R28 - 10 Gregory St	31	26	23	23
R29 - 42 Coranation Dr	31	27	24	24
R30 - 37 Longreach Court	35	30	28	28
R31 - 35 Longreach Court	35	30	29	29

As can be seen in **Table 6.2**, all calculated noise level are below limits, therefore no noise exceedance has been predicted. Due to the predicted noise compliance, no noise mitigation measures such as noise barriers or operational restrictions are considered to be necessary.

It is noted that noise mitigation barriers are not typically required for community pool facilities, even when located in residential areas. Noise emissions from such facilities are often relatively low, associated with swimming, people talking and fixed plant. Despite the relatively low noise, it is recommended that noise management is a priority for the site given the proximity of houses. In particular, noise management should particularly be considered for potential larger scale events (E.g. swimming carnival).

7. RECOMMENDATIONS

7.1 Overview

The following sections provide recommendations for noise management fixed plant design and use of the public address system.

7.2 Noise Management Plan

It is recommended that a Noise Management Plan be prepared for the site. Some recommended management measures for inclusion in the plan are listed below:

- Fixed plant:
  - Design and selection of plant as per **Section 7.3**
  - Regular maintenance of fixed plant according to manufacturer specifications.
- Management and restrictions on use of public address system (see **Section 7.4**)
- Provision of signage to keep noise to a minimum during early morning and evening operations.
- Major events should ideally be limited to 7 am to 6 pm only.

7.3 Mechanical Plant Noise Assessment

The project is expected to include air-conditioning plant, refrigeration plant and other exhaust fans. At this stage the mechanical design is not complete and therefore it is recommended that plant is designed and selected to achieve the above recommended noise limits. It is understood that the mechanical plant servicing the pool features will be fully enclosed in a building. Therefore, noise impacts on nearby residences can be effectively controlled through selection of appropriate construction materials (along with selection of site plant).

Consideration should also be given to the construction of acoustic screening to plant. A thorough assessment of the mechanical plant can be conducted at a future stage of the project design when the building plans are finalised and specific mechanical plant items are nominated.

7.4 Public Address

Noise from public address systems such as speakers or other amplified sound systems should be designed and limited to ensure their noise emissions are not intrusive and do not impact adversely on the nearby noise sensitive receivers.

Thus the proposed project is at its early design stage, public address system selection has not been confirmed. As good practice, the system should enable following within reasonable noise levels:

- Avoid interfering with the comfort of occupants and nearby noise sensitive places.
- Meet objectives of administration of the aquatic centre.
- Loud enough to ensure effective communication and safety of staff and occupants.

Potential noise impacts from the public address system onto nearby noise sensitive residences can be effectively managed through the following means:

- Low-power horn-type speakers should be used and located away from the closest noise sensitive receivers.
- Speakers should be mounted with a downward angles and should not face toward the nearest noise sensitive receivers (residential houses in this case).
- After an appropriate sound power level has been determined on site, public address system should be limited so that staff can not increase the sound power level.

8. RECOMMENDATIONS AND CONCLUSION

A noise impact assessment has been conducted for the proposed aquatic recreation centre at Lot 900 on SP152499, Tannum Sands. The results and recommendations of the assessment are as follows:

- Key noise sources for the site include patrons, vehicles using the car parks and mechanical fixed plant.
- Background noise levels in the area are defined by road traffic and typical residential activity. Acoustic measurements have been undertaken and the results are shown in **Section 4**.
- Background Plus noise criteria have been adopted based on the baseline noise monitoring. The acoustic criteria are outlined in **Section 5**.
- A noise impact assessment of the site noise emissions has been undertaken in **Section 6.** Full compliance with the adopted noise criteria has been predicted for different operating scenarios (e.g. typical day operations and busy operations during a summer period).
- Despite the compliant noise levels predicted, recommendations for noise management, mechanical fixed plant and the public address system are provided in **Section 7.**

Overall, the subject site represents a suitable location for the proposed aquatic centre provide the recommendations provided in this report are implemented.

APPENDIX A GLOSSARY

Parameter or Term	Description
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
Day	The period between 7am and 6pm.
Evening	The period between 6pm and 10pm.
Night	The period between 10pm and 7am.
Free-field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
L_1	The noise level exceeded for 1% of the measurement period.
L_{10}	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L_{90}	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L_{eq}	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.
$L_{eq,1hour}$	As for Leq except the measurement intervals are defined as 1 hour duration.
L_{max}	Maximum A-weighted sound pressure level.
L_{eq}(24 hour)	The average Leq noise level over the 24-hour period from midnight to midnight.
L_{10}(18 hour)	The arithmetic average of the one-hour L10 values between 6am and midnight. This parameter is used in the assessment of road traffic noise.
R_w	Weighted Sound Reduction Index – is a single number evaluation of the property of a partition to attenuate sounds. For the majority of partitions, the value of Rw will be similar to the value for STC. Partitions with particularly poor performance at 100 Hz may have lower values for Rw than for STC. Conversely, partitions with poor performance at 4000 Hz may have higher Rw than for STC. (As per AS1276.1-1999).
Habitable Rooms	According to the "Building Code of Australia" a Habitable Room is: " a room used for normal domestic activities and Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre, and sunroom, but Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods."
Acoustic fence	Solid, gap free fence with minimum panel surface density of 12.5kg/m^2.

APPENDIX B DRAWINGS

GLADSTONE REGIONAL COUNCIL

BOYNE TANNUM AQUATIC RECREATIONAL CENTRE

12537620

LOCALITY PLAN

NOT TO SCALE

3D CONCEPT VIEW

NOT TO SCALE

DRAWING INDEX

PROJECT No.	DRG NO. SHEET	DRAWING TITLE
1. ARCHITECTURAL		
12537620	A001	PROJECT COVER SHEET, LOCALITY PLAN & DRAWING INDEX
12537620	A050	SITE PLAN
12537620	A100	GENERAL ARRANGEMENT AND ROOF PLAN
12537620	A101	GENERAL ARRANGEMENT PLAN
12537620	A110	50m POOL & GRANDSTAND
12537620	A115	WATERSLIDE & SPLASH PAD
12537620	A400	ELEVATIONS & INTERNAL ELEVATIONS
12537620	A450	SECTIONS
2. CIVIL		
12537620	C100	GENERAL ARRANGEMENT PLAN
12537620	C101	CAR PARK LAYOUT
12537620	C102	EARTHWORKS CUT/FILL PLAN
12537620	C200	CORONATION DRIVE INTERSECTION
12537620	C400	TYPE SECTIONS - SHEET 1 OF 2
12537620	C401	TYPE SECTIONS - SHEET 2 OF 2
12537620	C410	ROAD LONG SECTION - CAR PARK
12537620	C800	SITE SERVICES PLAN
3. ELECTRICAL		
12537620	E001	NOTES, LEGEND & SCHEMATICS
12537620	E050	SITE RETICULATION PLAN
12537620	E100	INTERNAL LIGHTING LAYOUT
12537620	E101	CARPARK EXTERNAL LIGHTING LAYOUT
12537620	E110	POOL EXTERNAL LIGHTING LAYOUT
4. HYDRAULIC		
12537620	W100	MECHANICAL PIPEWORK SITE PLAN
12537620	W110	MECHANICAL PIPEWORK 50m POOL
12537620	W120	MECHANICAL PIPEWORK WATERSLIDE & SPLASH PAD
12537620	W130	MECHANICAL PIPEWORK FILTRATION ROOMS, HEAT PUMPS AND CHEMICAL DOSING
5. STRUCTURAL		
12537620	S100	SLAB, FOOTING AND ROOF FRAMING PLAN
12537620	S101	SWIMMING POOL SLAB PLAN, STORE ROOMS SLAB AND ROOF FRAMING LAYOUTS
12537620	S102	SWIMMING POOL SECTIONS AND DETAILS
12537620	S103	SWIMMING POOL BALANCE TANK DETAIL
12537620	S104	AWNING FOOTING AND FRAMING LAYOUT
12537620	S105	ELEVATION FRAMING LAYOUT

Rev	Description	Checked	Approved	Date
0	FINAL CONCEPT ISSUE	AC	DW	07.10.22

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Project BOYNE TANNUM AQUATIC RECREATIONAL CENTRE

Status FINAL CONCEPT ISSUE **Status Code** -

Drawing Title PROJECT COVER SHEET, LOCALITY PLAN & DRAWING INDEX

Size A1

Drawing No. 12537620-A001 **Rev** 0

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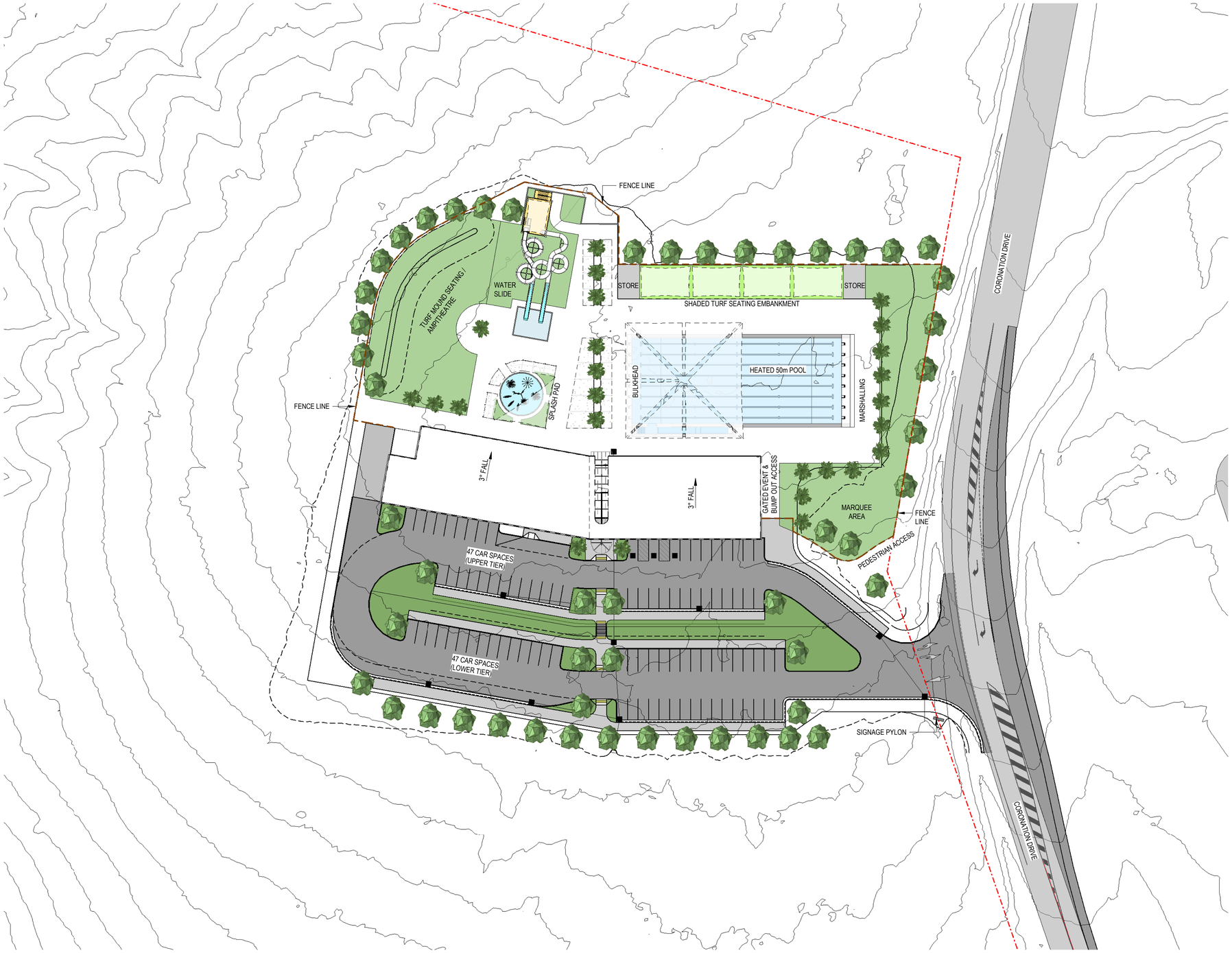

SITE PLAN
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Drawing Title ARCHITECTURAL SITE PLAN

Size A1

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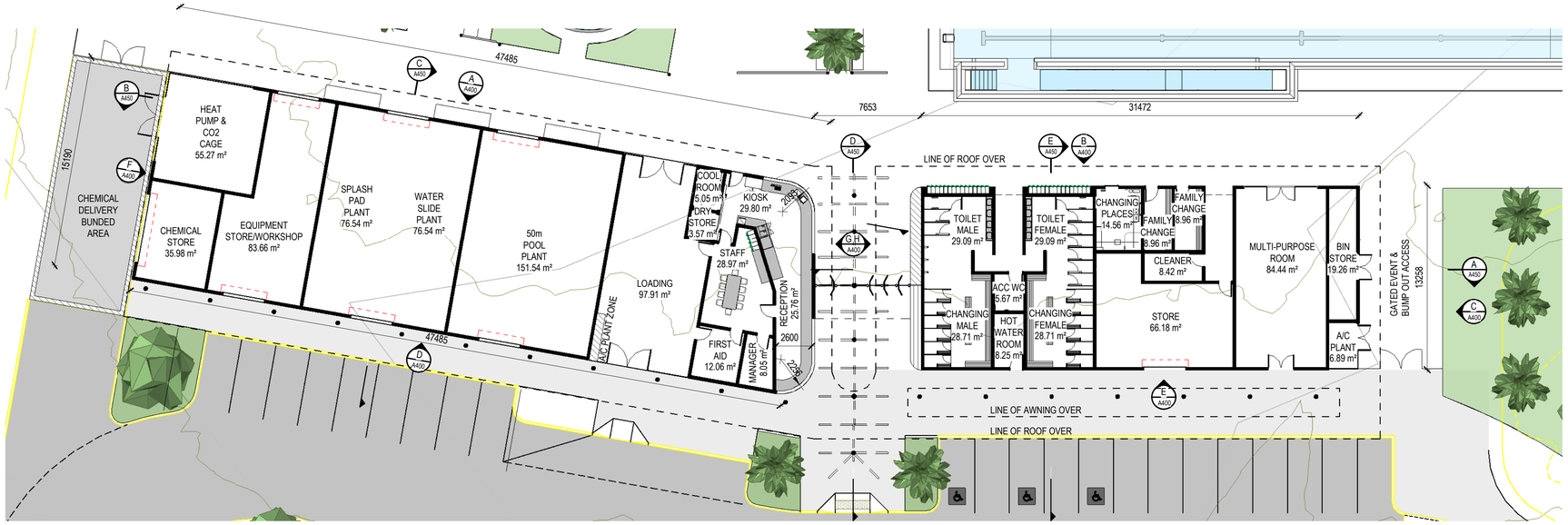

GENERAL ARRANGEMENT PLAN

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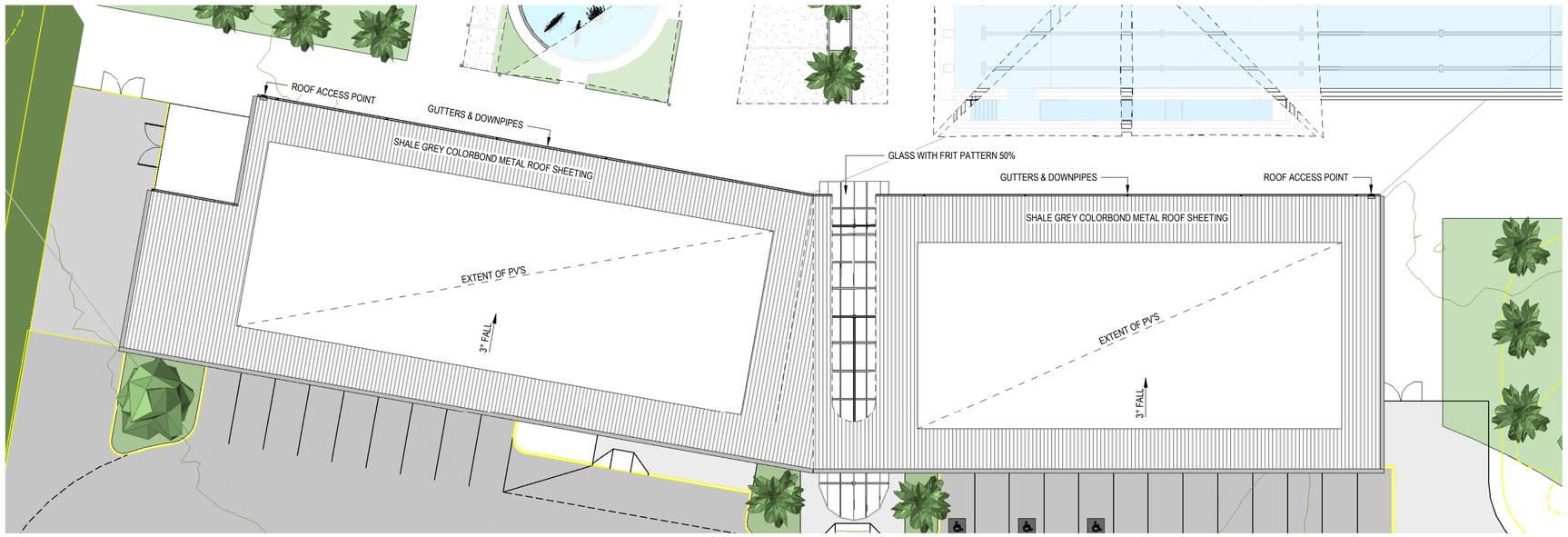

ROOF PLAN

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Status: FINAL CONCEPT ISSUE — Status Code: -

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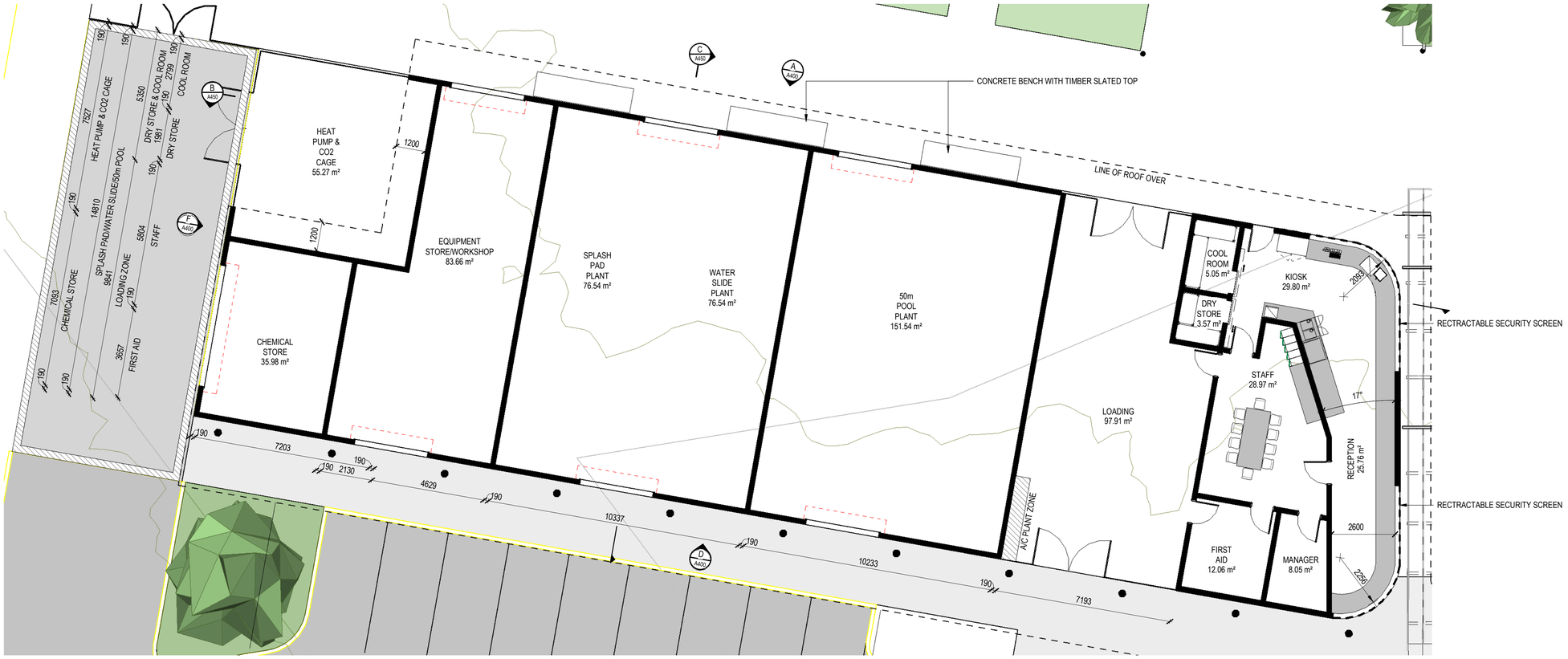

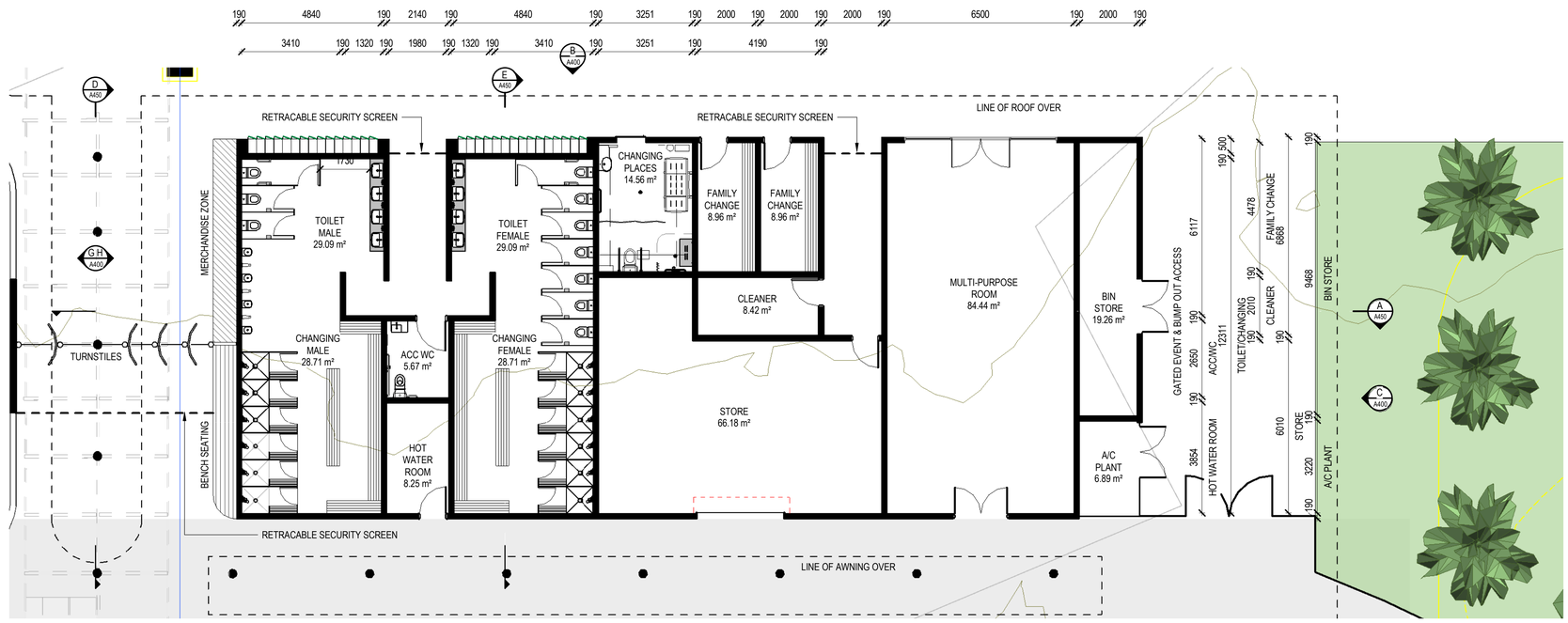

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Designer T.POTTER **Design Check** C.ACEVSKI

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Project BOYNE TANNUM AQUATIC RECREATIONAL CENTRE

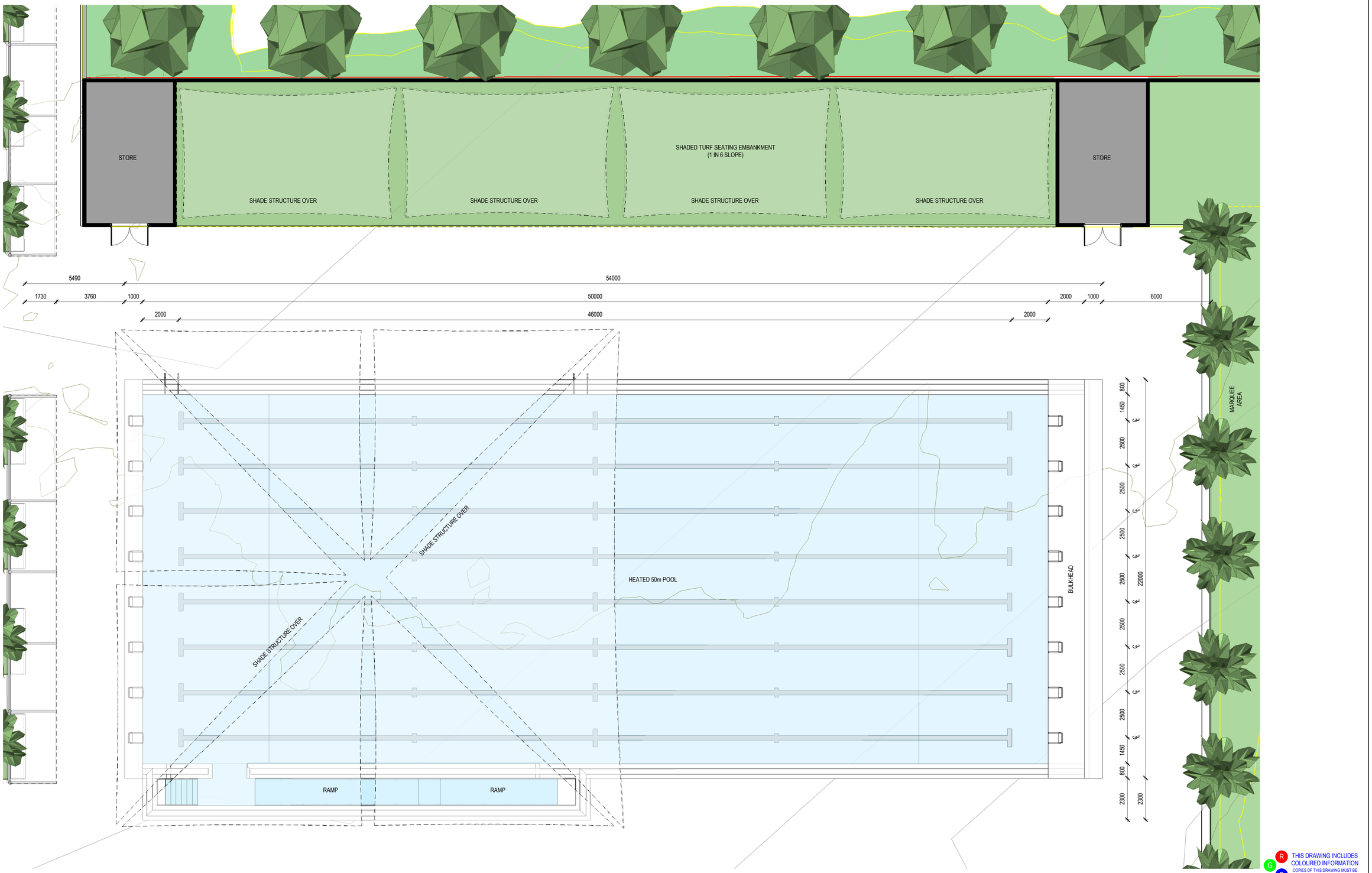
Status FINAL CONCEPT ISSUE **Status Code** -

Drawing Title ARCHITECTURAL GENERAL ARRANGEMENT PLAN

Size A1

Drawing No. 12537620-A101 **Rev** 0

Plot Date: 10/10/2022 4:30:16 PM File Name: Autodesk Docs://12537620 - Boyne Tannum Aquatic Centre/12537620 - Boyne Tannum_SITE.rvt



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Rev	Description	Checked	Approved	Date
0	FINAL CONCEPT ISSUE	AC	DW	07.10.22

Author H.TOLL **Drafting Check** C.CARMELITO
Designer T.POTTER **Design Check** C.ACEVSKI

0 1000 2000 3000 4000 5000 mm
SCALE 1:100 AT ORIGINAL SIZE

N

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Project BOYNE TANNUM AQUATIC RECREATIONAL CENTRE

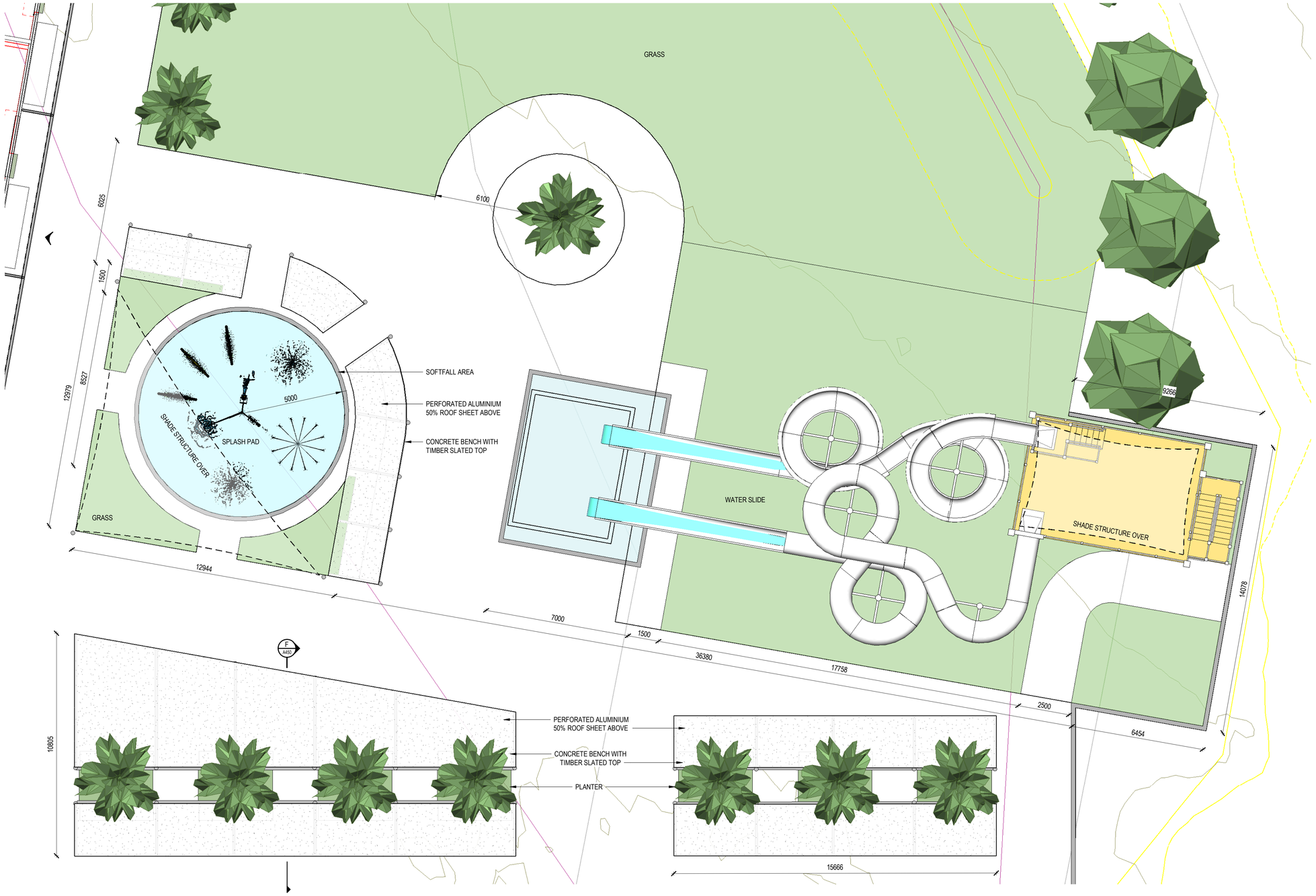
Status FINAL CONCEPT ISSUE **Status Code** -

Drawing Title ARCHITECTURAL 50m POOL & GRANDSTAND

Size A1

Drawing No. 12537620-A110 **Rev** 0

Plot Date: 10/10/2022 4:30:17 PM File Name: Autodesk Docs://12537620 - Boyne Tannum Aquatic Centre/12537620 - Boyne Tannum_SITE.rvt



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Status FINAL CONCEPT ISSUE | Status Code -

Drawing Title ARCHITECTURAL WATERSLIDE & SPLASH PAD

Size A1

Drawing No. 12537620-A115 | Rev 0

Plot Date: 10/10/2022 4:30:19 PM

File Name: Autodesk Docs://12537620 - Boyne Tannum Aquatic Centre/12537620 - Boyne Tannum_SITE.rvt

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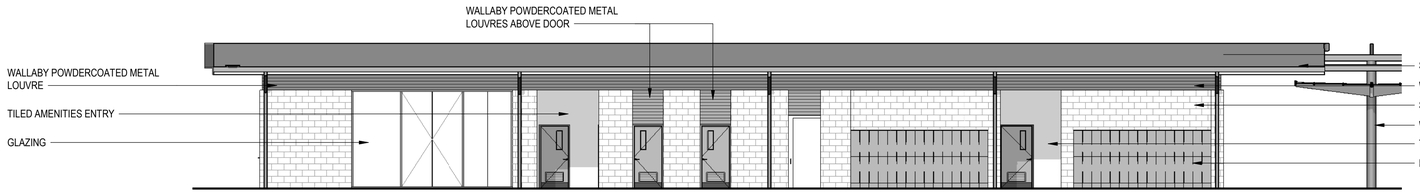

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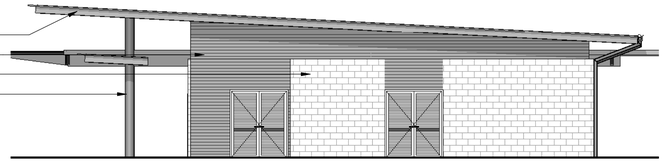

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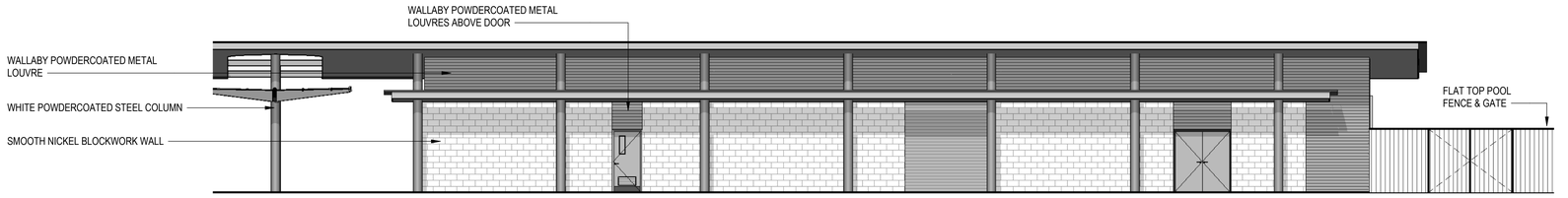

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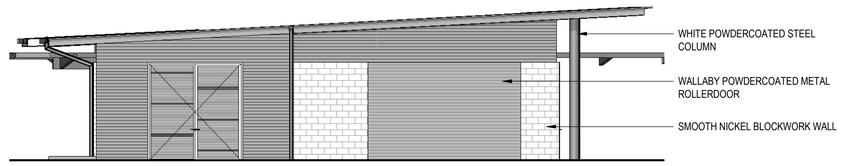

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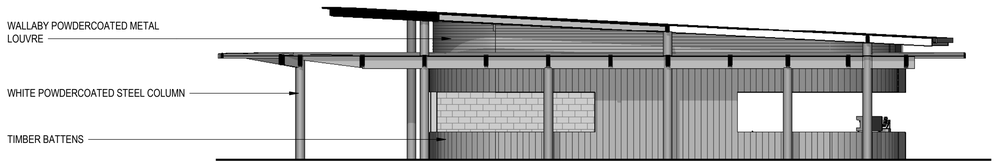

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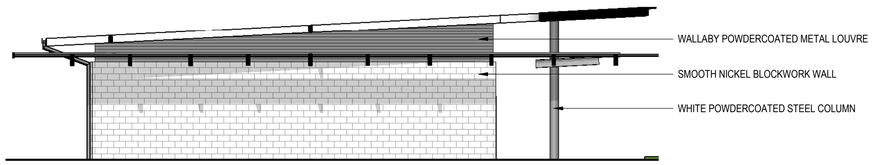

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0 1000 2000 3000 4000 5000 mm
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Project No. 12537620

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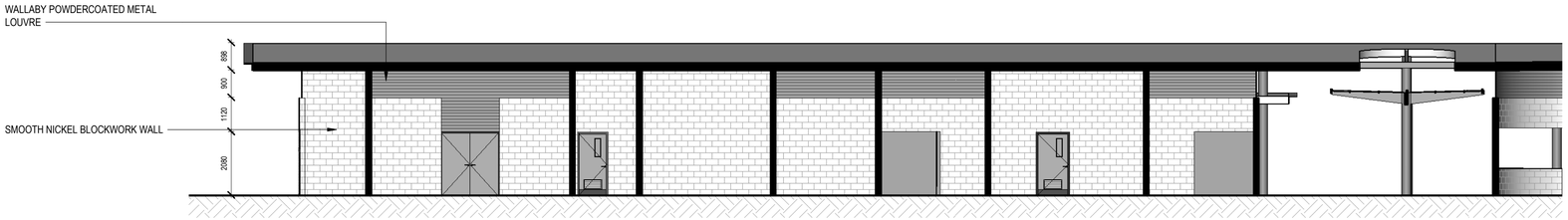
Project BOYNE TANNUM AQUATIC RECREATIONAL CENTRE
Status FINAL CONCEPT ISSUE **Status Code** -

Drawing Title ARCHITECTURAL ELEVATIONS & INTERNAL ELEVATIONS
Size A1
Drawing No. 12537620-A400 **Rev** 0

Plot Date: 10/10/2022 4:30:20 PM File Name: Autodesk Docs://12537620 - Boyne Tannum Aquatic Centre/12537620 - Boyne Tannum_SITE.rvt



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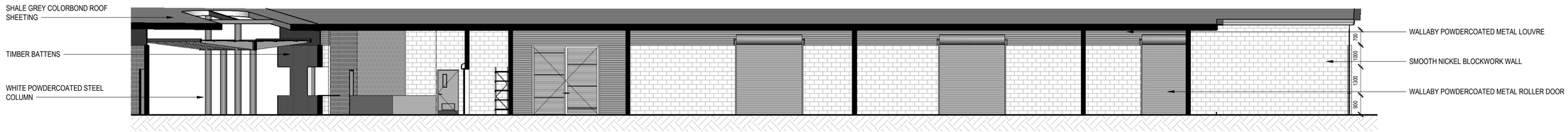

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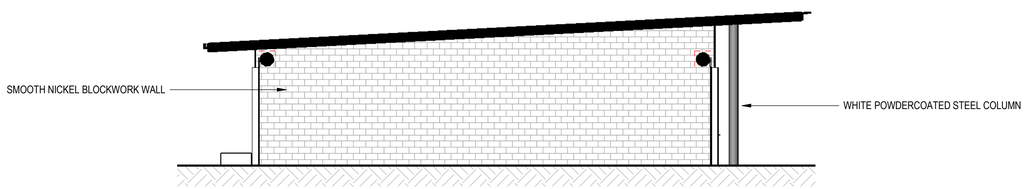

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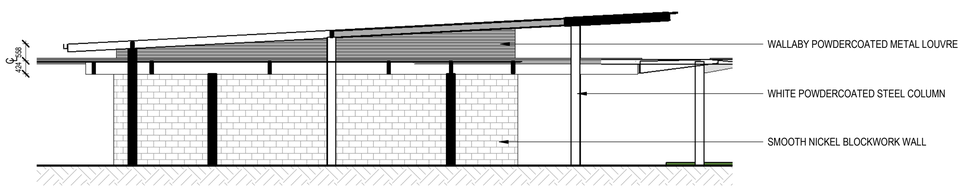

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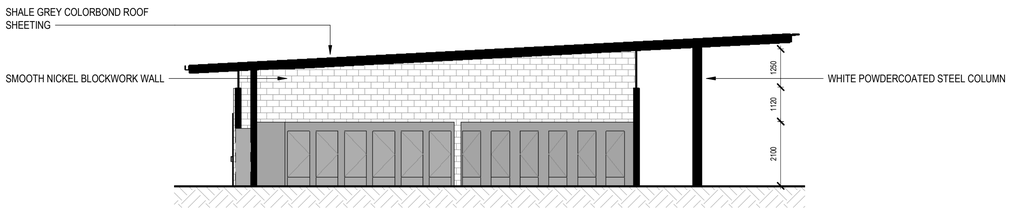

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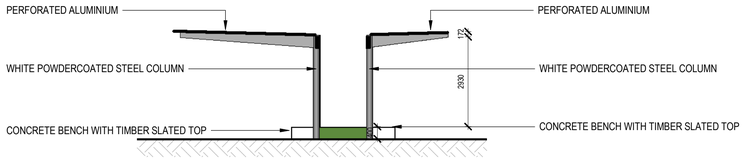

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Designer T.POTTER **Design Check** C.ACEVSKI

0 1000 2000 3000 4000 5000 mm
SCALE 1:100 AT ORIGINAL SIZE

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Project BOYNE TANNUM AQUATIC RECREATIONAL CENTRE
Status FINAL CONCEPT ISSUE **Status Code** -

Drawing Title ARCHITECTURAL SECTIONS
Size A1
Drawing No. 12537620-A450
Rev 0

Plot Date: 10/10/2022 4:30:21 PM File Name: Autodesk Docs://12537620 - Boyne Tannum Aquatic Centre/12537620 - Boyne Tannum_SITE.rvt

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APPENDIX 10: ACID SULFATE SOIL ASSESSMENT

AP10

CQ SOIL TESTING

Acid Sulfate Soil Assessment

SITE ADDRESS:	**Boyne Tannum Aquatic Recreational Centre** Lot 900 (SP152499) Coronation Drive, Tannum Sands
Prepared for:	PSA Consulting Pty Ltd
Job Number:	CQ21635
Issue Date:	21/12/2022

CQ SOIL TESTING technical excellence

ABN 87 656 845 448
QBCC License 15 305 465

PO Box 9654
Park Avenue QLD 4701

P (07) 4936 1163
F (07) 4936 1162

info@cqsoiltesting.com.au

Client & Document Information

Client:	PSA Consulting Pty Ltd
Project:	Lot 900 (SP152499) Coronation Drive, Tannum Sands
Investigation Type:	**Acid Sulfate Soil**
Job Number:	CQ21635
Date of Issue:	21/12/2022

Contact Information

CQ SOIL TESTING
ABN 87 656 845 448

PO Box 9654
PARK AVENUE QLD 4701

Telephone: (07) 4936 1163
Facsimile: (07) 4936 1162

Email: info@cqsoiltesting.com.au

Document Control

Version	Date	Author	Design Drawings	Reviewer	Reviewer Initials
A	21/12/2022	R Jackson	NA	Scott Walton	SWW
		B Blake			

1.0 Introduction

This report relates exclusively to the proposed aquatic centre at the address stated on page one of this report and has been prepared for the express purpose stated above. This document does not cover any other elements related to construction on the site.

2.0 Site Description

The subject site is a commercial type allotment, which fronts a sealed road.

The allotment is densely vegetated with large trees scattered throughout (see photographs). The proposed construction site falls primarily to the northwest and is considered to have fair. Surface water from the adjoining allotments may traverse the proposed construction site.

A site sketch is attached to this report.

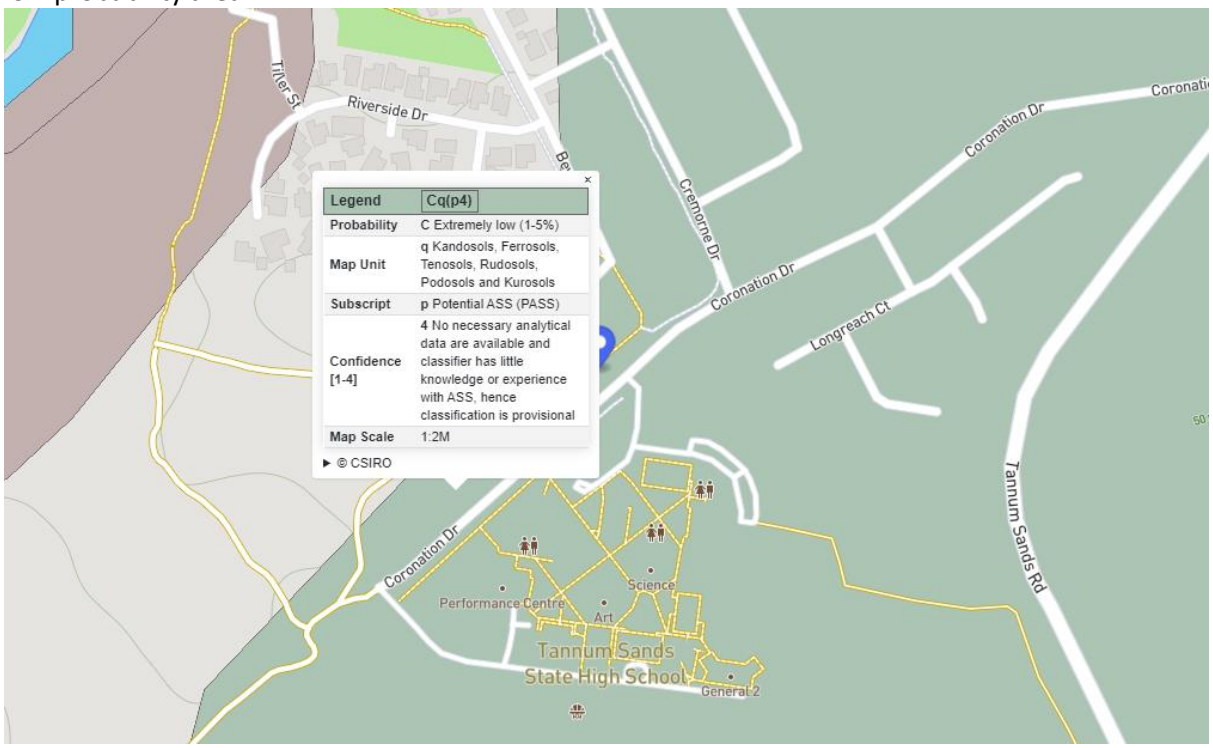
3.0 Soil Profile

Boreholes carried out at the site (refer attached site sketch for approximate localities) indicated a soil profile typically consisting of clay soil underlain by weather rock (see Appendix 2 for detailed logs and test results). Tungsten carbide refusal was encountered. Groundwater was not encountered during the site investigation

It is possible that the soil profile may vary across the site from those shown in the bore logs which were used for this site assessment. CQ Soil Testing are required to be notified if different conditions are encountered during construction. No allowance has been made for any substantial earthworks on the site or importing building platform material.

4.0 Acid Sulfate Soil Testing and Comments

The extract from the relevant acid sulfate soil potential mapping indicates the site is in an extremely low probability area.



Samples were recovered from the bore at regular depth intervals to 2.0 m depth for screening by measurement of pH after the addition of distilled water and peroxide (pH_f and pH_{fox} respectively). These preliminary tests give an indication of actual acidity due to previous oxidation and potential acidity due to unoxidized sulphides. To provide confirmation of the above qualitative testing, quantitative analytical testing was carried out on selected samples, generally with the greatest difference in pHf and pHfox readings and strongest reaction using the Chromium Suite method.

The testing was undertaken with reference to the Queensland Acid Sulfate Soil Technical Manual (QASSIT), the Soil Management Guidelines and the Laboratory Methods Guidelines.

Based on QASSIT Guidelines, the following criteria was adopted to determine the presence of Acid Sulfate Soils:

- pH_f of greater than 5.5 indicates the soil has little or no actual acidity.
- pH_{fox} of greater than 5 indicates that potential acid sulfate soils (PASS) is unlikely.
- The chromium reducible sulfar value (S_{CR}), where greater than 0.01%S indicates significant levels of sulfides and where greater than 0.03%S, exceeds QASSIT guideline values. All values recorded were <0.01%S indicating negligible levels of potential acid sulfate soils (PASS).
- Total actual acidity (TAA) values in excess of 17 mol/t exceed the QASSIT guideline values.

Generally, the action criterion from the chromium suite of tests, which triggers a requirement for ASS disturbance to be managed, derived from the Soil Management Guidelines is as follows:

- Net Acidity (TAA + SCR + SNAS) of greater than or equal to 0.03% S

The action criterion was not exceeded in either of the samples tested, indicating that the tested samples are not attributable to acid sulfate soils but more likely naturally acidic soils.

If you should have any queries regarding this report, please do not hesitate to contact the undersigned at your convenience.

Yours faithfully

BILLY BLAKE
Senior Geotechnical Engineer – RPEQ, CPEng, NER, MEIAust

SCOTT WALTON
Laboratory Manager

Soil Logs

BOREHOLE 1		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.4	CI	Gravelly Sandy CLAY, medium plasticity, fine to coarse grained, yellowish brown, D, VST.
0.4 0.7	CH	CLAY, high plasticity, with fine to coarse grained sand, reddish brown, D, VST.
0.7 1.0	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
1.0 1.1	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 1.1 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 2		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.4	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.4 0.7	CI	Silty CLAY, medium plasticity, trace fine to coarse grained sand and gravel, reddish brown, D, VST.
0.7 0.9	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 0.9 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 3		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.3	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.3 1.7	CI	Silty CLAY, medium plasticity, trace fine to coarse grained sand and gravel, reddish brown, D, VST.
1.7 1.9	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 1.9 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
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2300		
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2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 4		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.2	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.2 0.3	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 0.3 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
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2400		
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2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 5		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.2	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.2 0.3	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 0.3 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
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2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 6		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.2	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.2 0.7	CH	CLAY, high plasticity, with fine to coarse grained sand, reddish brown, D, VST.
0.7 1.7	CI	Silty CLAY, medium plasticity, trace fine to coarse grained sand and gravel, reddish brown, D, VST.
1.7 1.9	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 1.9 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 7		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.4		**With 'Floaters' throughout**

Tungsten carbide bit refusal at 0.4 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 8		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.2	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD.
0.2 0.8	CH	CLAY, high plasticity, with fine to coarse grained sand, reddish brown, D, VST.
0.8 0.9	CI	Silty CLAY, medium plasticity, trace fine to coarse grained sand and gravel, reddish brown, D, VST.
0.9 1.0	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, greyish brown, D, VD. **Weathered Rock**

Tungsten carbide bit refusal at 1.0 m

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Photographs

Image 1 – Cleared area adjacent to proposed development

Site Plan

- Not to scale
- All measurements are to be used as a guide only

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CERTIFICATE OF ANALYSIS

Report No. 22-6293
Rev No. 00

Client:	CQ Soil Testing Pty Ltd	Sample Date:	30/11/2022
Client Contact:	Scott Walton	Date Samples Received:	5/12/2022
Client Address:	PO Box 9654 Park Avenue QLD 4701	Date Analysis Commenced:	5/12/2022
		No. Samples Received:	29
Purchase Order #:		No. Samples Analysed:	29
Project / Site Ref:	CQ21635 - PSA Consulting - Boyne Tannum	Date Issued:	7/12/2022

Lab Ref No.			pH	pH_{FOX}	pH_{FOX} Reaction Rating
Units	Sample Description	Depth (m)	pH	pH	
LOR			0.1	0.1	
22-6293/1	BH1	0	6.8	4.3	X
22-6293/2	BH1	0.25	6.2	4.4	X
22-6293/3	BH1	0.5	6.3	4.6	X
22-6293/4	BH1	0.75	6.5	4.0	X
22-6293/5	BH1	1	5.8	3.4	X
22-6293/6	BH2	0	5.4	4.8	X
22-6293/7	BH2	0.25	5.6	5.3	X
22-6293/8	BH2	0.75	6.0	4.9	X
22-6293/9	BH3	0.25	6.3	4.9	X
22-6293/10	BH3	0.5	6.4	4.4	X
22-6293/11	BH3	0.75	6.1	4.1	X
22-6293/12	BH3	1	5.6	4.3	X
22-6293/13	BH3	1.25	5.5	3.6	X
22-6293/14	BH3	1.5	5.3	4.8	X
22-6293/15	BH3	1.75	5.3	4.7	X
22-6293/16	BH3	1.9	5.2	4.6	X
22-6293/17	BH4	0.25	5.9	4.8	X
22-6293/18	BH5	0.25	6.3	4.2	X
22-6293/19	BH6	0.25	6.5	5.3	X
22-6293/20	BH6	0.75	5.6	4.0	X
22-6293/21	BH6	1	5.3	3.8	X
22-6293/22	BH6	1.25	5.5	4.0	X
22-6293/23	BH6	1.5	5.2	4.8	X
22-6293/24	BH6	1.75	5.6	3.8	X
22-6293/25	BH7	0	6.0	4.7	X
22-6293/26	BH7	0.25	6.3	4.0	X
22-6293/27	BH8	0.25	6.2	4.6	X
22-6293/28	BH8	0.75	6.1	4.5	X
22-6293/29	BH8	1	7.1	4.4	X

Test Methodology: Analysis is conducted in accordance with inhouse method LAB300 which is in compliance with AS 4969-2008. Analysis Methods are derived from: Ahern CR, McElnea AE, Sullivan LA (2004). Acid Sulfate Soils Laboratory Methods Guidelines. Queensland Acid Sulfate Soils Manual 2004. Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

pH Screen Reaction Rating Table

Reaction Scale	Rate of Reaction
X	Slight Reaction
XX	Moderate Reaction
XXX	High Reaction
XXXX	Very vigorous reaction, gas evolved and heat generated, commonly >80ºC

Approved Signatory

Report Approved By: Lachlan Modina

Notes:

NATA Accreditation does not cover the sampling performance
OCTIEF accepts no responsibility for the collection, packaging and transportation of samples submitted by external parties
All samples are analysed as received and the results contained within this report relate only to the sample(s) submitted for analysis.
Measurement uncertainty data is available here.
NATA Accreditation Number: 15172
Accredited for compliance with ISO/IEC 17025- Testing
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CERTIFICATE OF ANALYSIS

Report No. 22-6608
Rev No. 00

Client:	CQ Soil Testing Pty Ltd	Date Samples Received:	16/12/2022
Client Contact:	Scott Walton	Date Analysis Commenced:	16/12/2022
Client Address:	PO Box 9654 Park Avenue QLD 4701	No. Samples Received:	2
		No. Samples Analysed:	2
Purchase Order #:		Date Issued:	20/12/2022
Project / Site Ref:	CQ21635		

Lab Ref No.	UNIT	LOR	22-6608-1	22-6608-2
Sample Desc.			BH01	BH3
Depth (m)			0	1.75
Sample Date			30/11/2022	30/11/2022
pH_{KCL}	pH Unit	0.1	6.6	5.3
Chromium Reducible Sulfur	%w/w S	0.005	<0.005	<0.005
Chromium Reducible Sulfur	mol H^+/t	3	<3	<3
TAA pH 6.5	mol H^+/t	5	<5	39
s-TAA pH 6.5	%S w/w	0.005	<0.005	0.063
KCl Ext S	%w/w S	0.005	<0.005	<0.005
HCl Ext S	%w/w S	0.005	<0.005	<0.005
Retained Acidity	%S	0.005	N/R	N/R
ANC	mol H^+/t	5	<5	<5
Net Acidity	mol H^+/t	5	<5	39
Net Acidity	%w/w S	0.005	<0.005	0.062
Net Acidity-ANC	mol H^+/t	5	<5	39
Liming Rate	kg $CaCO_3$/t	1	<1	3
Liming rate-ANC	kg $CaCO_3$/t	1	<1	3

General Comments

I. *OCTIEF accepts no responsibility for the collection, packaging and transportation of samples submitted by external parties*
II. *All samples are analysed as received (unless indicated otherwise) and the results contained within this report relate only to the sample(s) submitted for analysis.*
III. *Measurement uncertainty data is available here.*
IV. *NATA Accreditation Number: 15172*
V. *Accredited for compliance with ISO/IEC 17025 – Testing*
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VII. *Tests not covered by NATA are denoted with **

Report Comments

Test Methodology: Analysis is conducted in accordance with inhouse method LAB-300 which is in compliance with AS 4969-2008. Analysis Methods are derived from: Ahern CR, McElnea AE, Sullivan LA (2004). Acid Sulfate Soils Laboratory Methods Guidelines. Queensland Acid Sulfate Soils Manual 2004. Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.
Notes:

1. Net Acidity = Actual Acidity + Retained Acidity + Potential Sulfidic Acidity.
2. ANC is typically only included in the Net Acidity calculation where the neutralising capacity of the soil has been corroborated with other data.
3. Retained Acidity required where pHKCl <4.5. Retained Acidity (SNAS) calculated as (2 * S-HCl) - S-KCl.
4. Acid Neutralising Capacity is required only where pHKCl >=6.5, however, the ANC results have been reported to identify any previous lime dosing.
5. Liming Rate calculation and Acidity - ANC calculation assumes the use of agricultural lime and incorporates a safety factor of 1.5.
6. The neutralising capacity for Ag lime is 96, hence to convert from kg $CaCO_3$ to kg Ag Lime ($CaCO_3$/t), multiply by 100/96.
7. N/R denotes Not Required.

Report Approved By: Lachlan Modina

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CERTIFICATE OF ANALYSIS

Report No. 22-6379
Rev No. 00

Client:	CQ Soil Testing Pty Ltd	Date Samples Received	5/12/2022
Client Contact:	Scott Walton	Date Analysis Commenced:	5/12/2022
Client Address:	PO Box 9654	No. Samples Received:	8
	Park Avenue QLD 4701	No. Samples Analysed:	8
Purchase Order #:		Date Issued:	7/12/22
Project / Site Ref:	PSA Consulting - Boyne Tannum	Temperature (°C):	

Laboratory ID	Sample Description	Sample Date	pH in Soil (1:5 Aq. Extract)	Total Dissolved Solids*	Sulfate (1:5 Aq. Extract)*	Chloride (1:5 Aq. Extract)*
Method			LAB-309	LAB-355	LAB-358	LAB-356
Units			pH Units	mg/kg	mg/kg	mg/kg
LOR			0.1	2	1	1
22-6379/1	BH4 - 0.0m	30/11/2022	5.8	157	11	32
22-6379/2	BH8 - 0.0m	30/11/2022	5.4	97	6	18
22-6379/3	BH6 - 0.5m	30/11/2022	4.6	157	28	26
22-6379/4	BH8 - 0.5m	30/11/2022	4.8	181	37	30
22-6379/5	BH5 - 0.0m	30/11/2022	5.8	134	9	19
22-6379/6	BH2 - 0.5	30/11/2022	5.2	613	20	136
22-6379/7	BH2 - 0.8m	30/11/2022	5.8	265	18	59
22-6379/8	BH6 - 0.0m	30/11/2022	5.0	137	20	28

General Comments

Notes:

ACCREDITED FOR TECHNICAL COMPETENCE

I. OCTIEF accepts no responsibility for the collection, packaging and transportation of samples submitted by external parties
II. All samples are analysed as received and the results contained within this report relate only to the sample(s) submitted for analysis.
III. Measurement uncertainty data is available here.
IV. NATA Accreditation Number: 15172
V. Accredited for compliance with ISO/IEC 17025 – Testing
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Approved Signatory

Report Approved By: Lachlan Modina

Limitations

1. Recommendations given in this report are based on the information supplied by the client regarding the proposed building construction in conjunction with the findings of the investigation. Any change in construction type, building location or omission in the client supplied information, may require additional testing and/or make the recommendations invalid.

2. The recommendations herein may identify a target soil stratum into which the footings should be founded. The target stratum has been located by the depth in mm of the target stratum's upper horizon boundary below the existing ground surface level at the time of the site investigation. Any cutting or filling works and any surface erosion or deposits subsequent to the site investigation, will alter the measured location of the stratum relative to the surface. Where required, the author should be notified in such cases to confirm the location of the target stratum.

3. The description of the soil given in Section 3.0 of this report is intended as a brief overview of the soil's primary constituents. For a detailed classification of the soil, the reader should refer to the Soil Profile Reports and/or Borehole Reports.

4. Every reasonable effort has been made to locate the test sites so that the borehole profiles are representative of the soil conditions within the area investigated. The client should be made aware however, that exploration is limited by time available and economic restraints. In some cases soil conditions can change dramatically over short distances, therefore, even careful exploration programs may not locate all the variations.

5. If soil conditions different from those shown in this report are encountered or are inferred from other sources, then the author must be notified immediately.

6. This report may not be reproduced except in full, and only then with the permission of the entity trading as CQ Soil Testing. The information and site sketch shall only be used and will only be applicable for the development shown on the client-supplied information provided for this site.

7. All information contained within this report is the intellectual property of the entity trading as CQ Soil Testing. All information contained with can only be used for the express purposes of the commissioned scope of works.

8. Any dimensions, contours, slope directions and magnitudes shown on the site sketch plan shall not be used for any building construction or costing calculations. The purpose of the plan is to show approximate location of field tests only.

9. Any changes made to these recommendations by persons unauthorized by the author will legally be interpreted at that person assuming the responsibility for the long-term performance of the footing system.

10. The recommendations contained in this report have not taken into consideration the long term effects of any previous, current or potential subsurface work by mining companies or potential slope instability problems. At the time of writing this report neither our client (nor his agent) nor the local authority had made the author aware that these problems may be affecting this allotment. If a mining subsidence or slope stability assessment is required for this allotment, the recommendations of a suitably qualified geotechnical engineer should be sought.

11. Removal of trees from a site before an investigation can cause significant swelling of the soil over large areas. The removal of large trees from a construction site during development is rarely picked up during the investigation phase and is generally outside the scope of AS2870. Sites affected by large trees are often classified "P". If, during the footing excavation, it is noticed that there are soils with varying moisture contents or evidence of large trees having been removed CQ Soil Testing should be notified immediately.

12. The following documents are available from the CSIRO and QBCC and shall be read and adhered to in relation to this site:

    - Builder's Guide to Preventing Damage to Dwellings- Part 1 Site Investigation and Preparation http://www.publish.csiro.au/nid/22/pid/3621.htm
    - Builder's Guide to Preventing Damage to Dwellings- Part 2 Sound Construction Methods http://www.publish.csiro.au/nid/22/pid/3661.htm
    - QBCC Subsidence Fact Sheet https://www.qbcc.qld.gov.au/sites/default/files/Homeowner%27s%20Guide%20to%20Subsidence.pdf