

Report

Tully BESS Stormwater Management Plan & Flood Assessment

Attexo

15 December 2025



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Project Name	Tully BESS Stormwater Management Plan & Flood Assessment
Client	Attexo
Client Project Manager	Sue Walker
Water Technology Project Manager	Carl Wallis
Water Technology Project Director	Andrew Thompson
Authors	Mary-Anne Kossen Danni-Elle Clowes
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Level 5, 43 Peel Street
South Brisbane QLD 4101
Telephone (07) 3105 1460
Fax (07) 3846 5144
ACN 093 377 283
ABN 60 093 377 283





ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.



Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- Seven circles representing each of the States and Territories in Australia where we do our work
- Blue dots between each circle representing the waterways that connect us
- The animals that rely on healthy waterways for their home
- Black and white dots representing all the different communities that we visit in our work
- Hands that are for the people we help on our journey



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1 INTRODUCTION

Water Technology (WT) has been engaged by Attexo to prepare a Stormwater Management Plan (SMP) and Flood Assessment (FA) for the proposed Tully battery energy storage system (BESS), situated south of Tully in the Cassowary Coast Regional Council (CCRC) Local Government Area (LGA) in far north Queensland. The Location of the proposed site is presented in Figure 1-1.

1.1 Proposed Development

Attexo are assisting RWE Renewables Australia Pty Ltd (RWE) in submitting a development application for a proposed BESS, occupying an area of approximately 28.7 hectares (ha), that comprises of two freehold parcels, Lot 1 on RP735276 and Lot 1 on RP852238. The site is situated approximately 4 km south-west of Tully. The project is expected to have an approximate capacity of up to 200 MW / 800 MWh with grid connection proposed via the Powerlink owned 132 kV existing Tully Substation, located to the northeast on Lot 1 on RP716718. Figure 1-2 illustrates the BESS area with the layout of the batteries and supporting infrastructure. The proposal includes:

- BESS development area including earthworks, temporary construction ancillary facilities, foundations for installation of containerised battery system, drainage works, appropriate fencing, perimeter and site access road.
- An easement for an overhead electrical infrastructure connection running from the north of the BESS area to substation on the adjoining lot.
- Site access road off Sandy Creek Road.

1.2 Assessment Objectives and Scope

This report describes a conceptual SMP and FA to support the proposal and includes:

- A review and summary of relevant planning and legislative requirements as they relate to stormwater management and flooding.
- Identification of Environmental Values (EV's) and Water Quality Objectives (WQO's) applicable to the development.
- A SMP documenting the methodology and outcomes of the assessments undertaken to demonstrate that the proposed development achieves the stormwater quality requirements of CCRC and the Queensland State Government, including:
 - Compliance with the relevant Performance Outcomes associated with The Department of State Development, Infrastructure and Planning (DSDIP) State Code 9: Great Barrier Reef wetland protection area¹.
 - Details of construction phase erosion and sediment control measures.
 - MUSIC modelling to quantify changes to stormwater runoff quality during the operational phase.
 - Conceptual sizing of stormwater quality management measures to meet the relevant WQO's.
- A FA documenting modelling undertaken to characterise existing overland flow flood behaviour within and surrounding the site and quantify potential impacts of the proposal on overland flow flooding as well as:
 - Development of a local flood model (using TUFLOW) to characterise existing overland flow behaviour.
 - High-level recommendations to minimise impacts of flooding on the development.
 - Quantification of hydraulic impacts associated with the development and high-level recommendations to ensure the development does not cause material impacts on flooding external to the site.

¹ Queensland Department of State Development, Infrastructure, Local Government and Planning, Planning guidance – State Code 9: Great Barrier Reef wetland protection areas, 18/02/2022

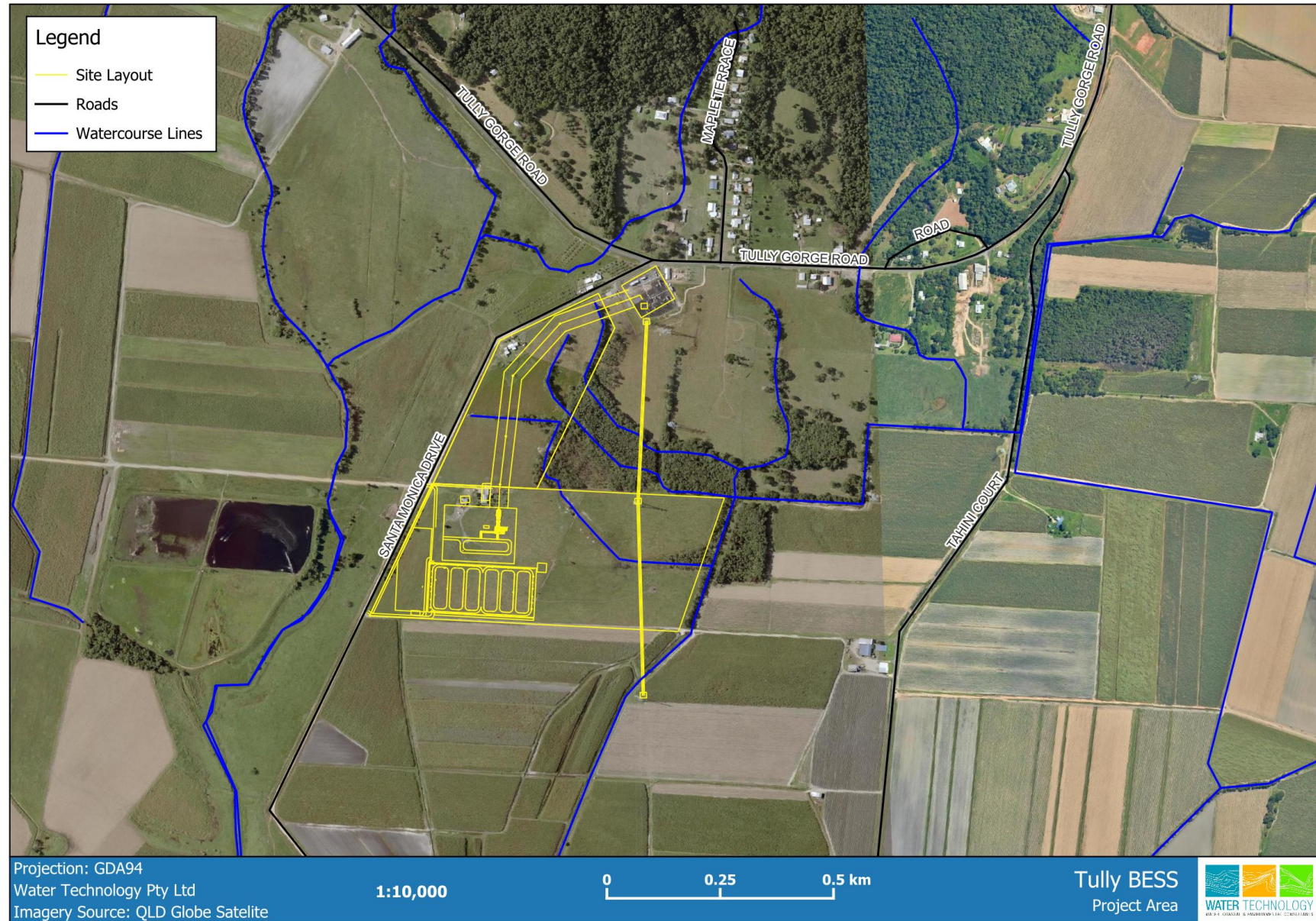


Figure 1-1 Tully BESS – Site Location





2 LEGISLATIVE CONTEXT

There are a number of legislative acts and policies in Queensland that govern development throughout the state. Those that are particularly relevant to the proposed Tully BESS in the context of the SMP are detailed in the following sections.

2.1 Environmental Protection Act 1994

The stated object of the act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development). Subordinate to this act is the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 whose purpose is to achieve the *Environmental Protection Act (1994)* objectives in relation to waters and wetlands.

2.1.1 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP Water) is designed to uphold the objectives of the *Environmental Protection Act 1994* concerning the protection of Queensland's water environment while permitting ecologically sustainable development. It aims to determine Environmental Values (EV's) and Water Quality Objectives (WQO's) for Queensland waters progressively. EV's define water uses by both aquatic ecosystems and humans (such as drinking water, irrigation, aquaculture, and recreation), while WQO's set objectives for the physical, chemical, and biological characteristics of water (including nitrogen content, dissolved oxygen, turbidity, toxicants, and fish health).

The policy adopts the management framework outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) to guide its implementation.

2.2 Water Act 2000

The purpose of the act, with relevance to the project, is to provide a framework for the sustainable management of Queensland's water resources. This requires:

- Incorporating the principles of ecologically sustainable development;
- Sustaining the health of ecosystems, water quality, water-dependent ecological processes and biological diversity associated with watercourses, lakes, springs, aquifers and other natural water systems, including where practicable, reversing degradation that has occurred; and
- Recognising the interests of Aboriginal people and Torres Strait Islanders and their connection with water resources.

Subordinate to this act is the Water Plan (Wet Tropics) 2013. The Water Plan provides a framework for sustainable water management balancing human development with environmental systems including the reversal of degradation in natural ecosystems.

2.3 Planning Act 2016

The *Planning Act 2016* is the primary piece of legislation that governs land use planning and development in Queensland. It establishes a framework for the preparation and implementation of planning schemes that regulate the use of land in Queensland. The development of 'battery storage facilities' advances the purpose of the Planning Act under section 5 (c) and (h):

- c. promoting the sustainable use of renewable and non-renewable natural resources, including biological, energy, extractive, land and water resources that contribute to economic development through employment creation and wealth generation



h. supplying infrastructure in a coordinated, efficient, and orderly way.

2.3.1 Planning Regulation 2017

The Planning Regulation 2017 is subordinate to the *Planning Act 2016*, detailing operational elements of the Planning Act. The Planning Regulation sets out the only land use terms that may be adopted in local planning schemes in Schedule 3. These are complemented by the use terms defined in Schedule 24 of the Planning Regulation. Battery storage facilities have not yet been given a State Code with assessable benchmarks under the State Development assessment Provisions.

2.3.2 State Code 9: Great Barrier Reef Wetland Protection Areas

The project site is located within the designated Great Barrier Reef wetland protection areas, as defined by the Map of Great Barrier Reef Wetland Protection Areas under State Code 9: Great Barrier Reef Wetland Protection Areas. Table 2-1 lists the performance outcomes from State Code 9 that are applicable to this SMP.

Table 2-1 State Code 9: Great Barrier Reef wetland protection areas

Performance outcomes
Hydrology
PO3 Development maintains or improves the existing surface and groundwater hydrology in a wetland protection area.
Water Quality
PO4 Development does not unacceptably impact the water quality of the wetland in the wetland protection area and in the wetland buffer
PO5 Development does not use the wetland in the wetland protection area for stormwater treatment

2.3.3 State Planning Policy (SPP) – Water Quality

The State Planning Policy (SPP) ensures Queensland's state interests are delivered through local planning and development assessment. The SPP identifies water quality as a state interest, and local governments must reflect it in their planning schemes; where a scheme has not fully integrated a state interest, the SPP's interim development assessment requirements apply. Development must achieve post-construction stormwater design objectives, including minimum reductions in:

- Total Suspended Solids (TSS): 80%
- Total Phosphorus (TP): 60%
- Total Nitrogen (TN): 45%
- Gross Pollutants (>5 mm): 90%

These are typically achieved through water sensitive urban design (WSUD) measures such as bioretention basins, swales, and gross pollutant traps (GPT).

2.3.4 Cassowary Coast Regional Council Planning Scheme 2015 (V4)

The Cassowary Coast Regional Council Planning Scheme advances state and regional policies through detailed local provisions. While the scheme does not specifically define Battery Energy Storage Systems (BESS), development remains subject to relevant zoning provisions and infrastructure standards, including stormwater management requirements specified in the desired standards of service. These provisions align with the State Planning Policy (SPP) – Water Quality objectives discussed in Section 2.2.



2.3.4.1 Desired Standards of Service

Section 4.4 of the Planning Scheme specifies the desired standards of service for the stormwater network:

1. Collect and convey stormwater in a system of natural and engineered channels, a piped drainage network and system of overland flow paths to a lawful point of discharge in a safe manner that minimises nuisance, damage and inundation of habitable rooms and protects life;
2. Manage the water quality within urban catchments and waterways to protect and enhance environmental values and pose no health risk to the community;
3. Adopt water-sensitive urban design principles and on-site water quality management to achieve relevant water quality objectives;
4. The design of the stormwater network is in accordance with the FNQROC Regional Development Manual – Issue 7 (2017).

2.4 Fisheries Act 1994

The primary purpose of this act as stated is to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to apply and balance the principles of and promote ecologically sustainable development. Of relevance to this project, this act manages the introduction of waterway barrier works that may impact fish movement through the project area.

2.5 Vegetation Management Act 1999

The *Vegetation Management Act 1999* provides a comprehensive framework for vegetation management in Queensland, including the protection of riparian vegetation, while the specific policies and guidelines for the protection and management of riparian vegetation in Queensland aim to ensure that this unique and important type of vegetation is protected and preserved for future generations. These include the following:

- Vegetation Management Regulation 2012: Subordinate to the Vegetation Management Act 1999 and provides accepted development vegetation clearing codes.
- Queensland Government Riparian Vegetation Management Guidelines: Provides guidance on the management of riparian vegetation and aims to ensure that riparian areas are protected and managed in an ecologically sustainable manner.
- State Planning Policy: Sets out the Queensland government's position on the protection of riparian vegetation and the requirement for local governments to include provisions for the protection of riparian areas in their planning schemes.
- Regional Ecosystems: Defined areas within Queensland that have similar vegetation types and ecological characteristics and include specific provisions for the protection and management of riparian vegetation.

2.6 Soil Conservation Act 1986

This act relates to the conservation of soil resources and mitigation of soil erosion through soil conservation measures.



2.7 Non-Statutory Water Quality Guidelines

2.7.1 Reef 2050 Water Quality Improvement Plan

The Reef 2050 Water Quality Improvement Plan is a strategic framework designed to safeguard the health of the Great Barrier Reef's marine ecosystems. It focuses on reducing sediment runoff, nutrient pollution, and pesticide contamination. Key elements include targeted actions, improved land management practices, robust monitoring, community engagement, research, and adaptive management. The plan involves stakeholders from various sectors and emphasizes the use of best management practices to minimize environmental impact.

These guidelines list specific water quality objectives for relevant catchments to achieve 2025 Great Barrier Reef water quality targets. This site is situated in the Tully Catchment which covers 1,683 km² (8% of the Wet Tropics region).

Table 2-2 summarises the 2025 end-of catchment anthropogenic water quality targets for the Tully Catchment and associated priorities for water quality improvement.

Table 2-2 End-of-catchment anthropogenic load reductions required from 2013 baseline

Region: Wet Tropics Region, Tully catchment water quality targets		
Parameter	Target	Management Priority
Dissolved inorganic nitrogen (DIN)	190 tonnes, 50% reduction	High
Fine sediment	17 kilo-tonnes, 20% reduction	Low
Particulate phosphorus (PP)	23 tonnes, 20% reduction	Low
Particulate nitrogen (PN)	68 tonnes, 20% reduction	Low
Pesticides	n/a	Low

2.7.2 Wet Tropics Water Quality Improvement Plan

The Wet Tropics Water Quality Improvement Plan (WQIP) was developed to establish and achieve water quality targets for the region, ensure the protection of the Great Barrier Reef. The plan identifies priority areas and outlines targeted management actions that aim to reduce pollutant loads, improve land management practises and enhance ecosystem resilience.

The short-term water quality and land management targets are in accordance with the broader Reef 2050 Water Quality Improvement Plan, reinforcing efforts to protect coastal and marine environments. The Wet Tropics region is divided into distinct catchment areas to facilitate localised and strategic interventions. Key pollutants of concern include fine sediment, nutrients and pesticides, which originate mainly from agriculture activities. While some catchments have been identified as priority areas for investment, the plan promotes a proactive and preventative approach to managing water quality risks across the region, ensuring long-term sustainability.

2.7.3 Application to the Project

While the Reef 2050 WQIP and the Wet Tropics WQIP are not statutory instruments, adopting their catchment-specific targets and best-practice measures supports compliance against State Code 9 by

- (a) maintaining or improving site hydrology (PO3),
- (b) preventing unacceptable water quality impacts to wetlands and their buffers (PO4), and
- (c) ensuring wetlands are not used as part of the stormwater treatment system (PO5).



2.8 Other Relevant Guidelines

In addition to relevant legislation, several surface water and stormwater management guidelines have been considered to ensure best practice methods and design outcomes are utilised at Tully BESS. These include:

- Australian and New Zealand Governments (ANZG) 2018, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- Australian Drinking Water Guidelines, 2011 (Updated August 2018).
- Queensland Urban Drainage Manual, 2017.
- Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia - Geoscience Australia, 2019.
- Best Practice Erosion and Sediment Control, IECA, 2008.



3 CATCHMENT HYDROLOGY AND SITE CHARACTERISTICS

3.1 Topography and Catchments

The Tully catchment is located in the south of the Wet Tropics region. The location surrounding the site is relatively flat, with lower-lying regions at approximately 4 mAHD and higher elevations at 30 mAHD, the site topography is shown in Figure 3-1. The site is situated in the lower part of the Tully River Drainage Basin, which occupies an area of approximately 1,675 km² extending south from Innisfail, as shown in Figure 3-2. The Tully River Basin drains primarily to the Pacific Ocean, with additional contributions from the Hull River and smaller tributaries. Given the region's high rainfall and complex topography, the site is subject to dynamic hydrodynamic processes, including floodplain inundation, overland flow, and potential backwater effects from downstream constraints.

3.2 Land Use

The project area is predominantly used for grazing native vegetation, as identified by the Queensland Land Use Mapping Program. The surrounding catchment features also include areas of Environmental Significance according to Cassowary Coast Regional Council online planning scheme mapping, as shown in Figure 3-3.

3.3 Great Barrier Reef Wetland Protection Areas

Figure 3-4 shows the location of the mapped Great Barrier Reef Wetland Protection Areas in the vicinity of the project. The areas of high ecological significance identified in this dataset closely correspond to the areas of Environmental Significance shown in the Cassowary Coast Regional Council online planning scheme mapping, which includes mapped wetlands near the site. The proposed infrastructure has been designed to be located wholly outside these mapped high ecological significance areas.

However, the site is within the mapped Great Barrier Reef Wetland Protection Area trigger area, which means the development must be assessed against the provisions of State Code 9: Great Barrier Reef Wetland Protection Areas under the State Development Assessment Provisions (SDAP). Compliance with State Code 9 performance outcomes is addressed in Section 5.5.3.

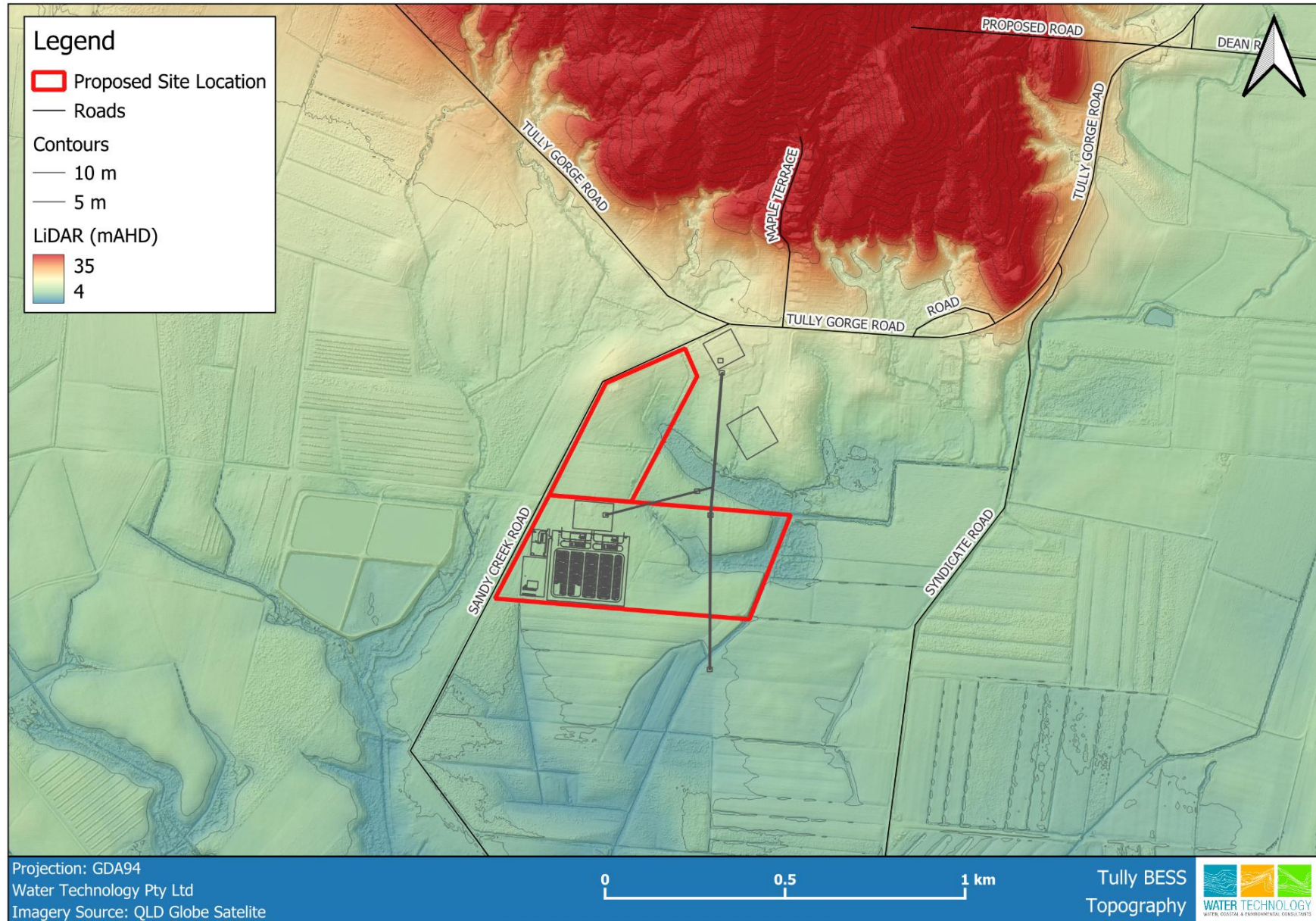


Figure 3-1 Site Topography and Local Catchment

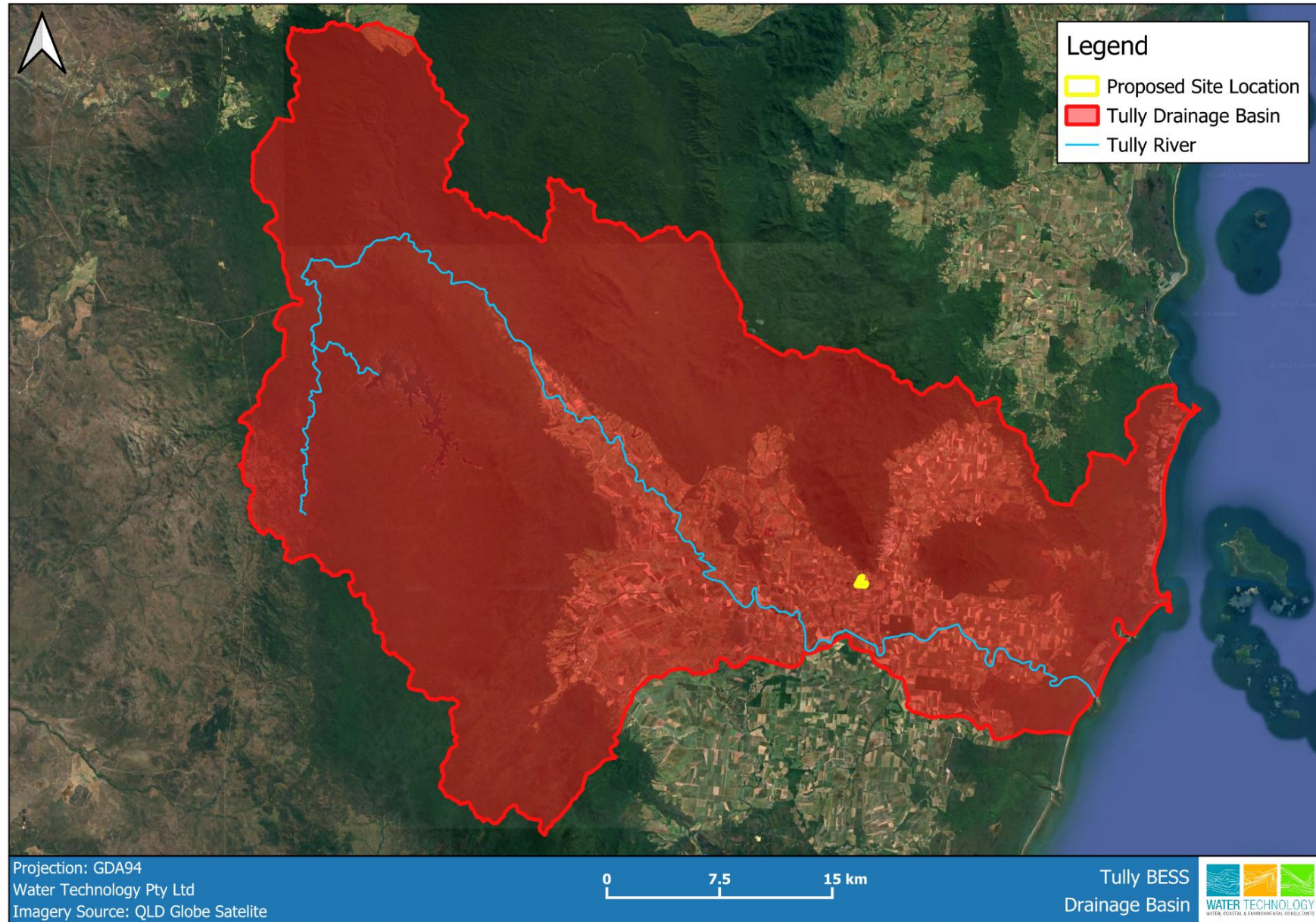


Figure 3-2 Tully Drainage Basin



Figure 3-3 Areas of Environmental Significance (Cassowary Coast Regional Council Online Planning Scheme)

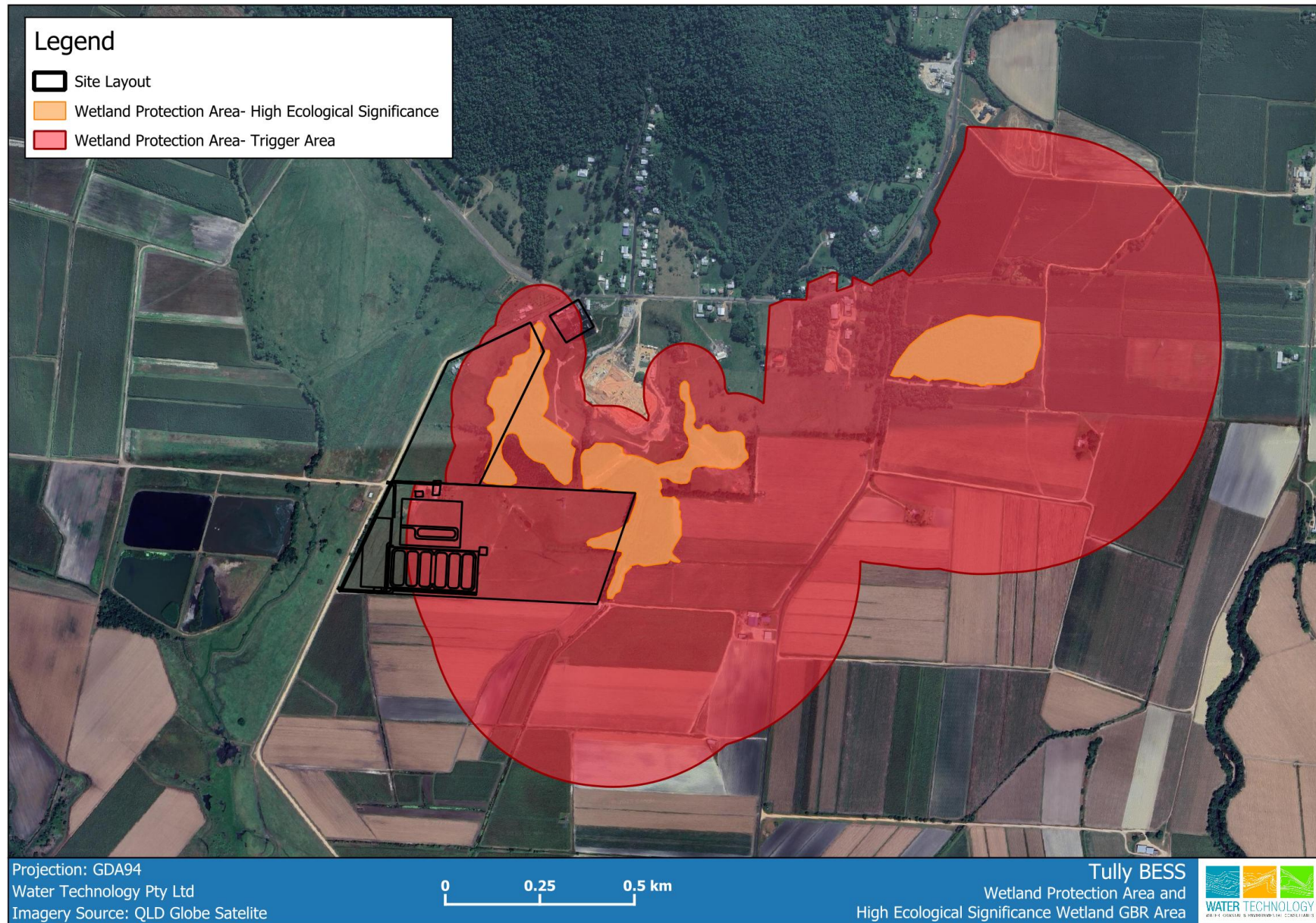


Figure 3-4 Great Barrier Reef Wetland Protection Areas



3.4 Climate

Tully Station is the nearest open station providing climate statistics and is located approximately 3 km northeast of the centroid of the project area. Annual rainfall statistics are provided in Table 3-1 with gauge locations presented in Figure 3-6.

Table 3-1 Annual Rainfall Statistics

Parameter	Units	Tully Sugar Mill	Bingil Bay
Station number		032042	32009
Rainfall record		1956-present	1925-present
Distance from project area centroid	km	3 km NE	24.5 km NE
Mean rainfall	mm/year	3,921	3,127
10 th percentile rainfall	mm/year	2,881	2,339
Median rainfall	mm/year	3,825	3,002
90 th percentile rainfall	mm/year	5,103	4,225
Maximum rainfall	mm/year	6,211	5,165

Figure 3-5 shows the mean monthly rainfall and pan-evaporation derived from the SILO point data for the Tully gauging station. Mean annual rainfall and evaporation at Tully are 3,921 mm and 1,833 mm, respectively. The wet season tends to occur from December - May, with lesser rainfall throughout the remainder of the year.

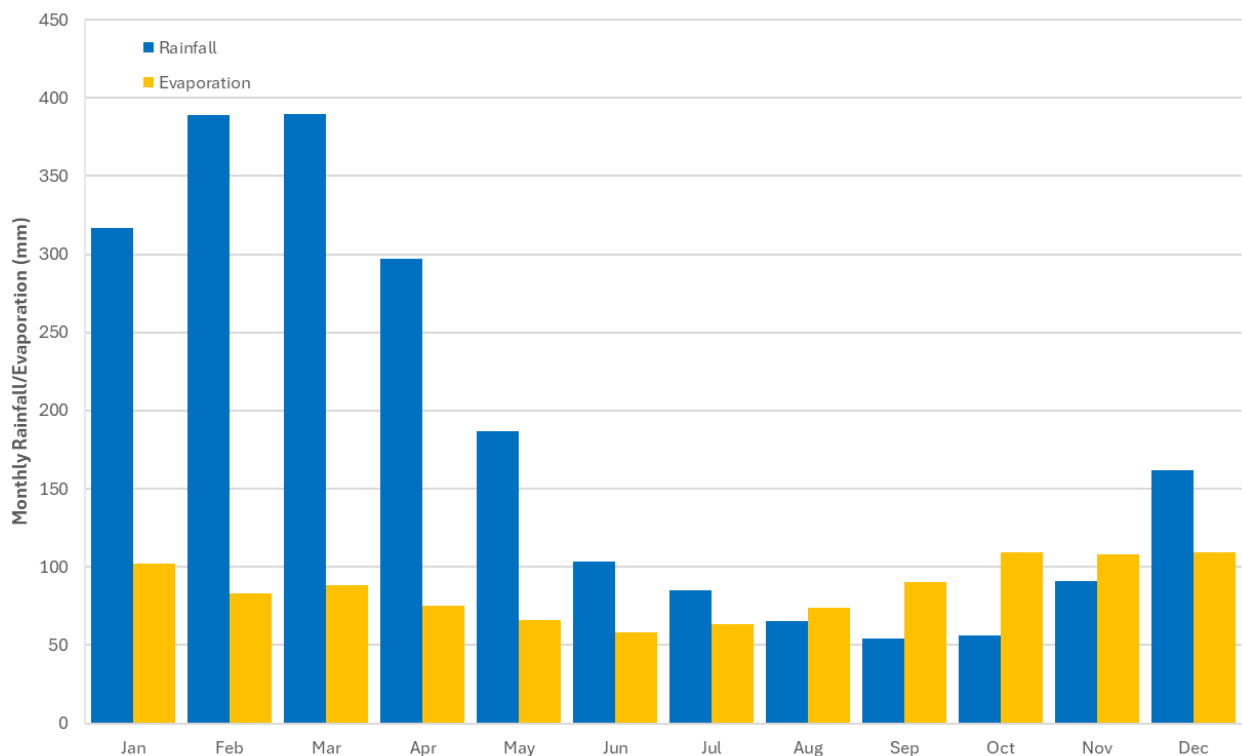


Figure 3-5 Mean Monthly Rainfall and Evaporation at Tully Sugar Mill (032042)



Figure 3-6 Gauge Locations



3.5 Soils

Soil data at a scale of 1:50,000 was accessed via Queensland Globe as illustrated in Figure 3-7. The Hewitt soil series dominates the site and typically comprises poorly drained soils formed on alluvial deposits, which may influence infiltration capacity and foundation design.

A portion of the site is mapped as MSC (Miscellaneous Soils Complex), a classification used for areas where detailed soil assessment is limited or where heterogeneous soil conditions occur. This designation indicates that site-specific geotechnical investigations will be important to confirm soil properties for earthworks and stormwater management design.

3.6 Geomorphology

A high-level desktop geomorphic assessment was undertaken to characterise the waterways assessed in this Study Area. The Study Area is located on the floodplain of the Tully River, at the southern foothills of Tully Gorge National Park. The geology of the area consists of alluvium materials underlain by granites. The area receives high rainfall and high intensity rainfall often leads to the River overtopping its bank and inundating the floodplains. Flat topography, regular inundation of the floodplain and poor infiltration of granitic geologies supported the development of extensive wetlands in the area historically.

To support the development of agriculture on the alluvial floodplains, many of these wetlands were drained and infilled. Channels were also constructed to divert flows. Consequently, most of the waterways in the Study Area are artificial or highly modified channels of Stream Order 1 and 2. The construction of this extensive channel network has greatly increased the drainage density of the landscape. Many of these drains have been constructed as straight channels, resulting in an increase in the efficiency of flow and sediment transfer downstream. The increase in flow rate also increases the risk of channel bank and/or bed erosion.

Extensive clearing of vegetation from the floodplain also contributed to the increased rate and volume of runoff. This further reduced the resilience of channel banks and bed. While lower order streams such as those bordering the Study Area are less likely to be affected by the cumulative effects of these erosive processes, localised disturbances may trigger changes such as channel deepening or widening.

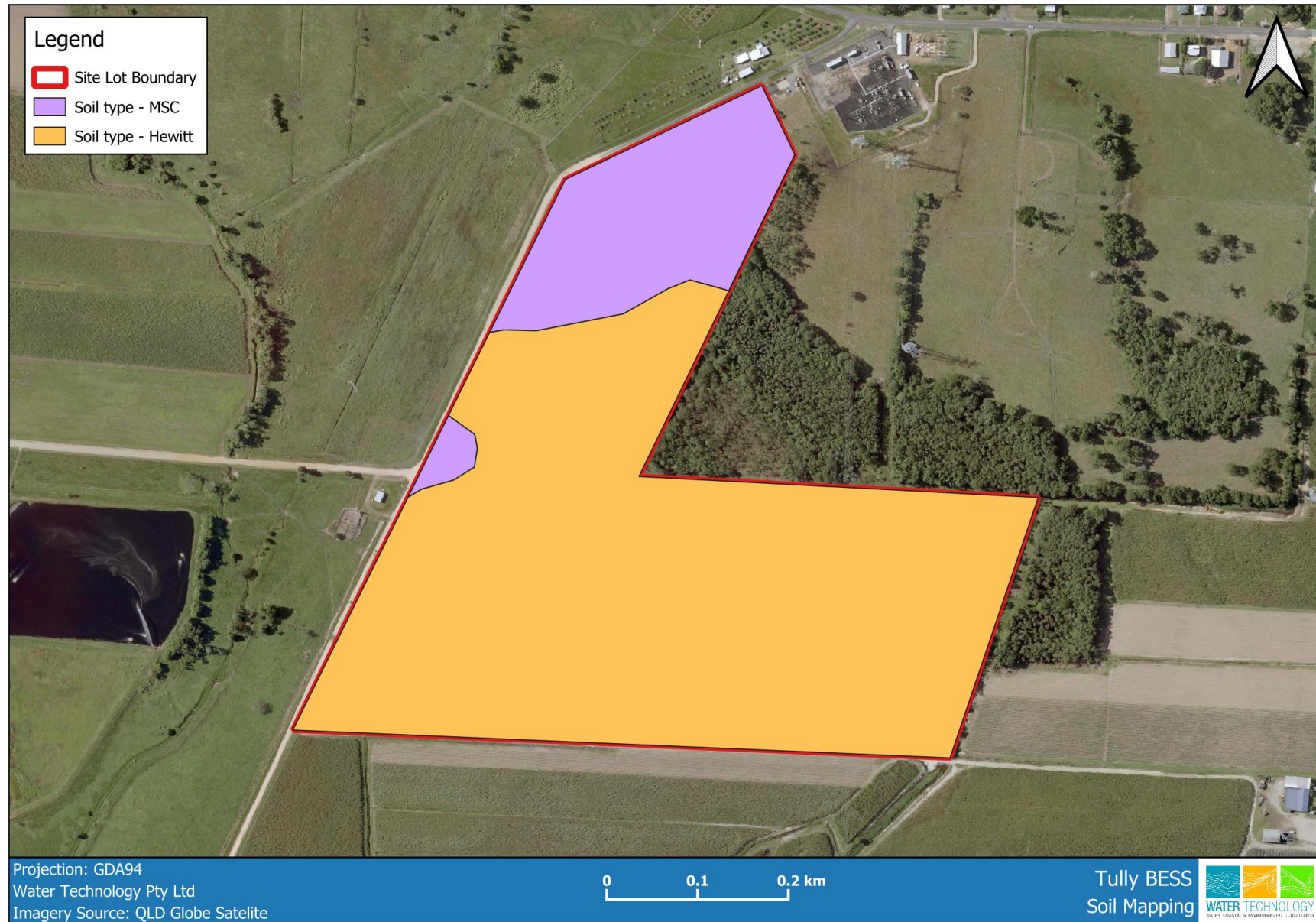


Figure 3-7 Site Soil Mapping



4 SURFACE WATER QUALITY

4.1 Environmental Values

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019, which is subordinate legislation to the Environmental Protection Act 1994, provides a framework for identifying environmental values (EV) for a waterway and deciding water quality objectives (WQO) to protect or enhance those EV's. EV's for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

The site is located in Tully River (WQ1131 – Tully River, Murray River and Hinchinbrook Island Basins) and is mapped in the Environmental Protection (Water) Policy 2009, Wet Tropics Map Series. The site is located within the Tully River lowland fresh waters environmental value zone. The EVs specified for protection are as follows:

- Aquatic Ecosystems
- Irrigation
- Farm Supply
- Stock Water
- Human consumer
- Primary Recreation
- Secondary Recreation
- Visual Recreation
- Drinking Water
- Industrial Use
- Cultural and Spiritual Values

4.2 Water Quality Objectives

Water Quality Objectives are intended to protect the EV's of receiving waters and as such set out parameters for biological, chemical and other measures to be met in the receiving waters. The site is located in the Tully River lowland freshwaters and a management intent of 'moderately disturbed for the protection of aquatic ecosystems. Water quality should be maintained or improved in line with the WQOs. The relevant aquatic ecosystem WQOs for the Tully River catchment waters are outlined in Table 4-1 to Table 4-4.

The management of riparian vegetation related to WQOs shall be conducted with reference to regional vegetation management codes under the Vegetation Management Act 1999. This is aimed at maintaining water quality, bank stability and aquatic a terrestrial habitat. Clearing control varies according to stream order.



Table 4-1 Water quality objectives for nutrients and suspended soils to protect aquatic ecosystems EVs during high flow periods- 50th percentile

Parameter	Value*
Ammonia N	8 µg/L
Oxidised N	66 µg/L
Particulate N	153 µg/L
Dissolved organic nitrogen	106 µg/L
Total nitrogen	370 µg/L
Filterable reactive phosphorous	3 µg/L
Particulate P	10 µg/L
Dissolved organic phosphorous	5 µg/L
Total phosphorus	20 µg/L
Total suspended solids	20 mg/L

*High flow WQOs are based on measured data from high flow periods at a reference site on the Tully River in Tully Gorge National Park (gauging station 113015A).

Table 4-2 Water quality objectives for specific pesticides and biocides to protect aquatic ecosystem EVs for moderately disturbed developed fresh water

Parameter	Value
Atrazine	13 µg/l
Chlor-pyrifos	0.01 µg/l
Endo-sulfan	0.03 µg/l
Simazine	3.2 µg/l
Hexa-zinone	75 µg/l
2,4-D	280 µg/l
Tebu-thiuron	2.2 µg/l
Diazinon	0.01 µg/l

Table 4-3 Water quality objectives for ions, metals and chemical indicators in surface waters for general data across the Wet Tropics- 50th percentile

Parameter	Value
Na	7 mg/l
Ca	3 mg/l
Mg	2 mg/l
HCO ₃	25 mg/l
Cl	9 mg/l
SO ₄	1 mg/l
EC	72 mg/l
Hardness	17 mg/l
Alkalinity	20 mg/l
SAR	0.70



Table 4-4 Water quality objectives to protect human use environmental values (Source: DES 2020)

Environmental Value	Water quality objectives to protect EV
Suitability for drinking water supply	<p>Local WQOs for drinking water supply are provided in Table 4 of DES (2020). Note: For water quality after treatment or at point of use refer to legislation and guidelines, including:</p> <ul style="list-style-type: none"> ■ Public Health Act 2005 and Regulations ■ Water Supply (Safety and Reliability) Act 2008, including any approved drinking water management plan under the Act ■ Australian Drinking Water Guidelines.
Protection of the human consumer	Objectives as per AWQG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.
Protection of cultural and spiritual values	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.
Suitability for industrial use	No WQOs are provided in this scheduling document for industrial uses. Water quality requirements for industry vary within and between industries. The AWQG do not provide guidelines to protect industries and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This EV is usually protected by other values, such as the aquatic ecosystem EV.
Suitability for irrigation	<p>ANZECC objectives for pathogens and metals are provided in Tables 8 and 9 of DES 2020.</p> <p>For other indicators, such as salinity, sodicity and herbicides, see AWQG.</p>
Suitability for stock watering	<p>Objectives as per AWQG, including median faecal coliforms <100 organisms per 100 mL.</p> <p>WQOs for total dissolved solids and metals are provided in Tables 10 and 11 of DES 2020, based on AWQG.</p> <p>For other objectives, such as cyanobacteria and pathogens, see AWQG.</p>
Suitability for farm supply/use	Objectives as per AWQG.
Suitability for primary contact recreation	<p>Objectives as per NHMRC (2008), including:</p> <ul style="list-style-type: none"> ■ water free of physical (floating and submerged) hazards ■ temperature range: 16–34°C ■ pH range: 6.5–8.5 ■ DO: >80% ■ faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin. Two principal components are required for assessing faecal contamination: <ul style="list-style-type: none"> ■ assessment of evidence for the likely influence of faecal material. ■ counts of suitable faecal indicator bacteria (usually enterococci). ■ These two components are combined to produce an overall microbial classification of the recreational water body ■ intestinal enterococci: 95th percentile ≤ 40 organisms per 100mL (for healthy adults) (NHMRC, 2008; Table 5.7).



Environmental Value	Water quality objectives to protect EV
Suitability for primary contact recreation	<ul style="list-style-type: none"> ■ direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms ■ waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes. ■ cyanobacteria/algae: Recreational water bodies should not contain: <ul style="list-style-type: none"> ■ Level 1: $\geq 10 \mu\text{g/L}$ total microcystins; or $\geq 50\,000$ cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent of $\geq 4 \text{ mm}^3 / \text{L}$ for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or ■ Level 2: $\geq 10 \text{ mm}^3 / \text{L}$ for total biovolume of all cyanobacterial material where known toxins are not present; OR cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and Table 12 of DES 2020.
Suitability for secondary contact recreation	<p>Objectives as per NHMRC (2008), including:</p> <ul style="list-style-type: none"> ■ intestinal enterococci: 95th percentile ≤ 40 organisms per 100 mL (for healthy adults) (NHMRC, 2008; Table 5.7). ■ cyanobacteria/algae—refer objectives for primary recreation, NHMRC (2008) and Table 12 of DES 2020.
Suitability for visual recreation	<p>Objectives as per NHMRC (2008), including:</p> <ul style="list-style-type: none"> ■ Recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life. ■ cyanobacteria/algae—refer objectives for primary recreation, NHMRC (2008) and Table 12 of DES 2020.



5 STORMWATER MANAGEMENT PLAN

5.1 Construction Phase

5.1.1 Overview

Management of water quality during the construction phase is necessary to minimise environmental harm to downstream receiving waters. The following section provides a brief outline of the construction phase stormwater management requirements for the proposed development. Construction phase water quality management approaches are highly-site specific. Therefore, the management approach will be refined as more details of the construction timeline are known.

5.1.2 Construction Water Quality Management

Construction phase stormwater quality management will occur in accordance with current industry standards including the requirements of the *State Planning Policy (SPP)* and *Best Practice Erosion and Sediment Control (International Erosion Control Association (IECA) 2008)*. The main tenets of construction phase water quality management are contained in Table 5-1. These have been adapted from the SPP and a general management approach has been nominated for each issue. Further details of the management approach will be determined in the erosion and sediment control plan (ESCP) developed for the site by a suitably qualified person.

Table 5-1 Stormwater Management Actions (Construction Phase)

Issue	Management Actions
Drainage control	<ul style="list-style-type: none">▪ Design storm and design life for temporary works:<ul style="list-style-type: none">– Disturbed area open for <12 months – 1 in 2-year ARI event– Disturbed area open for 12-24 months – 1 in 5-year ARI event– Disturbed area open for >24 months – 1 in 10-year ARI event▪ Design capacity excludes minimum 150 mm freeboard.▪ Temporary culvert crossing – minimum 1 in 1-year ARI hydraulic capacity.▪ Manage sheet flow to minimise gully and rill erosion.▪ Temporary drainage to provide stable concentrated flow paths, catch drains and flow diversions where necessary.▪ The disturbed area is anticipated to be greater than 2,500 m², therefore, a sediment basin will likely be required to manage sediment run-off and regulate flows.▪ Temporary sediment basin/s to be constructed in accordance with the <i>Best Practice Erosion and Sediment Control Guideline (IECA 2008)</i>.
Erosion control	<ul style="list-style-type: none">▪ Stage clearing and construction activities to minimise exposed soil.▪ Progressive stabilisation is to be undertaken in accordance with IECA 2008 Table 4-2 and nominated groundcover percentages achieved prior to the removal of control devices.
Sediment control	<ul style="list-style-type: none">▪ Implement sediment controls such as sediment traps, silt fences, channel linings and check dams in accordance with construction ESCPs.▪ Sediment traps are to be designed and positioned by a suitably qualified person to achieve site discharge water quality objectives.
Flow management	<ul style="list-style-type: none">▪ Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics are not worsened.



5.2 Operational Phase

An assessment of stormwater quality at the site, including Water Sensitive Urban Design (WSUD) measures adopted to mitigate impacts to the quality of stormwater runoff from the developed site, has been undertaken using the Model for Urban Stormwater Conceptualisation (MUSIC).

The following section documents the conceptual sizing of a treatment train, consisting of a bioretention basin and vegetated swale, to inform site layout and civil design. These WSUD measures are proposed for the operational phase of the development and are, therefore, long-term water quality management measures following the post-construction phase of the proposed development. Potential pollutants from this development are listed in Table 5-2 below.

Table 5-2 Potential Pollutants from Site (Post-Construction Phase)

Pollutant Type	Pollutant sources
Sediment	Sediment brought in by vehicles, erosion, atmospheric deposition, organic matter, spills and accidents.
Nutrients	Fertiliser, decaying organic matter, animal faeces, detergents, atmospheric deposition.
Gross Pollutants	Litter such as food, drink and materials packaging and wrappers, leaf matter and grass clippings.
Hydrocarbons	Fuel and oil spills from cars and trucks, asphalt pavements.

5.3 MUSIC Model Schematisation

Water quality modelling of the proposed development has been undertaken using the Model for Urban Stormwater Conceptualisation (MUSIC). The MUSIC model allows the user to estimate the pollutant loads generated within and exported from the proposed BESS area within the site and quantify the relative effectiveness of the proposed stormwater quality treatment train. MUSIC provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN), and Gross Pollutants (GP).

The MUSIC model was set up in accordance with the *Water by Design MUSIC Modelling Guidelines (2018)* (WBD, 2018) which has been published under the Water by Design Program by the South-East Queensland Healthy Waterways Partnership. In addition, Healthy Waterways recommends using the latest version, MUSIC 6 to ensure compliance with stormwater pollutant load reduction objectives.

5.3.1 Catchment Areas

The proposed BESS layout was used to estimate sub-catchment areas for input to the MUSIC model, following a split catchment land use approach to modelling pollutant loads from the proposed development footprint within the site. Five land use areas were delineated for the post-development scenario, whilst a single land use was used to represent the pre-development scenario. The catchment areas adopted in the MUSIC modelling are shown on Figure 5-1. The sub catchment split is shown in Figure 5-2, and summarised in Table 5-3.



Figure 5-1 MUSICX Model Catchment Area Breakdown

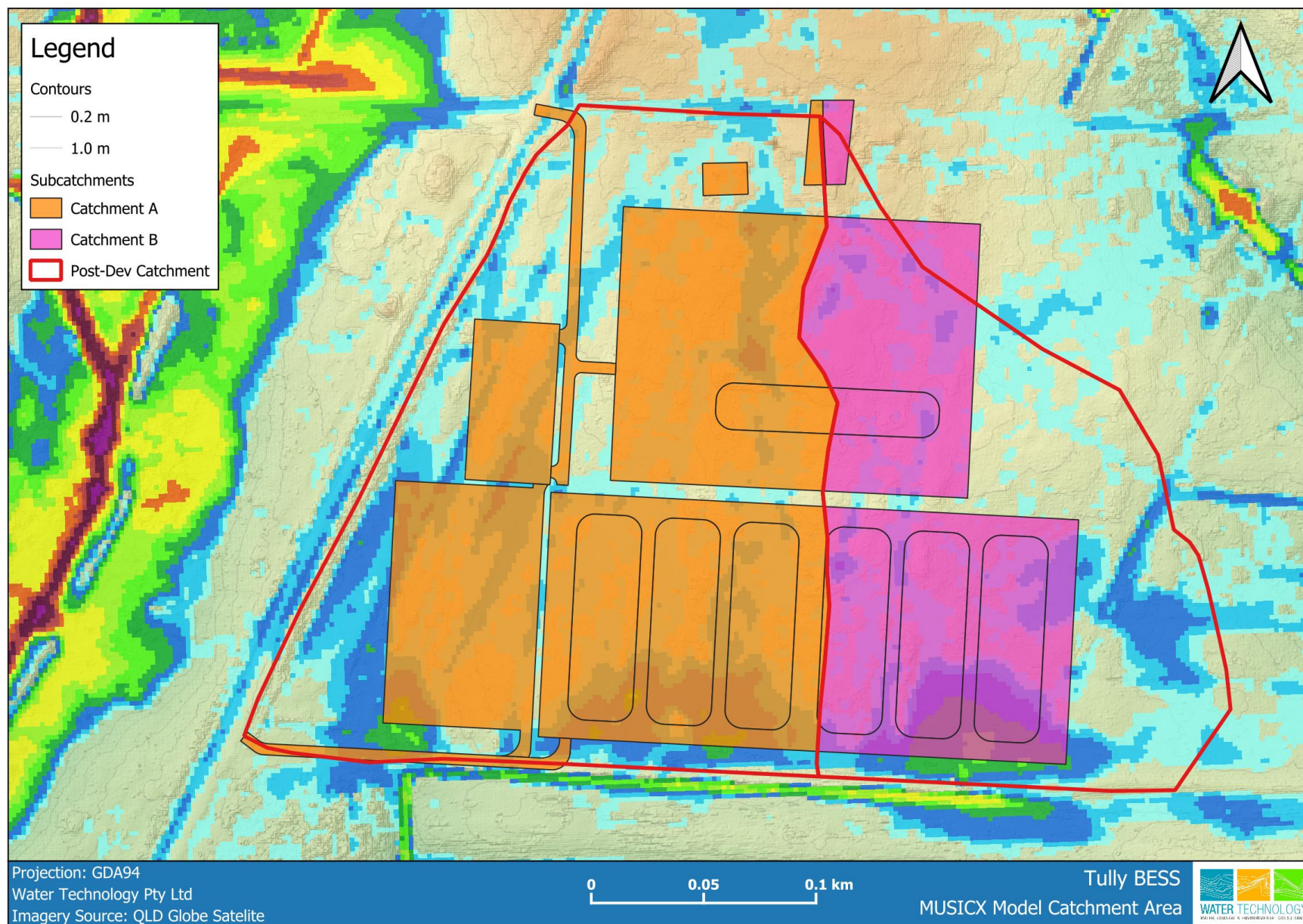


Figure 5-2 MUSICX Model Sub-catchment Areas



Table 5-3 Modelled BESS Sub-catchment Breakdown

Catchment	Total Area (ha)	Fraction Impervious (%)	MUSIC Model Landuse Type
Pre-developed Case Catchment A			
Existing	5.60	0	Rural residential
Post-Developed Catchment A			
Pervious Gravel	1.81	20%	Rural residential
Operational Area	0.33	95%	Rural residential
Battery Pad	0.79	95%	Rural residential
Switch Room	0.11	95%	Rural residential
Open Grass	1.85	0%	Rural residential
BESS Laydown	0.66	95%	Rural residential
Bioretention Basin	0.05	-	Rural residential
Total	5.60	67%	n/a
Pre-developed Case Catchment B			
Existing	3.50	0	Rural residential
Post-Developed Catchment AB			
Pervious Gravel	1.18	20%	Rural residential
Operational Area	0.04	95%	Rural residential
Battery Pad	0.77	95%	Rural residential
Switch Room	0.09	95%	Rural residential
Open Grass	1.40	0%	Rural residential
Bioretention Basin	0.02	-	Rural residential
Total	3.50	61%	n/a

5.3.2 Rainfall Runoff Parameters

WBD (2018) does not include any region-specific rainfall runoff parameters. However, the values recommended for southeast Queensland have been adopted for this study as they are the closest region with available data (see Table 5-4).

Table 5-4 Rainfall Runoff Parameters Adopted in MUSIC Modelling

Parameter	Rural Residential
Rainfall threshold (mm)	1
Soil storage capacity (mm)	98
Initial storage (% capacity)	10
Field capacity (mm)	80
Infiltration capacity coefficient a	84
Infiltration capacity coefficient b	3.3
Initial depth (mm)	50
Daily recharge rate (%)	100
Daily baseflow rate (%)	22
Daily deep seepage rate (%)	0



5.3.3 Pollutant Export Parameters

In the absence of any site-specific water quality or pollutant data, and in keeping with industry best practice the modelling adopted pollutant load export parameters from WBD (2018). The landuse types adopted in the model for the various site areas are displayed in Table 5-3 and the pollutant export parameters for each land use type are provided in Table 5-5.

Table 5-5 Pollutant export parameters

Landuse	Flow Type	TSS log ¹⁰ values		TP log ¹⁰ values		TN log ¹⁰ values	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Rural Residential	Baseflow Parameters	0.53	0.24	-1.54	0.38	-0.52	0.39
	Stormflow parameters	2.26	0.51	-0.56	0.28	0.32	0.30

5.3.4 Rainfall and Evapotranspiration Data

As per the recommendations in WBD (2018), climate datasets were adopted from MUSIC's included data, with rainfall data sourced from the Tully Sugar Mill Radar 6-minute gauge, and monthly average areal potential evapotranspiration (PET) taken for the Tully Sugar Mill SILO dataset.

Rainfall, in the form of a 6-minute pluviometer data, was available from November 1972 to May 2010. From this, a ten-year period from 1 June 1999 to 31 May 2009 was selected for modelling purposes. The mean annual rainfall for the selected MUSICX dataset is 3,782 mm.

5.3.5 Treatment Nodes

The site has been split into two sub-catchments for the purposes of treating and directing clean and dirty water run-off. It is proposed to treat run off from the developed site and surrounding post-development catchment using grassed swales which channel flow into two (2) bioretention basins (BRB) located in each sub-catchment. BRB A will be located along the southern boundary of Subcatchment A and adjacent to the BESS laydown area at the down-slope end of the site. BRB B will be located to the east of Subcatchment B, adjacent to the right corner of battery pad laydown. The MUSIC model schematisation is shown below in Figure 5-3. The modelling considered a range of BRB sizes to determine the most suitable options within respect to achieving the required load reduction targets. The adopted model parameters for the proposed treatment devices is shown in Table 5-6 and Table 5-7. Indicative locations of the proposed treatment devices are shown in Figure 5-1.

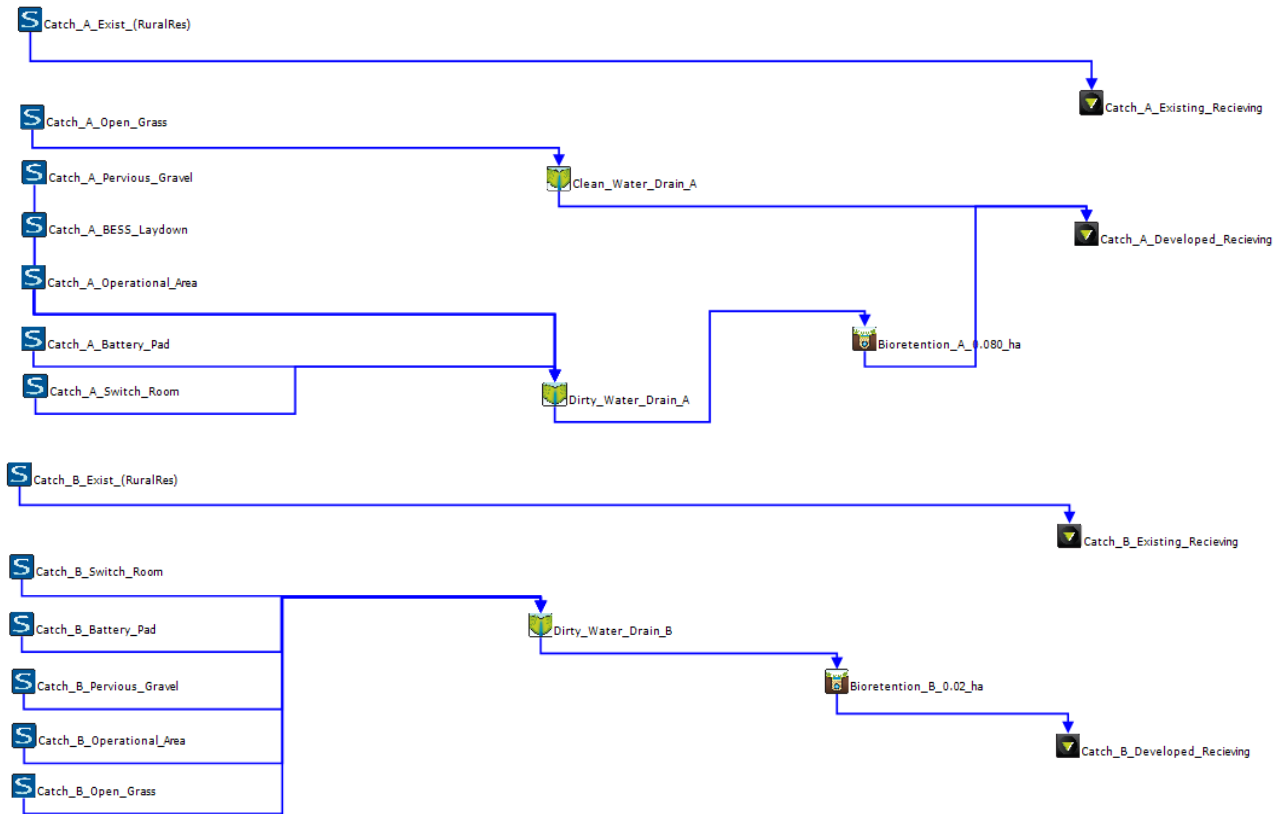


Figure 5-3 MUSIC Model Schematisation

Table 5-6 MUSIC Swale Properties

Parameter	Clean Water A	Dirt Water A	Dirty Water B
Low Flow By-pass (m³/s)	0	0	0
Length (m)	235	150	260
Bed Slope %	1	1	1
Base Width (m)	3	3	3
Top Width (m)	4	4	4
Depth (m)	0.5	0.5	0.5
Vegetation Height (m)	0.25	0.25	0.25



Table 5-7 MUSIC Bioretention Basin Properties

Parameter	Bioretention Basin A Properties	Bioretention Basin B Properties
Low Flow By-pass (m³/s)	0	0
High Flow By-pass (m³/s)	1.5	1.5
Surface Area (m²)	800	200
Extended Detention Depth (m)	0.30	0.30
Filter Area (m²)	800	200
Unlined Filter Media Perimeter (m)	89	56
Filter Depth (m)	0.50	0.50
Saturated Hydraulic Conductivity (mm/hr)	200	200
TN Content of Filter Media (mg/kg)	400	400
Orthophosphate Content of Filter Media (mg/kg)	30	30

5.4 MUSIC Results and Discussion

Pollutant load reduction targets for the Tully Catchment have been set by the Great Barrier Reef Discharge Standards as described in the Reef 2050 Water Quality Improvement Plan (WQIP) 2017-2022 (State of Queensland, 2018). The relevant load reduction targets were described in Section 2.7. The performance of the proposed water quality treatment train must be compared to the pre-developed condition of the site, as required by the Reef WQIP's stipulation of achieving reductions compared to the 2013 baseline.

The results for BRB A, which are summarised in Table 5-8 show that the pollutant load reduction targets are met for all pollutants using a treatment train with a BRB with a filter area of 800 m² and one (1) vegetated swale of at least 150 m long. The clean water vegetated swale is 235 m long and diverts clean water along the western boundary of the development, offsite into a preexisting water way suitable for discharge.

Table 5-8 MUSIC Model Results Bioretention Basin A

Parameter	Pre-Developed Source Load (kg/yr)[1]	Developed Source Load (kg/yr)	Residual Load (kg/yr)	Required Load Reduction	Pollutant Reduction from developed source	Pollutant Reduction from pre-developed source	Target Achieved from pre-developed source
Total Suspended Solids (TSS)	46,705	60,330	993	20%	98%	98%	YES
Total Phosphorus (TP)	45	56	9	20%	84%	81%	YES
Total Nitrogen (TN)	312	428	154	<i>Nil</i>	64%	51%	<i>Nil</i>
Particulate Nitrogen (PN) ²	94	128	46	20%	64%	51%	YES
Dissolved Inorganic Nitrogen (DIN) ³	218	299	108	50%	64%	51%	YES
Gross Pollutants (GP)	0	1,285	0	<i>Nil</i>	100%	100%	<i>Nil</i>

² Particulate Nitrogen is calculated as 30% of TN

³ Dissolved Inorganic Nitrogen (DIN) is calculated as 70% of TN



The results for BRB B, which are summarised in Table 5-9 show that the pollutant load reduction targets are met for all pollutants using a treatment train with a BRB filter area of 200 m² and two (2) vegetated swales with a combined length of at least 260 m.

Table 5-9 MUSIC Model Results Bioretention Basin B

Parameter	Pre-Developed Source Load (kg/yr)[1]	Developed Source Load (kg/yr)	Residual Load (kg/yr)	Required Load Reduction	Pollutant Reduction from developed source	Pollutant Reduction from pre-developed source	Target Achieved from pre-developed source
Total Suspended Solids (TSS)	27,614	35,005	730	20%	98%	97%	YES
Total Phosphorus (TP)	26	34	6	20%	84%	79%	YES
Total Nitrogen (TN)	212	257	106	<i>Nil</i>	59%	50%	<i>Nil</i>
Particulate Nitrogen (PN) ⁴	64	77	32	20%	59%	50%	YES
Dissolved Inorganic Nitrogen (DIN) ⁵	149	180	74	50%	59%	50%	YES
Gross Pollutants (GP)	0	651	0	<i>Nil</i>	100%	100%	<i>Nil</i>

5.4.1 Hazardous Materials

The introduction of contaminants to the project area for the construction, maintenance, operation and decommissioning of the project infrastructure poses a risk of these contaminants ending up in the receiving environment. Local storage of chemicals and fuels within the project area will increase this risk along with concrete batching and associated materials. Therefore, relevant guidelines and standards governing the storage and use of hazardous materials and waste removal will be followed to reduce this risk. Appropriate measures will be incorporated in the Final SMP, Construction Management Plan and Emergency Response Plan, which will be prepared in accordance with relevant conditions of the development approval.

5.4.2 Water Supply

5.4.2.1 Construction Phase

Water will be required during the construction phase for:

- Construction works
- Dust suppression
- Vegetation establishment

During the construction phase, water will be transported to the site by water tankers and stored appropriately at the site where required. Potable water will be supplied by contractors for their workforce during construction.

⁴ Particulate Nitrogen is calculated as 30% of TN

⁵ Dissolved Inorganic Nitrogen (DIN) is calculated as 70% of TN



5.4.2.2 Operational Phase

During the operational phase of the project there will be minimal demand for water. Potable water required by site personnel will be supplied by individuals as required. Any non-potable water requirements like short term dust suppression, cleaning or maintenance of vegetation will be transported to the site by water tankers as required. On-site water storage tanks will also be used to store water for firefighting.

5.5 Stormwater Quality Summary

An assessment of the proposed development has identified potential impacts on the environmental values of the surface waters in the receiving environment. However, these risks can be managed through proper design and the implementation of appropriate mitigation measures during the construction and operation of the BESS. The following provides details of the proposed mitigation measures.

5.5.1 Construction Phase

Any disturbance that involves the clearing of vegetation or earthworks should be carefully considered to ensure the project does not result in increased sediment loads and associated pollutants from entering the downstream receiving environment.

Construction of the proposed BESS represents the highest risk of erosion as there will be active disturbance occurring during this phase including earthworks. However, the construction period will be relatively short compared to the life of the project with construction expected to be completed within 18 months. All construction works should be completed in association with a detailed construction phase ESCP.

Once construction is complete, the risk of erosion will be greatly reduced as there will be no ongoing disturbance of soils. Further it is expected that disturbed areas not required for operations (including cut and fill batter slopes) will be revegetated.

5.5.2 Operational Phase

The surface water assessment showed that the proposed development has the potential to increase the quantity of pollutants discharging to the receiving environment. The MUSIC modelling outcomes demonstrate that the proposed BRB's and vegetated swales will benefit the receiving environment through pollutant load reduction and thus comply with the objectives of the Reef 2050 Water Quality Improvement Plan.

Appropriate measures for the safe handling and storage of chemicals and hazardous materials at the project site during the construction and operational phases should be included in the Final Stormwater Management Plan, Construction Management Plan and/or Emergency Response Plan as required.

5.5.3 Compliance note — State Code 9

The following address compliance with the requirements of PO3 to PO5 of State Code 9 Great Barrier Reef wetland protection areas:

- **PO3 (Hydrology)** — Maintain or improve existing surface and groundwater hydrology in the wetland protection area.
 - The layout avoids deep cuts and does not involve significant excavation, limiting disruption to natural grades and subsoil profiles that control shallow groundwater flows and interflow. Catchment areas to each release point will also be maintained. This reduces the risk of altering the site's pre-development water balance and baseflow pathways.
 - Where practicable, external areas will use pervious finishes (e.g., gravel and grassed/vegetated surfaces) to reduce runoff volume and promote infiltration, consistent with WSUD source-control principles to maintain more natural flow pathways.



- Vegetated swales will safely convey frequent flows at shallow depth/velocity and provide pre-treatment, then discharge to bioretention basins sized and modelled as part of the stormwater treatment train in Section 5.3 and Section 5.4. Bioretention systems filter runoff through vegetated media then exfiltrate to surrounding soils and discharge via underdrainage pipes, supporting maintenance of the local water balance.
- Collectively, these measures temper frequent-flow peaks/velocities, reduce runoff volumes, and sustain shallow recharge/baseflow contributions, helping to maintain the pre-development hydrologic regime within the mapped Wetland Protection Area. This approach aligns with WSUD hydrologic intent and Queensland stormwater policy objectives for post-development management.
- **PO4 (Water quality) — No unacceptable impact on wetland/buffer water quality.**
 - The stormwater strategy adopts WSUD treatment trains (including vegetated swales and bioretention) designed to achieve the Great Barrier Reef Discharge Standards as described in the Reef 2050 Water Quality Improvement Plan, with compliance demonstrated via MUSIC modelling. MUSIC modelling results presented in Section 5.4, show that the proposed water quality treatment infrastructure will result in a net improvement in the quality of water discharging from the site.
 - During construction, an Erosion and Sediment Control (ESC) plan will be developed and implemented minimising sediment export.
 - Infiltration measures will include adequate pre-treatment (e.g. vegetated swales) to avoid clogging and to protect groundwater quality.
 - Together, these measures reduce pollutant loads at the boundary and avoid unacceptable water-quality impacts to any downstream wetlands or buffers.
- **PO5 (Wetlands not used for stormwater treatment).**
 - All stormwater treatment devices are sited outside mapped wetlands and their buffers; wetlands are not used for detention, polishing, or conveyance as part of the treatment train. Discharges will be released to constructed conveyance or upland areas with energy dissipation prior to any natural features, ensuring wetlands are not utilised for stormwater treatment, consistent with the Code.



6 FLOOD ASSESSMENT

6.1 Overview

The proposed site is partially inundated during regional flood events within the Tully River catchment. Additionally, multiple defined watercourses traverse the site, requiring a detailed assessment of existing flood constraints.

To support the local flood assessment for the development, a rain-on-grid hydraulic model has been developed using TUFLOW. The model is configured to simulate direct rainfall-runoff interactions across the terrain and incorporates hydrodynamic processes to assess flood behaviour. The hydrologic analysis was conducted in accordance with Australian Rainfall and Runoff 2019 (ARR2019) guidelines, utilising the TUFLOW ARR tool. Key design rainfall parameters include:

- Design Rainfall Data sourced from ARR2019 and BOM 2016 IFD, incorporating all ten (10) ARR2019 temporal patterns to evaluate peak discharge variability.
- Rainfall losses adopted from ARR2019 Data Hub, with an Initial Loss of 43 mm and a Continuing Loss of 4.9 mm/hr.
- Design rainfall was implemented as a direct rainfall boundary in the hydraulic model, enabling a rain-on-grid approach.

In the absence of stream gauge data, estimated peak flows were validated using the Rational Method. A range of design storms including the 10%, 1%, 0.2% and 0.5% AEP events were assessed hydraulically in the TUFLOW model to quantify the local flood extent to inform the proposed development. The subsequent sections of this report provide detailed insights into the catchment modelling undertaken as part of this site-specific study.

6.1.1 Model Extent and Topography

As outlined in Section 3.1, the site is located within the Tully River Drainage Basin, a hydrologically active region of the Wet Tropics. The topography generally slopes south toward the Tully River, which plays a key role in local drainage and flood dynamics, and southeast toward Babinda Creek, a tributary of the Tully River. To the north, the terrain rises steeply beyond 100 mAHD, forming part of the mountain ranges adjacent to Mount Bartle Frere. These mountains receive high rainfall and generate significant runoff, contributing to floodplain inundation during extreme events. Major roads, including Tully Gorge Road and the proposed road network, traverse these elevated areas and may influence surface water flow and drainage patterns.

The Tully River catchment, covering approximately 1,675 km², drains primarily to the Pacific Ocean, with additional contributions from the Hull River and smaller tributaries. Given the region's high rainfall and complex topography, the site is subject to dynamic hydrodynamic processes, including floodplain inundation, overland flow, and potential backwater effects from downstream constraints. These factors will be critical in assessing site-specific flooding constraints.

6.2 Hydraulic Model Setup

The model was developed using two TUFLOW methods to accurately simulate the catchment dynamics. A rain-on-grid approach was applied to represent the catchment. To support the local flood assessment for the development, a TUFLOW hydraulic model (build 2023-01-AE) utilising the HPC (Highly Parallelized Computations) solution scheme was adopted. TUFLOW is a 1D-2D linked hydraulic model that solves the depth-averaged shallow water equations. A range of design storms including the 10%, 5%, 2%, 1%, 0.2% and 0.5% AEP events were assessed hydraulically in the TUFLOW model to quantify the local flood extent to inform the proposed development.



6.2.1 Base Case Model

The following represents a summary of the setup of the TUFLOW hydraulic model, with the hydraulic model setup illustrated in Figure 6-1.

- Detailed grid resolution of 2m to adequately reflect the topography surrounding the site.
- Model topography is based on LiDAR collected in 2014.
- Two large HQ downstream boundaries with relatively flat slope of 0.001% for the hydraulic model was positioned approximately 1km downstream of the investigation area to ensure boundary conditions did not affect the model results at the area.
- Topography modifiers were applied to the model to represent channels through Tully George Road, Sandy Creek Road and Syndicate Road at culvert locations. This approach was adopted as the culverts are non-critical structures for the investigation area. However, satellite imagery confirms their existence, indicating they were constructed to facilitate the free movement of flow.

6.2.2 Surface Roughness

Floodplain roughness was represented using a Manning's "n" roughness coefficient assigned to various land uses and spatial areas throughout the model based on aerial imagery. These are presented in Table 6-1. A depth-varying Manning's n over a building footprint has been used to realistically represent the effects of buildings on overland flow during flooding. The waterways identified as waterway barrier works under the *Fisheries Act 1994* have been adopted in the model to represent Manning's roughness for waterways, as shown in Figure 6-1.

Table 6-1 Manning's "n" roughness coefficient used in model

Land Use	Manning's "n" roughness coefficient
Grass	0.04
Medium Vegetation	0.07
Road	0.02
Watercourse	0.05
Bare Soil	0.03
Buildings	0.02 at shallow depths (< 0.03 m) 0.3 at significant depths, (> 0.1 m)

6.2.3 Catchment Hydrology

The hydrological analysis was conducted using the ARR&R (2019) Datahub and BOM 2016 IFD data. The hydrological model simulated all ten (10) temporal patterns for each duration to ensure comprehensive analysis. Rainfall hydrographs for the specific area were extracted using the ARR TUFLOW tool, enabling accurate representation of local rainfall-runoff dynamics. Key design rainfall parameters include:

- Design Rainfall Data sourced from ARR2019 and BOM 2016 IFD, incorporating all ten (10) ARR2019 temporal patterns to evaluate peak discharge variability.
- Rainfall losses adopted from ARR2019 Data Hub, with an Initial Loss of 43 mm and a Continuing Loss of 4.9 mm/hr.
- Design rainfall was implemented as a direct rainfall boundary in the hydraulic model, enabling a rain-on-grid approach.

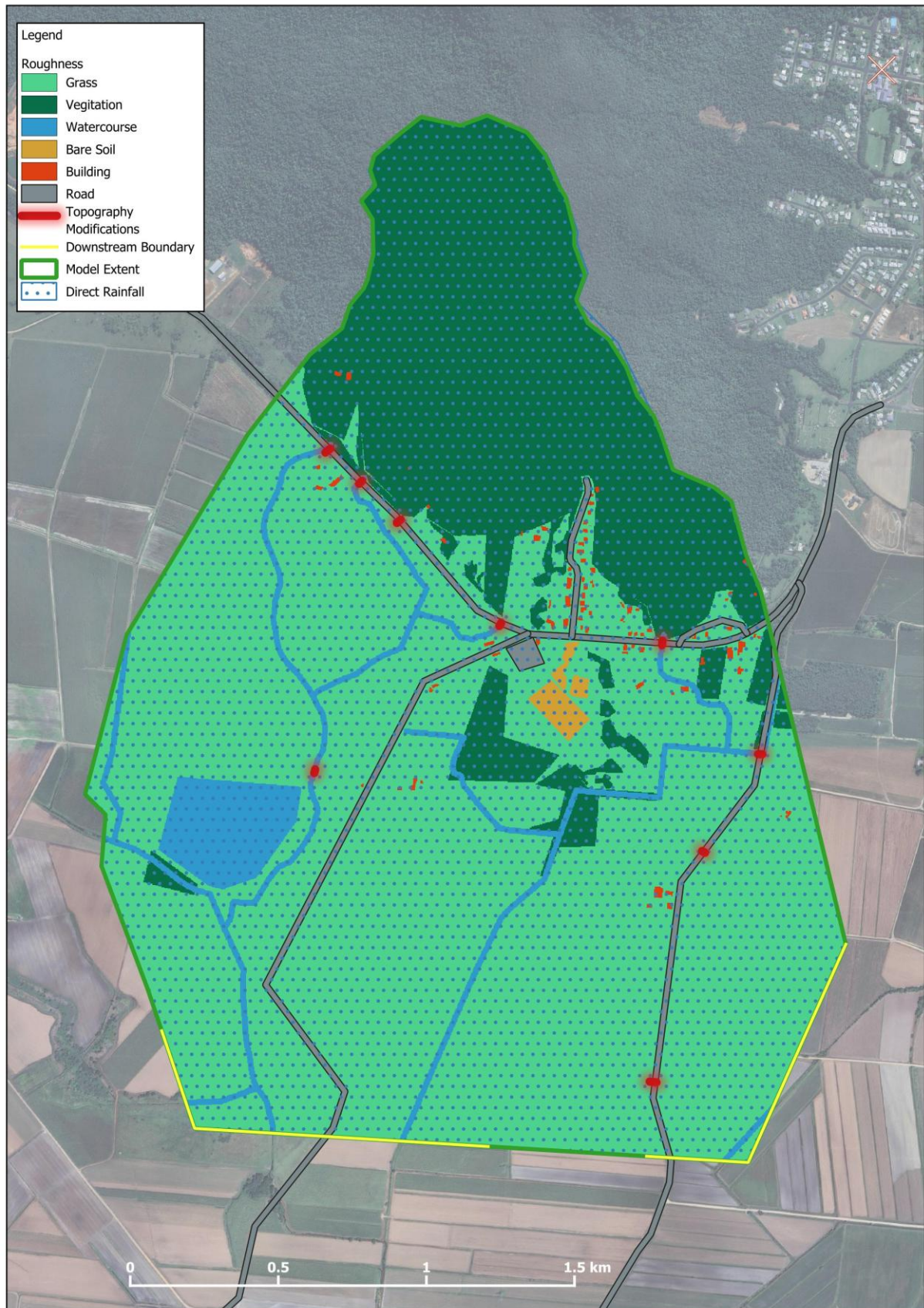


Figure 6-1 TUFLOW Model Layout



6.2.4 Validation of the Direct Rainfall Hydrology

This site-specific investigation involves an ungauged local catchment, and as such, no site-based data is available for calibrating runoff. Consequently, the TUFLOW direct rainfall modelling has been validated using the Rational Method, in accordance with the guidelines outlined in the Queensland Urban Drainage Manual (QUDM, 2008). Validation was conducted upstream of the Tully George Road before flows are impacted by the road itself, focusing on the primary drainage path to the north, which intersects the central area of the investigation area. The Rational Method parameters are summarised below and a comparison of discharges to the direct rainfall hydraulic model presented in Table 6-2.

- Stream length of 1.11 km
- Total catchment area of 33 ha.
- Fraction Imperviousness of 0.10 with medium soil permeability and dense vegetated coverage.

Table 6-2 Rational Method Comparison

Design Event	Rational Q (m ³ /s)	TUFLOW Peak Flow (m ³ /s)
1% AEP	8.86	7.7

The TUFLOW direct rainfall results are within 20% of the Rational Method results for the 1% AEP event. These flow comparisons are considered acceptable for the purposes of this study and accordingly the direct rainfall model was considered a reasonable representation of the investigation area hydrology.

6.3 Result Processing

For the direct rainfall modelling of the investigation area, the median grid for each duration was generated, followed by calculation of a max–max envelope in accordance with ARR2019 Guidelines. This process was applied across all flood events and all hydraulic variables, including peak water level, velocity, and depth. Within the infrastructure area of the site, the median temporal pattern analysis indicated notable variability. Critical storm durations ranged from 15–45 minutes for rare events and 30–45 minutes for more frequent events, confirming that shorter duration events generally represent the most critical scenarios for local flooding at the site.

Table 6-3 Critical Depth Durations

Scenario	Critical Duration
0.2% AEP	30-45 Minutes
0.5% AEP	30-45 Minutes
1% AEP	15-45 Minutes
2% AEP	15-45 Minutes
5% AEP	15-45 Minutes
10% AEP	15-45 Minutes

6.4 GIS Mapping

Appendix B provides the GIS mapping of the peak flood depth and velocity for the 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP events. The flood inundation extents based on the TUFLOW model results for the 1% AEP event is presented in Figure 6-2. A 50mm depth cutoff has been applied to the depth mapping to filter out artifacts from the direct rainfall modelling approach.



6.5 Local Flood Assessment Results

The results of the assessment are summarised as follows:

- Overland flow approaching the site from the north (originating near Mount Tyson) is conveyed via culverts beneath Tully George Road. Downstream of the culverts, the flow diverges, with a portion directed east of the site and another portion flows west of the site toward Sandy Creek Road. Western flows are guided through natural topographic depressions, bypassing an agricultural dam located on a neighbouring lot. The water continues through agricultural land southeast of the site and ultimately discharges into the Tully River. These flows do not break out east of Sandy Creek Road and are not considered to pose a flood risk to the Subject Property.
- Flows travelling along the eastern side of the site traverse the site itself. A portion of this flow is intercepted by an irrigation channel running westward from Syndicate Road. This channel appears to break out just northeast of the proposed site, redirecting flows into a wetland area located immediately south of the developed section.
- The wetland functions as an ephemeral watercourse and is considered an ecologically significant feature in the context of the site. It receives not only redirected flow from the irrigation channel but also overland sheet flow from the north.
- The wetland system drains via the irrigation channel located east of the site. A secondary flow path branches into the site lot and discharges into a smaller additional downstream wetland area before continuing south. This path intersects with another smaller irrigation channel approximately 0.57 km south of the site, which also captures minor sheet flow from the western portion of the site.
- Flood modelling indicates the presence of shallow overland sheet flow across portions of the proposed BESS site. Flow depths are generally less than 0.15 m, with some areas of localised ponding evident along the southern boundary adjacent to the irrigation channel. These conditions are anticipated to be mitigated through site development works, including filling, grading, and re-leveling of the affected areas during construction.
 - This shallow sheet flow can be managed by appropriate site stormwater infrastructure which can be addressed during detailed design.
- Flow velocities across the proposed infrastructure areas of the site are generally low, remaining below 0.5 m/s.

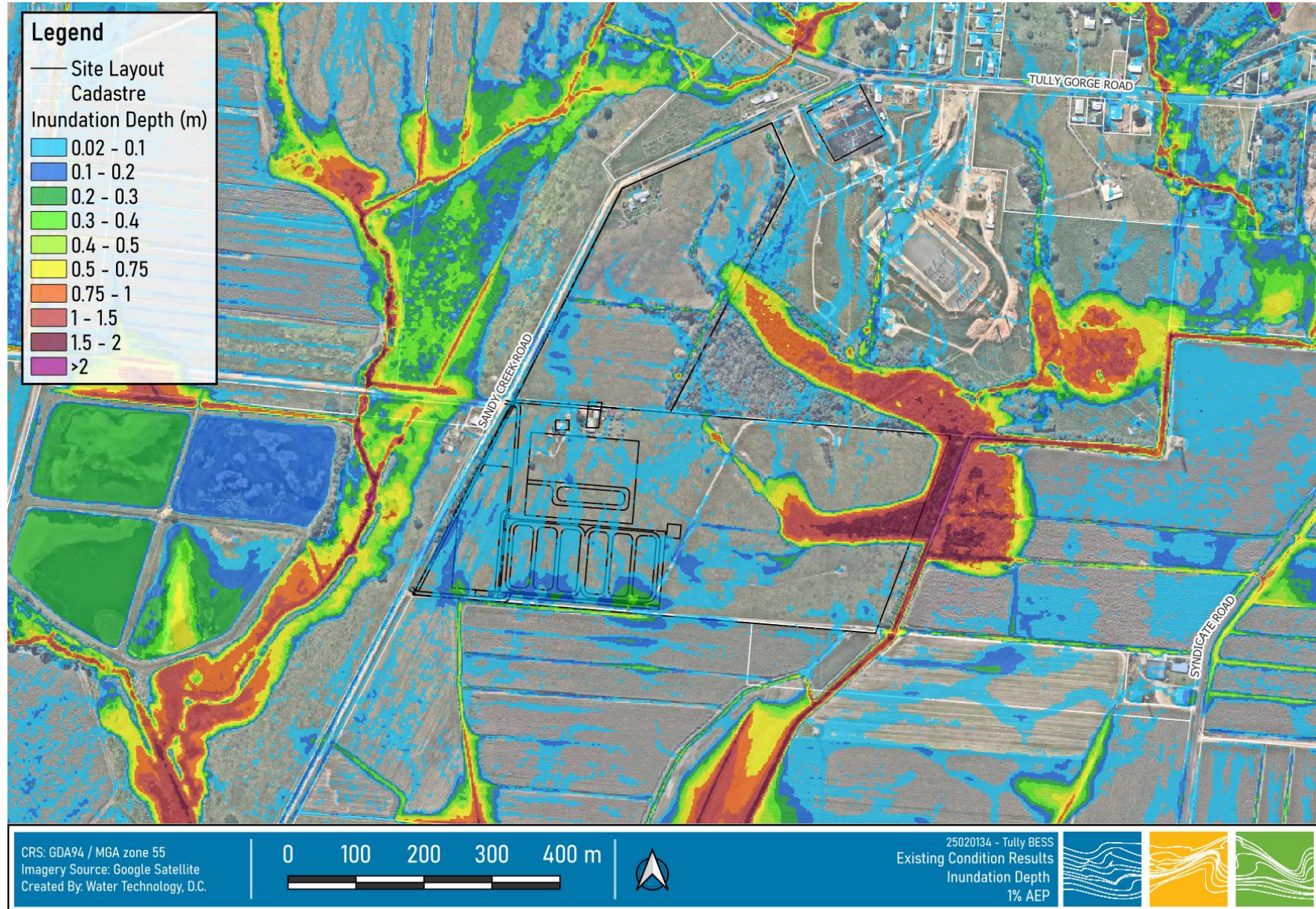


Figure 6-2 1% AEP Inundation Depth



6.6 Regional Flood Results

The regional flood model result grids were obtained from Cassowary Coast Regional Council and analysed to assess the potential impacts of regional flooding on the proposed site. The regional model is critical as it represents large-scale flood behaviour associated with the Tully River and its interaction with the site. Figure 6-4, Figure 6-5 and Figure 6-6 present the Q100 (1% AEP), Q200 (0.5% AEP), and Q500 (0.2% AEP) peak flood depths.

The results indicate that the site is only minimally affected in the 1% AEP event, with minor flood fringe inundation observed along the southern boundary. This inundation is consistent with localised pooling of water identified in the local model. Maximum flood depths in this event were recorded at 0.30 m in the southwest corner and 0.23 m in the southeast corner of the site.

Table 6-4 summarises the water levels and depths for these reference points (locations shown in Figure 6-3). It should be noted that ground levels at the reference points are approximately 11.23 m AHD at the western corner and 11.49 m AHD at the eastern corner.

More significant inundation occurs under the 0.5% AEP and 0.2% AEP events, which extend further across the site and have greater potential to impact the planned infrastructure. These peak water levels should be considered when designing earthworks levels to site sensitive infrastructure (i.e. substations) to ensure they meet local planning requirements.

Table 6-4 Regional Flood Depths at Key Reporting Locations

Event	Reporting Point	Water Level (m AHD)	Depth (m)
Q100	A	11.75	0.40
	B	11.74	0.23
Q200	A	12.16	0.81
	B	12.11	0.60
Q500	A	12.71	1.36
	B	12.63	1.12

The site is located on the outer edge of the Tully River floodplain, and only a small portion of the development footprint—approximately 5,000 m²—overlaps the 1% AEP (Q100) flood extent, representing a minor fraction of the overall site area. Within this overlap, modelled flood depths are generally less than 0.1 m, indicating shallow, low-velocity inundation.

Given the limited encroachment, minimal fill requirements, and the fact that the majority of infrastructure is located outside the Q100 extent, the proposed works are not expected to cause any measurable change to flood storage or conveyance. The shallow inundation depth combined with the absence of significant earthworks in the flood-affected zone means flood behaviour will remain effectively unchanged.

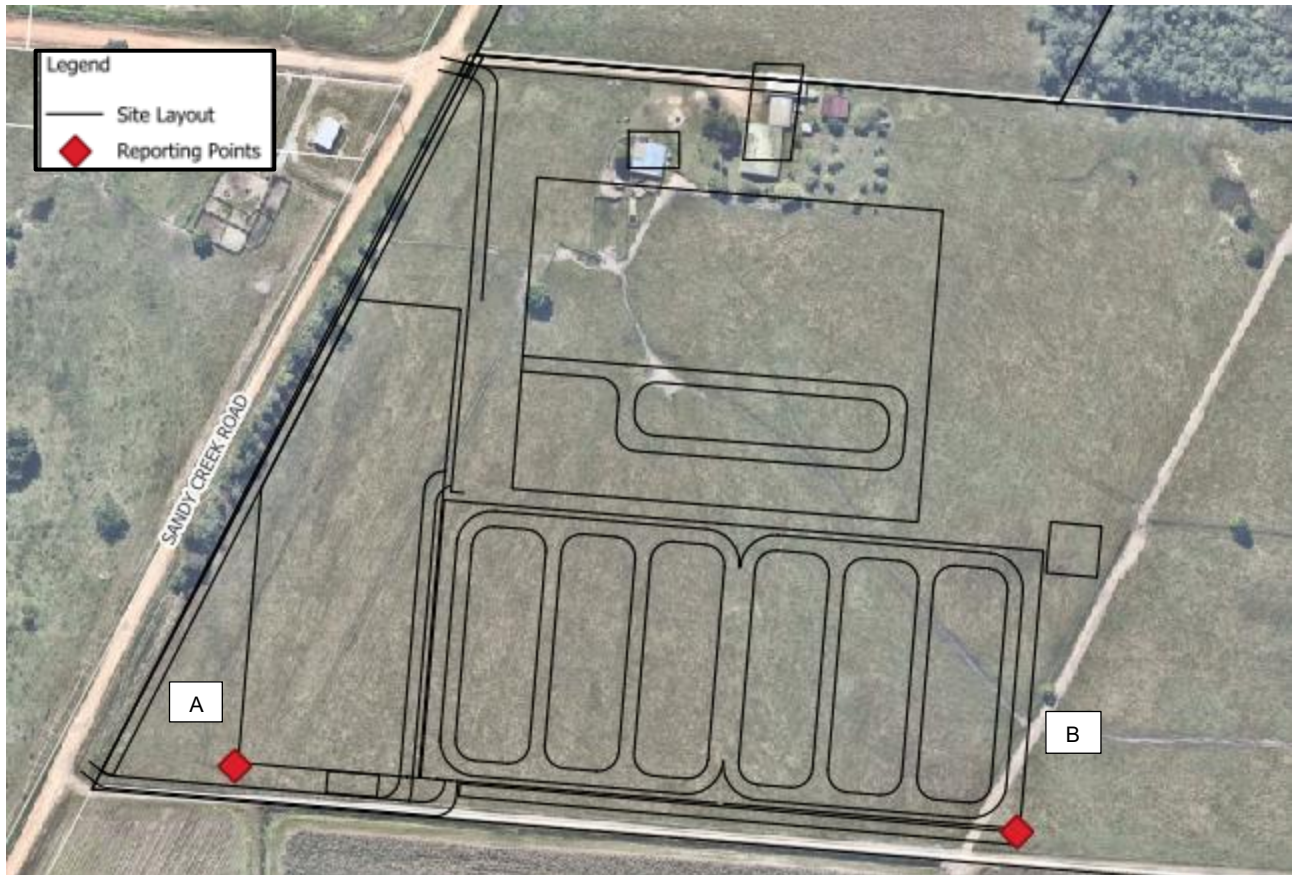


Figure 6-3 Key Reporting Locations

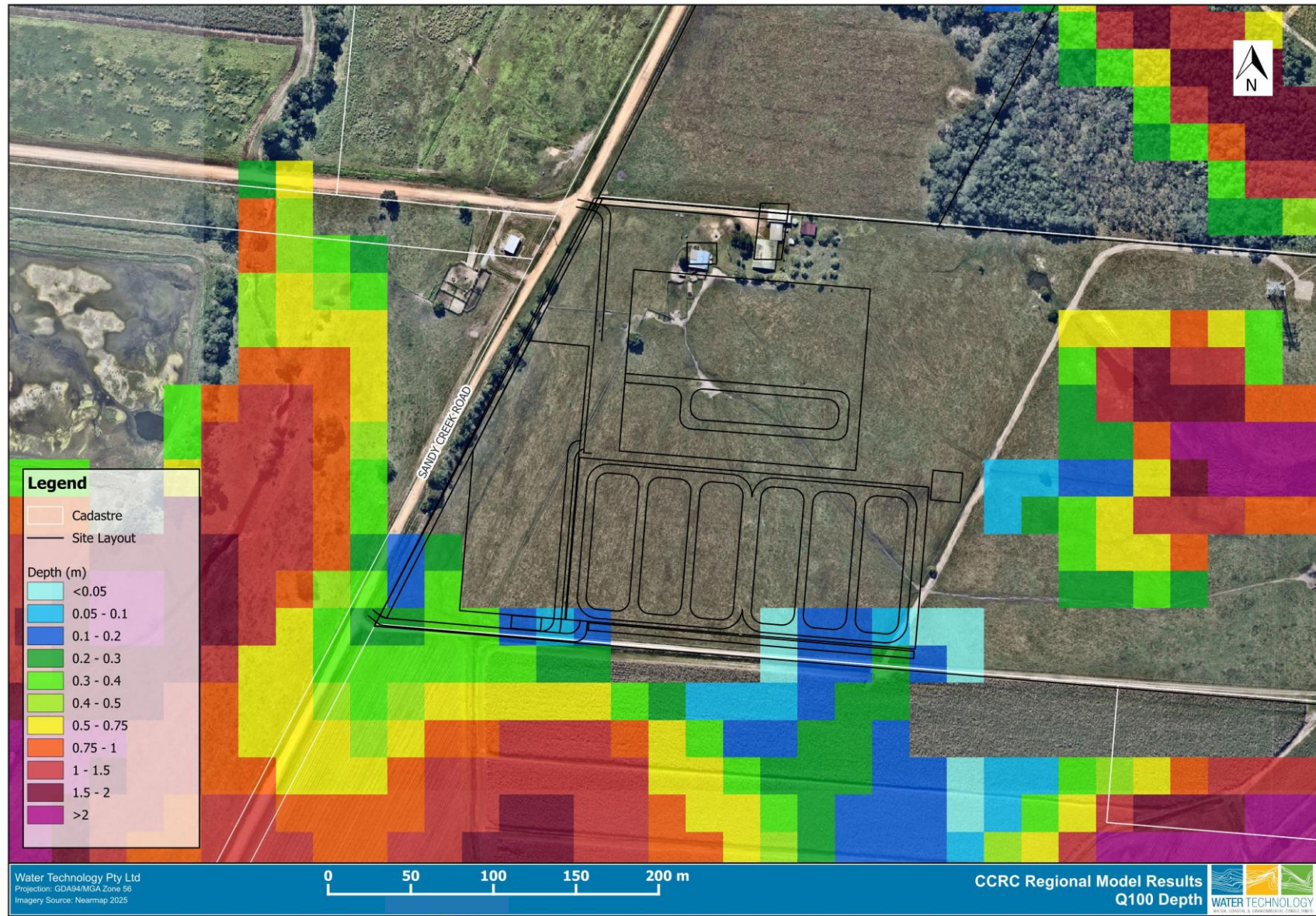


Figure 6-4 Q100 Regional Flood Results

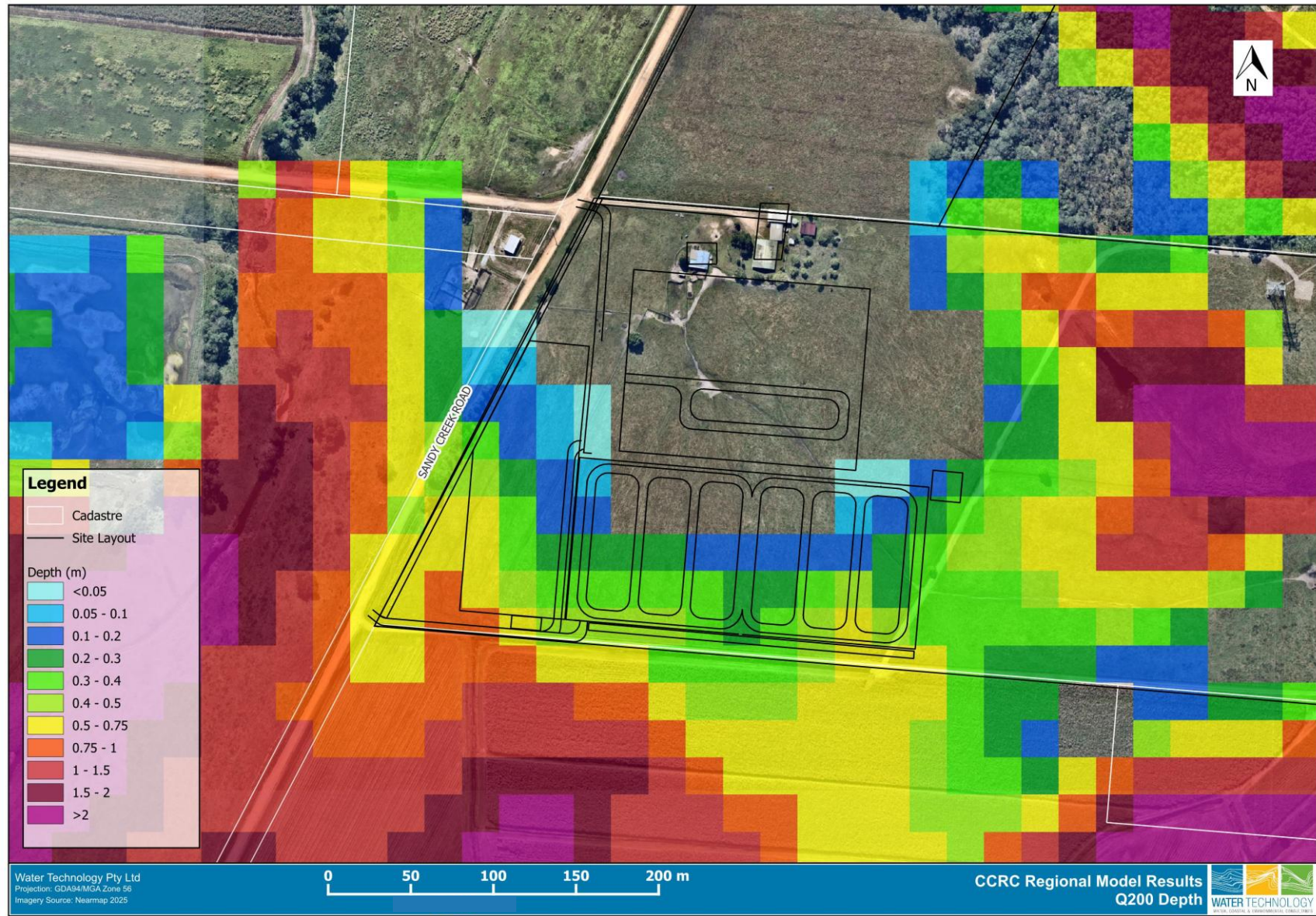


Figure 6-5 Q200 Regional Flood Results

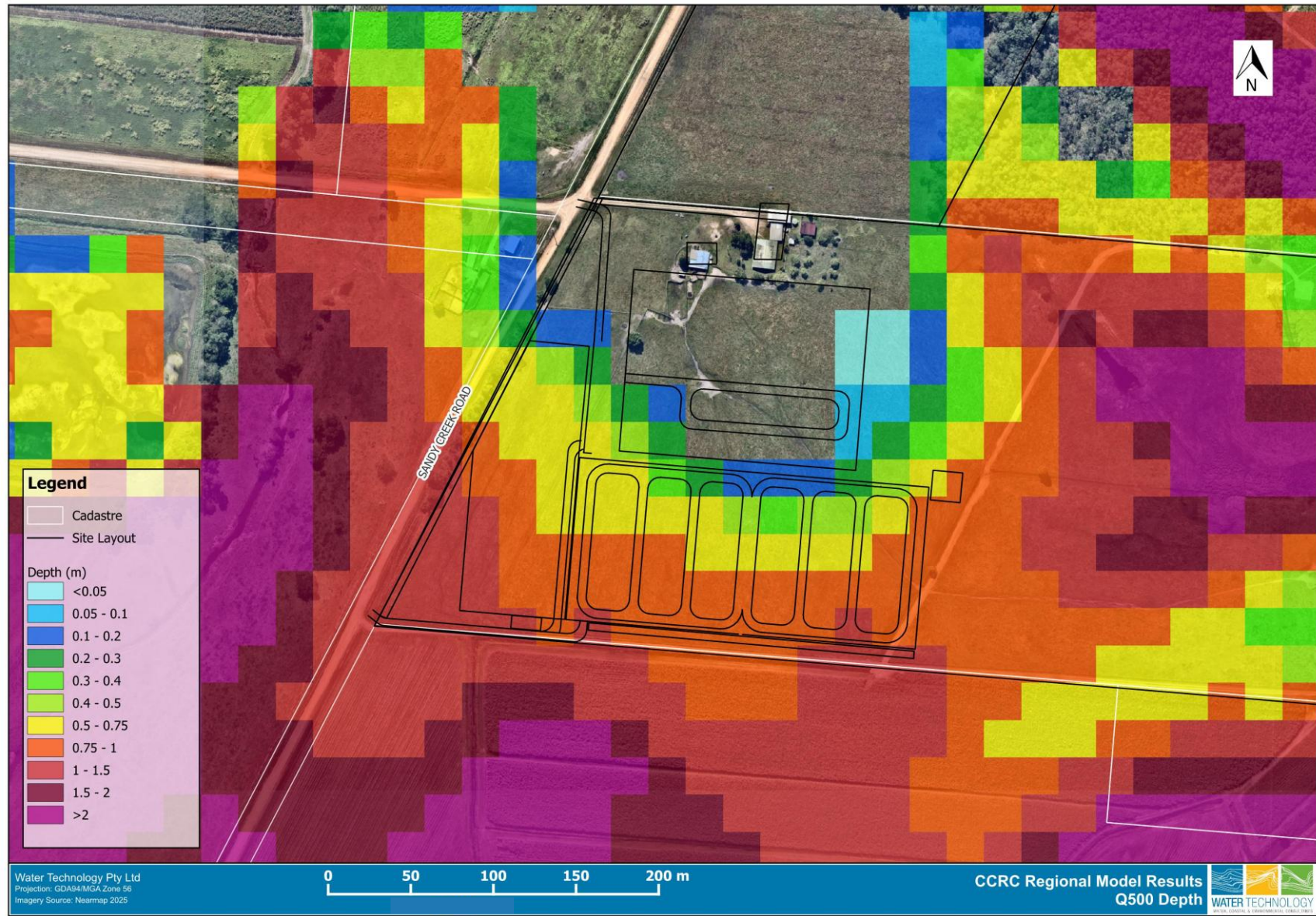


Figure 6-6 Q500 Regional Flood Results



6.7 Waterways and Fish Passage

Figure 6-8 illustrates the proposed development layout against the Department of Agriculture and Fisheries *Queensland waterways for waterway barrier works* spatial layer. This spatial layer classifies waterways defined by the *Fisheries Act* to assist in determining whether proposed barrier works are assessable or accepted (DAF, 2021). Waterways receive a fish passage attribute, a number between 1 and 5 which is additionally colour coded for easy reference. The classification does not indicate the relative importance of the fish habitat, rather it has been determined by several characteristics including stream order, stream slope and tidal influence.

- Waterways classified as 1 (low) (green) or 2 (medium) (amber) are typically in the upper reaches of a catchment where fish are typically smaller with stronger swimming abilities.
- Waterways classified as 3 (high) (red), 4 (major) (purple), or 5 (tidal) (grey) typically are host to a wider range of fish sizes and swimming abilities.

Figure 6-7 illustrates the assessment process matrix provided by DAF (2021) in the *Queensland waterways for waterway barrier works* spatial data layer: Guide to determining waterways Version 2.0 (April 2021). There were no waterway crossings identified for this project.

Waterway classification		Development work type			
Fish passage attribute	Colour	Some dams/weirs	Culvert crossing	Bed-level crossing	Temporary works
1	Green				
2	Amber	Development complies with accepted development requirements OR lodge a development application			
3	Red				
4	Purple				
5	Grey	Development application			

Figure 6-7 Assessment process matrix regarding waterway classification and proposed development work



Figure 6-8 Crossing Locations



7 SUMMARY

Water Technology was engaged by Attexo to prepare a Stormwater Management Plan (SMP) and Flood Assessment (FA) for the proposed Tully BESS facility located at Tully, Queensland. The SMP described modelling to quantify potential changes to runoff quality from the BESS and to undertake conceptual sizing of mitigation measures to meet relevant Water Quality Objectives (WQO's) for the development in respect of pollutant load reductions relative to the undeveloped site. Based on the modelling outcomes, the following measures are recommended to mitigate the potential impacts on stormwater quality:

- In Catchment A, a vegetated swale at least 150 m long to convey stormwater runoff from the developed site area to the end-of line treatment device and an end-of-line BRB with a minimum filter area of 800 m². It is proposed that the BRB will be located at the downslope end of the southern boundary, adjacent to the proposed location of the temporary construction area. A 235 m long vegetated swale will also be required to divert clean water runoff along the western boundary of the site.
- In Catchment B, vegetated swales with a combined length of 360 m in to convey stormwater runoff from the developed site area to the end-of line treatment device and end end-of-line BRB with a minimum filter area of 200 m². It is proposed that the BRB will be located to the east of the subcatchment, adjacent to the battery container.

Modelling demonstrated that the proposed stormwater quality management measures achieved the WQO's and provide an overall net improvement relative to baseline conditions. That is, the development returns a net improvement in the runoff water quality discharging from site.

The proposed stormwater treatment infrastructure ensures the proposed development complies with the requirements of PO3 to PO5 of State Code 9 Great Barrier Reef wetland protection areas by:

- **PO3 (Hydrology):** Minimising earthworks, using pervious surfaces, and incorporating vegetated swales and bioretention basins to maintain natural flow paths and support infiltration, helping preserve surface and groundwater hydrology.
- **PO4 (Water quality):** Implementing a WSUD treatment train designed to meet SPP and Reef 2050 water quality objectives, supported by MUSIC modelling and robust ESC measures during construction.
- **PO5 (Wetlands):** Locating all stormwater treatment devices outside mapped wetlands and buffers, ensuring wetlands are not used for detention or treatment.

Appropriate measures for the safe handling and storage of chemical and hazardous materials at the project site during the construction and operational phases should be included in the Final Stormwater Management Plan, Construction Management Plan and/ or Emergency Response Plan as required.

The FA described modelling to characterise existing local flood behaviour at the site. The assessment found:

- Overland flow from the north is conveyed via culverts beneath Tully George Road before diverging east and west of the site, ultimately draining to the Tully River without posing a flood risk to the Subject Property.
- Flows along the eastern boundary interact with an irrigation channel and an adjacent wetland system, which functions as an ephemeral watercourse and receives both channel breakout and minor sheet flow from the north.
- Within the proposed BESS site, modelling indicates shallow sheet flow (<0.15 m) and localised ponding near the southern boundary, which is expected to be mitigated through construction earthworks and site grading. Flow velocities are generally low, remaining below 0.5 m/s.



The regional flood model results indicate that the site is only minimally affected in the 1% AEP event, with minor flood fringe inundation observed along the southern boundary. These impacts are consistent with localised pooling identified in the local model. More significant inundation occurs under the 0.5% AEP and 0.2% AEP events, which extend further across the site and have greater potential to impact the planned infrastructure. The regional flood levels should be considered when designing earthworks levels to site sensitive infrastructure (i.e. substations) to ensure they meet local planning requirements.

The site is located on the outer edge of the Tully River floodplain, and only a small portion of the development footprint—approximately 5,000 m²—overlaps the 1% AEP (Q100) flood extent, representing a minor fraction of the overall site area. Within this overlap, modelled flood depths are generally less than 0.1 m, indicating shallow, low-velocity inundation.

Given the limited encroachment, minimal fill requirements, and the fact that the majority of infrastructure is located outside the Q100 extent, the proposed works are not expected to cause any measurable change to flood storage or conveyance. The shallow inundation depth combined with the absence of significant earthworks in the flood-affected zone means flood behaviour will remain effectively unchanged.

Overall, the assessments described in this SMP and FA demonstrate that the proposed development, including the mitigation measures described above, returns a no-worsening of existing conditions with respect to flood as well as providing an improvement in stormwater runoff quality. Detailed design of the management and mitigation measures described conceptually within this report will be required to ensure the final design provides the intended outcomes.



APPENDIX A WET TROPICS REGION: TULLY CATCHMENT WATER QUALITY TARGETS





APPENDIX B

FLOOD DEPTH AND VELOCITY MAPS

Melbourne

15 Business Park Drive
Notting Hill VIC 3168
Telephone (03) 8526 0800

Sydney

Suite 3, Level 1, 20 Wentworth Street
Parramatta NSW 2150
Telephone (02) 9354 0300

Brisbane

Level 5, 43 Peel Street
South Brisbane QLD 4101
Telephone (07) 3105 1460

Adelaide

1/198 Greenhill Road
Eastwood SA 5063
Telephone (08) 8378 8000

Perth

Level 1, 21 Adelaide Street
Fremantle WA 6160
Telephone (08) 6555 0105

New Zealand

7/3 Empire Street
Cambridge New Zealand 3434
Telephone +64 27 777 0989

Wangaratta

First Floor, 40 Rowan Street
Wangaratta VIC 3677
Telephone (03) 5721 2650

Geelong

51 Little Fyans Street
Geelong VIC 3220
Telephone (03) 8526 0800

Immerra

7 Joel South Road
Well VIC 3380
Telephone 0438 510 240

Gold Coast

Suite 37, Level 4, 194 Varsity Parade
Varsity Lakes QLD 4227
Telephone (07) 5676 7602

watertech.com.au

