



Appendix M

Natural Hazards and Extreme Weather Risk Assessment



REPORT

Tully Battery Energy Storage System (BESS)

Natural Hazards and Extreme Weather Events Risk Assessment

PREPARED FOR
RWE TULLY BATTERY PTY. LTD. C/- ATTEXO GROUP PTY LTD

June 2026



ACKNOWLEDGEMENT OF COUNTRY

Meridian Urban acknowledges the Traditional Custodians of the lands and waters where we live and work.

As resilience practitioners we have a responsibility in listening to and elevating Indigenous voices through our practice, and meaningfully engaging in processes of reconciliation. We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers, and pay our respect to Elders past and present.

Meridian Urban's 'Reflect' Reconciliation Action Plan (RAP) details our commitments to advancing cultural change, active participation and inclusive and informed approaches, with a focus on increasing economic and social equity for Aboriginal and Torres Strait Islander peoples and supporting First Nations self-determination. A copy of our RAP can be viewed online at meridianurban.com.

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Executive Summary

This Natural Hazard and Extreme Weather Risk Assessment (NHEWRA) has been prepared for Attexo Group Pty Ltd (Attexo) and RWE TULLY BATTERY PTY. LTD. to support a Material Change of Use (MCU) application for a proposed Battery Energy Storage System (BESS) at Tully, in the Cassowary Coast Local Government Area (LGA).

This risk assessment has been undertaken in accordance with *AS/NZ ISO 3100:2009 Risk management principles and guidelines* and *AS5534:2013 Climate change adaptation for settlements and infrastructure – a risk based approach to satisfy State Code 27: Battery storage facility development (version 3.5, effective 12 December 2025) (State Code 27)* and associated guideline. The adopted risk assessment methodology is shown in **Figure 1** below.



Figure 1: Risk Assessment Methodology. Adapted from ISO3100 and AS5334. Source: Meridian Urban

Overall, the top ranked natural hazard related risks include:

1. Extreme heat and heatwave
2. Severe storms
3. Bushfire
4. Cyclone and strong winds.

The risk management measures specified in Section 7 are required to achieve tolerable risk level.

The purpose of this risk assessment is to demonstrate, based on hazard-specific and climate projection evidence, those which may have increased aspects of likelihood and/or consequence that is relevant for design, construction, or operation to take forward for detailed facility planning purposes. The summary of risk rating assessment across all hazards is shown in Table 1 below.

Table 1: Summary of unmitigated risk rating assessment across all hazards, incorporating climate change data where relevant

Aspect	Extreme heat and heatwave	Cyclone/ strong winds	Severe storms	Flooding	Earthquake	Bushfire
Operational Infrastructure	High	High	High	Medium	Medium	High
Operational workers	Medium	Low	High	Low	Low	High

Overall, this risk assessment identifies that, through a combination of risk mitigation and risk treatment options, compliance with PO13, PO14 and PO15 of State Code 27 can be achieved. The development is responsive to natural hazards and extreme weather events and able to protect the safety of people in the event of natural hazards and extreme weather.

The following risk mitigation measures (Table 2) are recommended to reduce the level of risk and are required to achieve a tolerable risk level.

Table 2: Recommended risk mitigation measures

Hazard	Primary treatment pathway	Treatment options
Extreme heat and heatwave	Mitigation	<ul style="list-style-type: none"> Active cooling systems for key components Temperature sensors for key components Controlled shut down systems Install UV-rated housing for key components Regular maintenance Design to ambient heat temperatures of 50 degrees Employ battery monitoring systems to monitor temperature.
	Avoidance	<ul style="list-style-type: none"> Ensure operational health and safety policies for both temporary and permanent workers specify working hours and shut-down periods during times of extreme heat (to align with workplace health and safety requirements). Incorporate extreme heat operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.
Cyclones / strong winds and severe storm	Mitigation	<ul style="list-style-type: none"> Lightning protection systems (receptors, grounding, etc.) Implementation of weather and BESS monitoring systems Surge protection Battery enclosures/bays containing the battery modules/cells is IP66 rated Ensure shut down and isolate procedures are in place for strong winds Consider wind rated engineering for components Secure the surroundings and anchor objects, including temporary equipment, shipping containers, etc. in the event of approaching strong winds, cyclones or severe storms Identify protective / durable coatings and coverings for sensitive components to ensure they are not damaged by flying debris or hail Undertake regular maintenance
	Avoidance	<ul style="list-style-type: none"> Incorporate operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.

Hazard	Primary treatment pathway	Treatment options
Flooding	Mitigation	<ul style="list-style-type: none"> • Achieve a minimum 0.2% AEP + climate change flood immunity • Drainage system designed for site specific rainfall and flooding • Cross drainage structures for access roads • Raised / elevated electrical and other system components • Waterproof housings and rust-proofing • Resilient foundation design • Undertake regular maintenance • Sufficient warning time is generally available for flooding to ensure the facility is secured. Workers are not expected to be on site during these conditions, but immediately after.
	Avoidance	<ul style="list-style-type: none"> • Incorporate operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.
Landslide	Mitigation	<ul style="list-style-type: none"> • Resilient foundation design • Any relevant slope stabilisation, subsurface and surface drainage systems, and minimisation of slope cutting per mitigations of separate erosion and sediment control plan • Reinforced access road embankments • Geotechnical certified retaining • Geotechnical assessment
Earthquake		
Bushfire	Avoidance Mitigation Transfer	Refer to the separate Bushfire Hazard Assessment and Bushfire Management Plan prepared by Meridian Urban for recommended treatment options relevant to design and layout and operational procedures.

Tully Battery Energy Storage System (BESS)

Natural Hazards and Extreme Weather Events Risk Assessment

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1 Introduction

This Natural Hazard and Extreme Weather Risk Assessment (NHEWRA) has been prepared for Attexo Group Pty Ltd (Attexo) and RWE TULLY BATTERY PTY. LTD. to support a development application for a material change of use for the proposed Battery Energy Storage System (BESS) at Sandy Creek Road, Tully. The project site is across three parcels and has a proposed project area of approximately 9ha.

The BESS is proposed to be located on the western side Lot 1 on RP852238 on Sandy Creek Road, approximately 4km south-west of Tully township. The BESS is proposed on land in proximity to the existing Tully 132 kV substation (Lot 1 on RP716718) and a new Tully 275 kV substation (Lot 5 on SP140625). The BESS will be connected to the existing substation (Lot 1 on RP716718) via a transmission connection, consisting of overhead transmission line. The transmission connection traverses the adjoining Lot 1 on RP735276 to the north of the BESS site to connect with the substation.

This assessment provides analysis of climate and extreme weather indicators for the Cassowary Coast Regional Council LGA and a risk assessment for existing and future extreme weather and natural hazard risks, and proposed risk mitigation options for the proposed change to the BESS development. This assessment has been prepared to satisfy the relevant requirements of State Code 27: Battery storage facility development.

2 Context

2.1 Overview of the Site Details

Table 3: Site details

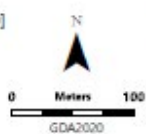
RP Description	Lot 1 on RP852238 Lot 1 on RP735276 Lot 1 on RP716718 (Figure 2)
Project Area	Lot 1 on RP852238 – 20.6ha Lot 1 on RP735276 – 8.094ha Lot 1 on RP716718 – 2.704ha
Local Government	Cassowary Coast Shire Council
Tenure	Freehold Easements for high voltage powerlines across the rear of the site
Current Land Use	Cattle grazing, dwelling houses and ancillary structures



Project Layout Plan

Figure 1

DWG No: RWE-002-014 [D]
DATE: 7/05/2026
DRAWN: KB, JM
REVIEWED EJ
SCALE (A4): 1:5,000



- | | | | |
|-------------------------------------|----------------------------|---------------------|-------------------------------|
| Project Area | Proposed Transmission Line | Noise Wall | Emergency Containment Storage |
| Development Footprint | 20m Exclusion Zone | Landscaping Area | Fence |
| Proposed Access Track Footprint | Substation Area | Existing 132kV Line | Main Road |
| Proposed Transmission Line Corridor | BESS Area | Existing Dwellings | Local Road |
| | Bioretention Basin A | Water Storage | Cadastral Parcels |
| | Bioretention Basin B | O&M Building | |
| | Construction Laydown Area | O&M Area | |

Vector: © State of Queensland (Department of Resources) 2023, © State of Queensland (Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development) 2025

Figure 2: Project Layout Plan

(Source: Attexo)

2.2 Description of the Site

The proposed BESS will be located on the western half of Lot 1 on RP852238. Lot 1 is relatively flat with a gentle slope from the west down to an unnamed Tributary of the Tully River (Sandy Creek) toward the eastern, rear boundary of the lot.

The site contains little vegetation, with only scattered vegetation following drainage / waterway corridors at the rear of the site.

The site has frontage to Sandy Creek Road along its western boundary and is not currently connected to a reticulated water supply.

A high voltage powerline traverses the rear of the site, connecting with a substation fronting Tully Gorge Road to the north of the site (Lot 1 on RP716718).

2.3 Description of the Locality and Region

The Cassowary Coast Region has a number of ecologically significant rainforests, waterways, beaches, and islands as well as iconic species including the Southern Cassowary and the Mahogany Glider.

Typically, as a tropical area, the Cassowary Coast Region has warm mean temperatures year round with a distinct wet season (over the summer months) and high annual rainfall from monsoonal lows and the occasional Tropical Cyclone. Warmer temperatures over the summer months is typically accompanied by a high relative humidity.

The site is approximately 4km (via Tully Gorge Road) to the south-west of the centre of the Tully township and approximately 145km south of Cairns via the Bruce Highway. The site is located approximately 20 kilometres inland from the coast at Mission Beach.

The immediate land surrounding the project site is predominately used for farming purposes, with the exception of the existing Tully substation, referred to above, and a new substation immediately to the north-east.

To the north and north-west of the site, across Tully Gorge Road, is a large expanse of heavily vegetated and elevated area, forming part of the Tully Gorge National Park and the Japoon National Park.

Sandy Creek Road provides access to the surrounding farming land and Tully Gorge Road provides access to Tully Gorge and the National Park area.

Refer to Figure 3 for the context of the site in the locality.



Figure 3: The Locality

(Source: Qld Globe, 2025)

2.4 Proposed development

The proposed development is for a BESS and associated infrastructure on Lot 1 on RP852238. The BESS is intended to take electricity from the grid in periods of low demand, and feed back into the grid at periods of high demand.

The BESS is proposed on land in proximity to the existing Tully 132 kV substation (Lot 1 on RP716718) and a new Tully 275 kV substation (Lot 5 on SP140625). The BESS will be connected to the existing substation (Lot 1 on RP716718) via a transmission connection, consisting of overhead transmission line. The transmission connection traverses the adjoining Lot 1 on RP735276 to the north of the BESS site to connect with the substation.

The primary components of the Project relevant to this assessment are described below:

- **Battery Units:** Up to 188 battery units will cover a total area of up to 2.5 ha. The BESS will be connected to the adjacent switch rooms via underground cables.
- **Switching Station:** A switching station will be located to the north of the battery units and will include a 132/33 kV high-voltage transformer, associated switchgear, an auxiliary transformer, two 33 kV switch rooms, and, if required, harmonic filters.
- **Site Access and Internal Circulation:** Access to the site will be via the existing road network, including the Bruce Highway and Tully Gorge Road, with upgrades proposed to the two access point from Sandy Creek Road. The BESS facility will be secured by perimeter fencing. Internal access tracks will be provided around the battery units to facilitate operations, maintenance, and emergency response.
- **Grid Connection Infrastructure:** The Project will connect to the adjacent substation via an overhead transmission line extending north from the BESS area. The line will be supported approximately five (5) single-circuit 132 kV concrete poles, each approximately 27.5 metres in height.
- **Asset Protection Zone (APZ):** An Asset Protection Zone will be established and maintained around the battery infrastructure to mitigate bushfire risk and provide access for firefighting activities. The APZ has been informed by this assessment.
- **Fire Safety Measures:** Fire protection infrastructure will include, subject to detailed design, approximately 472,000 litres of on-site static water storage (including 40,000L dedicated for bushfire fighting purposes), together with a fire hydrant system designed in accordance with Australian Standard AS 2419.1.
- **Stormwater Management:** Stormwater infrastructure will be designed and constructed to ensure the safe collection, containment, and management of runoff across the site during both construction and operational phases. This will include any emergency containment storage for containment for fire water in an emergency event.
- **Earthworks:** Earthworks will include site levelling, formation of batters, and clearing necessary to facilitate construction and access.
- **Laydown and Operations Areas:** Temporary construction laydown areas and a permanent operations and maintenance (O&M) building will be established adjacent to Sandy Creek Road. This will include an O&M building, yard, parking areas, office facilities, and storage sheds.
- **Landscaping and Screening:** Landscape buffer planting will be established along the frontage and partially along the side boundaries of Lot 1 on RP852238 to provide visual screening and enhance integration with the surrounding landscape.

The BESS site is largely cleared of vegetation, with only scattered trees and shrubs will be removed during the construction phase of the project. The existing dwelling and structures on Lot 1 on RP852238 may be utilised as operations and management area at some point in the future, or they may be demolished.

The BESS will be operational 24 hours a day, every day of the year. The primary operation of the premises will be undertaken from a remote operations control centre, with physical

monitoring and maintenance of the facility undertaken periodically. Planned maintenance activities will likely include:

- Monthly inspections (electricity, civil and environmental)
- Vegetation management (in line with various management plans)
- Other activities as defined in the O&M management plans
- During fire danger period weekly inspections of the APZ, access road, water supply, signage and building protection systems.

Corrective maintenance activities will likely include:

- Testing and replacement of faulty plant components (fuses, etc)
- Any other corrective actions within the O&M scope.

The proposed development layout is included in **Appendix A**.

2.5 Statutory Requirements

The relevant assessment benchmarks are the State Development and Assessment Provisions (SDAP) (version 3.6, effective 1 May 2026), State Code 27: Battery storage facility (Stage Code 27). The provisions relevant to natural hazards and extreme weather risk are outlined in **Table 4** below, and assessment against these provisions is included at Section 8.

Table 4: State Code 27 relevant provisions.

Relevant Provision	
Purpose Statement (1)	The BESS avoids and/or appropriately integrates risk mitigation strategies and responsive design measures to address potential fire hazards, and other environmental risks, ensuring long-term safety and resilience for people, surrounding land uses and the environment
Purpose Statement (3)	The BESS does not result in unacceptable adverse impacts on individuals, communities, the environment , adjacent sensitive land uses and sensitive receptors, landscape values and infrastructure and services.
Natural hazards	
Performance Outcome PO13	Development is located and sited to avoid natural hazard areas including high erosion risk areas and bushfire prone areas .
Performance Outcome PO14	Where development cannot be located and sited to avoid natural hazard areas (e.g. Bushfire prone areas , and high erosion risk areas), demonstrate that: <ul style="list-style-type: none"> • there is no suitable alternative location; • infrastructure can function effectively during and after a natural hazard event; and • mitigation measures are implemented to reduce the risk to people, property and the environment to a tolerable level.

Relevant Provision
**Performance Outcome
PO15**

Bushfire hazard is identified and risk is mitigated through strategies for vegetation management, landscape management, water supply, provision of appropriate access, identification of safe assembly or evacuation routes and establishing cleared and maintained asset protection zones around infrastructure that is wholly contained on site.

State Code 27 is supported by the Planning guideline State Code 27: Battery storage facility development. The Guideline outlines that development applications should be supported by a Natural Hazard Risk Assessment Report to demonstrate compliance with PO13 – PO15. This report satisfies that requirement.

A Flood Assessment has been prepared by Water Technology dated June 2026, addressing and respond to the relevant technical assessment requirements.

To appropriately respond to PO15, the guideline also requires:

- Bushfire Management Plan (BMP) - The BMP has been prepared by Meridian Urban in a separate report 'Bushfire Hazard Assessment and Management Plan' dated May 2026; and
- Safety and Emergency Management Plan (SEMP) – The SEMP has been prepared by Riskcon Engineering, dated June 2026.

Where relevant, the recommendations of the abovementioned reports have been incorporated into this Natural hazards and extreme weather risk assessment.

A complete response to the State Code and guideline is provided in Section 8 of this report.

3 Methodology

3.1 Data Sources

To understand the extreme weather risk for the proposed BESS facility in this region, climate indices relevant to each climate variable and hazard have been collected. To obtain these climate indices, data has been collated from the Queensland Future Climate Dashboard where available, and from Bureau of Meteorology (BOM) and the Queensland Government where there is not specific data in the Dashboard.

The Queensland Future Climate Dashboard provides downscaled climate change projections across Queensland. This project will utilise climate models completed by the Coupled Model Intercomparison Project Phase 6 (CMIP6). The projections are determined based off an ensemble of 15 downscaled CMIP6 climate models. As each model provides a different output, data is presented as the 'mean' (average) of the 15 model outputs to provide an averaged indication of all models. In addition, a range (minimum and maximum) is also presented in this report to provide an indication as to the variation between the different models. The spatial scale for this assessment is set at the local government boundary for the Cassowary Coast LGA.

It is noted that the models are all run from a reference period from 1986 – 2005. As such, data presented in the tables below represents change from the reference period and therefore are not absolute values. To provide additional context, where possible the percentage change from the reference period is also provided.

The future climate projections provided on the Queensland Future Climate Dashboard range across different temporal resolutions (i.e. annual, summer, wet season). For the purposes of this report, an annual season has been utilised to ensure consistency.

The data presented in the dashboard is presented as different scenarios. Shared socio-economic pathway (SSP) scenarios are global emissions scenarios developed by the Intergovernmental Panel on Climate Change (IPCC). For the purposes of this risk assessment, data has been assessed under SSP3-7.0, a more conservative approach assuming global greenhouse gas emissions slow at a minor rate. It is noted however, that the Severe Thunderstorm Dashboard has not been updated to reflect the SSP scenarios, therefore the RCP 8.5 scenario has been selected for severe thunderstorm data.

The 2050 and 2090 scenarios represent an averaged measure over a 20 year time period. For the 2050 scenario, this time period is from 2040 – 2059. The 2090 scenario refers to the time period from 2080 – 2099.

The Australian Government Bureau of Meteorology data service has long-range weather and climate data. This has been used to supplement the data obtained from the Queensland Future Climate Dashboard, such as historical climate extreme data.

A summary of the climate indices used for each variable and hazard is provided in the following section.

Whilst the 2090 time horizon is used as standard practice, it must be noted the design life of the BESS is around 20 years. Therefore, regard to the 2050 time horizon is most appropriate for BESS infrastructure

3.2 Climate Indicators

3.2.1 Extreme rainfall

The following climate indices (**Table 5**) have been utilised to understand the effect of extreme rainfall across the LGA.

Table 5: Extreme rainfall climate indices

Climate Variable	Unit	Description
Maximum 1-day precipitation	mm	The maximum precipitation (rainfall) recorded in a single day within a year.
Maximum 5-day precipitation	mm	The maximum precipitation (rainfall) recorded across 5 consecutive days.
Extremely wet day precipitation	mm	The total precipitation (rainfall) annually where daily precipitation is greater than the 99 th percentile.

Source: Adapted from Queensland Future Climate Dashboard

3.2.2 Average rainfall

Average rainfall across the regions are understood by referring to the below climate indices (**Table 6**).

Table 6: Decreased average rainfall climate indices

Climate Variable	Unit	Description
Precipitation	mm / day	The average precipitation (rainfall) per day over the course of a year.

Source: Adapted from Queensland Future Climate Dashboard

3.2.3 Extreme temperature

To understand the effect of extreme temperature across a region, a number of climate indices are considered as identified in the table below (**Table 7**).

Table 7: Extreme temperate climate indices

Climate Variable	Unit	Description
Mean temperature	°C	The mean temperature refers to the average temperature averaged across a year.
Maximum temperature	°C	The highest temperature.
Hot Days	Days	The number of days where the maximum temperature exceeds 35°C.
Hot Nights	Nights	The number of nights where the minimum temperature does not drop below 20°C.
Very Hot Days	Days	The number of days where the maximum temperature exceeds 40°C.

Climate Variable	Unit	Description
Cold Nights	Nights	The number of nights where the minimum temperature is less than 5°C.

Source: Adapted from Queensland Future Climate Dashboard

3.2.4 Increased average temperatures

Decreased average temperatures across the regions are understood by referring to the below climate indices (**Table 8**).

Table 8: Increased average temperature climate indices

Climate Variable	Unit	Description
Mean temperature	°C	The mean temperature refers to the average temperature averaged across a year.

Source: Adapted from Queensland Future Climate Dashboard

3.2.5 Riverine (fluvial) flooding

For riverine (fluvial) flooding, the following (**Table 9**) climate indices have been used to inform riverine (fluvial) flooding across the region. It is noted that the 'duration of wet' variable is based on a Standardised Precipitation Index for a 12 month period (SPI-12). The SPI-12 refers to the difference of the precipitation from the average divided by the standard deviation. For this variable a 'severe wet' scenario ($SPI-12 \geq 1.5$) was used.

Table 9: Riverine (fluvial) flooding climate indices

Climate Variable	Unit	Description
Maximum 5-day precipitation	mm	The maximum precipitation (rainfall) recorded across 5 consecutive days.
Duration of wet	months	The average amount of time where conditions are above a Standardized Precipitation Index, at a severity category of moderate (Categories of Moderate, Severe, Extreme).

Source: Adapted from Queensland Future Climate Dashboard

3.2.6 Rainfall (pluvial) flooding

The following climate indices (**Table 10**) are considered to understand the effects of rainfall (pluvial) flooding.

Table 10: Rainfall (pluvial) flooding climate indices

Climate Variable	Unit	Description
Maximum 1-day precipitation	mm	The maximum precipitation (rainfall) recorded in a single day within a year.
Extremely wet day precipitation	mm	The total precipitation (rainfall) annually where daily precipitation is greater than the 99 th percentile.

Source: Adapted from Queensland Future Climate Dashboard

3.2.7 Heatwave

To understand the effects of heatwave the following climate indices (**Table 11**) are considered.

Table 11: Heatwave climate indices

Climate Variable	Unit	Description
Heatwave peak temperature	°C	The maximum temperature from the hottest heatwave recorded in a year.
Heatwave frequency	Days	Number of days a heatwave is recorded in any given year.
Hot days	Days	Seasonal count of days with maximum temperature > 35 degrees Celsius
Hot nights	Days	Seasonal count of nights with minimum temperature > 20 degrees Celsius
Very hot days	Days	Seasonal count of days with maximum temperature > 40 degrees Celsius
Heatwave duration	Days	Average duration in days of all heatwave events in the selected season

Source: Adapted from Queensland Future Climate Dashboard

3.2.8 Drought

The climate indices considered for drought are identified in the table below (**Table 12**). It is noted that the climate variables for drought are based on a Standardised Precipitation Index for a 12 month period (SPI-12). The SPI-12 refers to the difference of the precipitation from the average divided by the standard deviation. For this variable a 'severe drought' scenario (SPI-12 \geq 1.5) was used.

Table 12: Drought climate indices

Climate Variable	Unit	Description
Duration of droughts	months	The average duration (in months) of droughts per year over a 20 year period.
Frequency of droughts	# of events	The average number of drought events per year over a 20 year period.
Percent time in droughts	%	Average number of months spent in drought per year averaged over a 20 year period.

Source: Adapted from Queensland Future Climate Dashboard

3.2.9 Bushfire

The following climate indices (**Table 13**) are used to understand the effect of bushfire on the region.

Table 13: Bushfire climate indices

Climate Variable	Unit	Description
Relative humidity	%	The average humidity (ratio of vapor pressure to the saturation vapor pressure) across an annual period.
Hot Days	Days	The number of days where the maximum temperature exceeds 35°C.
Hot Nights	Nights	The number of nights where the minimum temperature does not drop below 20°C.
Very Hot Days	Days	The number of days where the maximum temperature exceeds 40°C.
Extreme fire weather days	Days	Seasonal count of days where Forest Fire Danger Index (FFDI) >50
95 th percentile fire days	days	Seasonal count of days with an FFDI greater or equal to the 95 th percentile for the reference period (1995 – 2014)

Source: Adapted from Queensland Future Climate Dashboard

3.2.10 Cyclone / strong winds

For cyclone / strong winds, reference is made to the Severe Wind Hazard Assessment for Queensland and information provided on the Tropical Cyclone Hazard Dashboard. For each disaster district, the regionalised wind speed is recorded based off a 1 per cent AEP event in 2050 and 2090 under an RCP8.5 scenario. Wind speeds are recorded in metres per second and correspond to a tropical cyclone category as follows:

- Tropical Cyclone Category 5 (TC5) (> 77.5 m/s)
- Tropical Cyclone Category 4 (TC4) (62.5 – 77.5 m/s)
- Tropical Cyclone Category 3 (TC3) (45.8 – 62.5 m/s)
- Tropical Cyclone Category 2 (TC2) (34.7 – 45.8 m/s)
- Tropical Cyclone Category 1 (TC1) (27.8 – 34.7 m/s)
- Tropical Depression (TD) (< 27.8 m/s).¹

3.2.11 Thunderstorm, hail and lightning

For thunderstorm, hail and lightning reference is made to the Bureau of Meteorology (BoM) for lightning flash data (average annual lightning ground flash density (flashes km⁻² yr⁻¹). This data shows the lightning ground flash density (Ng) using data over an 18-year period (1995 – 2012).

¹ Queensland Government, 2024, "Tropical Cyclone Hazard Dashboard". Available online at <https://www.longpaddock.qld.gov.au/qld-future-climate/tropical-cyclone/>

The State Disaster Risk Report is also referred to, to ascertain the number of recorded severe local storm events since 1921.

3.2.12 Landslide / Soil Erosion

Landslide hazard is typically derived from landslide hazard and/or steep slope mapping contained in the Cassowary Coast Council Planning Scheme.

3.2.13 Earthquake

Earthquake data is derived from the Queensland State Earthquake Risk Assessment² and the Geoscience Australia National Seismic Hazard Assessment (NSHA) for Australia³.

3.3 Defined operational assets

The BESS consists of permanent (operational) infrastructure. The risk assessment has been undertaken for permanent infrastructure, with each infrastructure type listed below.

Operational (permanent) assets:

- 188 battery units
- Substation
- Two switch rooms and site office
- Transformers
- Operations and maintenance area
- Grid connection overhead transmission line
- Carparking and perimeter road

3.4 Risk assessment

This risk assessment has been undertaken in accordance with AS/NZ ISO 3100:2009 Risk management principles and guidelines and AS5534:2013 Climate change adaptation for settlements and infrastructure – a risk-based approach. The adopted risk assessment methodology is shown in Figure 4 below.

² Queensland Fire and Emergency Services. 2024. 'Queensland 2024 State Earthquake Risk Assessment'. Available online at https://www.disaster.qld.gov.au/_data/assets/pdf_file/0021/339303/QFES-State-Earthquake-Risk-Assessment.pdf

³ Geoscience Australia. 'Earthquakes@GA'. Available online at <https://earthquakes.ga.gov.au/>

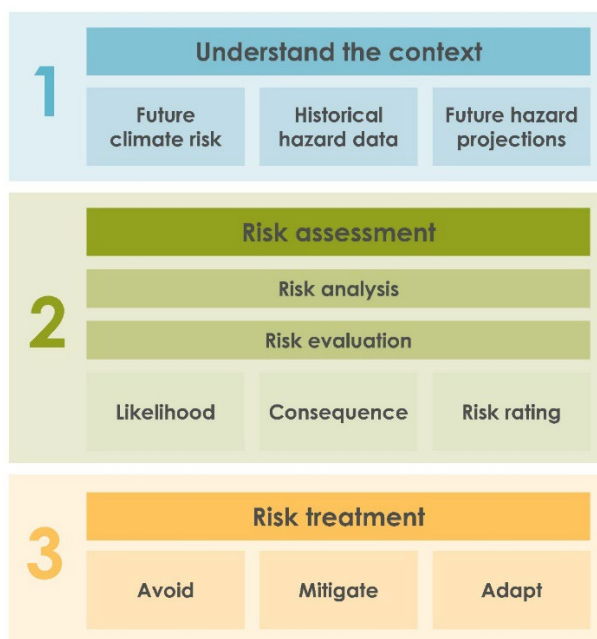


Figure 4: Risk Assessment Methodology. Adapted from ISO3100 and AS5334. Source: Meridian Urban.

3.4.1 Risk Analysis

3.4.1.1 Risk Criteria

The following has been considered in preparing this risk assessment:

- Responsiveness of the development to natural hazards and extreme weather events (as per PO13, PO14, and PO15)
- Safety of people in the event of natural hazards or extreme weather events occurring (as per PO5)
- The likelihood of each extreme weather or hazard event
- Consequence of extreme weather or hazard event occurring. Consequence has been considered regarding:
 - Responsiveness of operational infrastructure
 - Safety of operational staff such as transient and permanent workers on site.
- The nature of each extreme weather or hazard and how these may impact on the proposed Tully BESS development.

3.4.1.2 Likelihood

To determine the likelihood component of the risk assessment, the 'example of qualitative measures of likelihood', Appendix C from AS5334 is adopted. The descriptive likelihood table is shown in **Table 14**.

Table 14: Likelihood Table. Source: AS5334

Rating	Descriptor	Recurrent or event risks	Long term risks
Almost certain	Could occur several times per year	Has happened several times in the past year and in each of the previous 5 years Or	Has a greater than 90% chance of occurring in the identified time

		Could occur several times per year	period if the risk is not mitigated
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years <i>Or</i> May arise about once per year	Has a 60-90% chance of occurring in the identified time period if the risk is not mitigated
Possible	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year <i>Or</i> May arise once in 25 years	Has a 40-60% chance of occurring in the identified time period if the risk is not mitigated
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years <i>Or</i> May arise once in 25 to 50 years	Has a 10-30% chance of occurring in the future if the risk is not mitigated
Rare	Maybe once in a lifetime	Has not occurred in the past 5 years <i>Or</i> Unlikely during the next 50 years	May occur in exceptional circumstances, i.e., less than 10% chance of occurring in the identified time period if the risk is not mitigated.

3.4.1.3 Consequence

To determine the consequence component of the risk assessment, the 'example of qualitative measures of consequence, Appendix B1 from AS5334 has been adopted and varied to suit the

The descriptive likelihood table is shown in **Table 15**, with unmitigated consequence descriptions detailed below:

Table 15: Consequence descriptors. Source: AS5334 Appendix B1

Consequence descriptor	Infrastructure, service	Social/cultural
Insignificant	No infrastructure damage, little change to service	No adverse human health effects
Minor	Localised infrastructure service disruption No permanent damage. Some minor restoration work required Early renewal of infrastructure by 10-20% Need for new/modified ancillary equipment	Short-term disruption to employees, customers or neighbours Slight adverse human health effects or general amenity issues

Moderate	Limited infrastructure damage and loss of service Damage recoverable by maintenance and minor repair Early renewal of infrastructure by 20-50%	Frequent disruptions to employees, customers and neighbours. Adverse human health effects
Major	Extensive infrastructure damage requiring major repair Major loss of infrastructure service Early renewal of infrastructure by 50-90%	Permanent physical injuries and fatalities may occur Severe disruptions to employees, customers or neighbours
Catastrophic	Significant permanent and/or complete loss of the infrastructure and the infrastructure service Loss of infrastructure support and translocation of service to other sites Early renewal of infrastructure by >90%	Severe adverse human health effects, leading to multiple events of total disability or fatalities Total disruption to employees, customers or neighbours Emergency response at a major level

3.4.2 Evaluation (level of risk)

To determine the risk rating the 'example of risk rating matrix, Appendix D from AS5334 has been adopted. The descriptive risk rating matrix is shown in Table 16 below, with the assessment of each hazard against the likelihood descriptors for each natural hazard referenced in Section 7.

- E = extreme risk, requiring immediate action
- H = high risk issues requiring detailed research and planning
- M = moderate risk issue requiring change to design standards and maintenance of assets
- L = low risk issue requiring action through routine maintenance of assets

The below risk rating is based on unmitigated risk.

Table 16: Risk Rating Matrix

Source: AS5334

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	L	M	H	E	E
Likely	L	M	M	H	E
Possible	L	L	M	H	E
Unlikely	L	L	M	M	H

Rare	L	L	L	M	M
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3.5 Assumptions and Limitations

The following assumptions and exclusions apply to this risk assessment:

It is assumed the evidence sources utilised to inform this risk assessment are accurate and up-to-date, and can be reasonably relied upon for the purposes of its application.

Data sources include:

- Tully BESS Stormwater Management Plan & Flood Assessment prepared by Water Technology Pty Ltd
- Fire Safety Study for Tully BESS prepared by Riskcon Engineering
- Risk Management Assessment Report for Tully BESS prepared by Riskcon Engineering
- Safety and Emergency Management Plan (SEMP) for Tully BESS prepared by Riskcon Engineering
- Queensland Climate Future Dashboard
- Queensland Tropical Cyclone Hazard Dashboard
- Bureau of Meteorology Climate Data Online
- Geoscience Australia National Seismic Hazard Assessment
- State-wide data has been used for present day baseline in some instances
- It is acknowledged that the report relies on the now superseded Forest Fire Danger Index (FFDI), however this is necessary as the data sources are presented based on FFDI
- Climate projections are presented in relative terms to a reference period (1986 – 2005) and do not represent absolute values; and

4 Region Climate Projection Snapshot Summary

Below is a snapshot summary of the climate and natural hazards profile relative to the Cassowary Coast LGA and the area that is the subject of this risk assessment. Further detail is expanded upon in Sections 5 and 6 that follow.

For climate indicators:

- The rainfall indices, are projected to decrease across all indicators by 2050, with further decreases by 2090
- A projected increase in average temperature and maximum temperature by 2050 with further projected increases by 2090, including hot days, hot nights and heatwave duration
- The future average temperature is projected to increase by 2.69 degrees in the Cassowary Coast LGA; and
- A projected increase in duration and frequency of drought conditions as well as percentage of time in drought.

For natural hazards/extreme weather:

- The overall number of tropical cyclones is expected to decrease through to 2060, the number of more severe tropical cyclones is also projected to decrease
- The subject site is located within a mapped flood hazard area, and the BESS footprint is affected in 1%AEP flood event. Maximum flood depths occurring in the BESS footprint in the 1%AEP event were recorded at 0.30 m in the southwest corner and 0.23 m in the southeast corner of the site
- Whilst mean rainfall indicators project a slight reduction in rainfall to 2050 and 2090, the region remains one of the wettest places in Queensland with periods of extreme rainfall
- The detailed heatwave projections for 2050 and 2090 under SSP3-7.0 indicate that:
 - All heatwave indicators are projected to increase by 2050, and then a further increase by 2090; and
 - An increase in hot days and hot nights is projected by 2050, with a further increases projected by 2090.
- The subject site is not located within a mapped landslide hazard area in the Cassowary Coast Planning Scheme
- The site is at a deemed low earthquake risk. The site is identified as 0.005 – 0.01 units of g (the second lowest measure) at NSHA18 peak ground acceleration with a 10% chance of exceedance in 50 years. The site is identified as 0.02 – 0.04 units of g (the second lowest measure) at NSHA18 peak ground acceleration with a 2% chance of exceedance in 50 years
- The climate-adjusted (1:20 year Annual Return Interval at 2050) Forest Fire Danger Index (FFDI) applicable to the site is 50
- The time series of annual accumulated FFDI analysed by the BoM study identifies an increase of 14% for the North Coast subregion from 1950 to 2018. Annual highest daily FFDI from 1989 to 2018 shows increasing FFDI in the North Coast subregion;
- For bushfire, there are a range of climate indicators that reflect future fire weather conditions. For this location, these indicators reflect increasing fire weather conditions into the future.

5 Extreme Weather Climate Variables

In order to evaluate the future potential of natural hazards and extreme weather, it is important to first understand how climate change may effect or amplify natural hazard conditions. This section analyses the mean of selected climate variables or indicators from publicly available data sourced primarily from the Queensland Future Climate Dashboard (the Dashboard) where available, and from the Bureau of Meteorology (BoM).

The data presented in the Dashboard is presented across different scenarios. This assessment uses two IPCC Shared Socio-economic Pathways (SSPs) provided in the Dashboard: SSP2-4.5 and SSP3-7.0. Assessing both pathways presents a plausible range of futures—from a stabilising trajectory (SSP2-4.5) to a higher-emissions trajectory (SSP3-7.0).

The data reported in this section underpins a local understanding of projected impacts of climate change and its associated changes to the weather patterns that may affect the Cassowary Coast LGA to 2050 and to 2090.

5.1 Extreme Rainfall

5.1.1 Past and present historical rainfall

Table 17 below includes the highest monthly rainfall records for the Tully Sugar Mill (as one of the closest weather stations to the subject site).

Table 17: Historical extreme monthly precipitation totals for the Tully Sugar Mill weather station

Value (mm)	Month and Year	Weather station
2003.0	January 1981	Tully Sugar Mill
1907.4	March 1945	Tully Sugar Mill
1818.7	February 1936	Tully Sugar Mill
1745.6	March 1950	Tully Sugar Mill
1651.5	March 2018	Tully Sugar Mill

Source: Bureau of Meteorology

The present and historical data using average rainfall data for Cardwell Marine Parade (station 032004), located approximately 36 kilometres from the Tully, shows that historically the highest rainfall totals occur in the summer months, particularly January, February and March. The months of April – November typically have the lowest rainfall (see Figure 5 below). It is noted that the Cardwell Marine Parade weather station is located on the coast and the climate data may not be fully representative of the inland location of Tully. The Bureau of Meteorology's rainfall dataset is not comparative to that of the Tully Sugar Mill weather station, shown below. It is understood the dataset of the Tully Sugar Mill is accepted as locally accurate.

Location: 832004 CARDWELL MARINE PDE

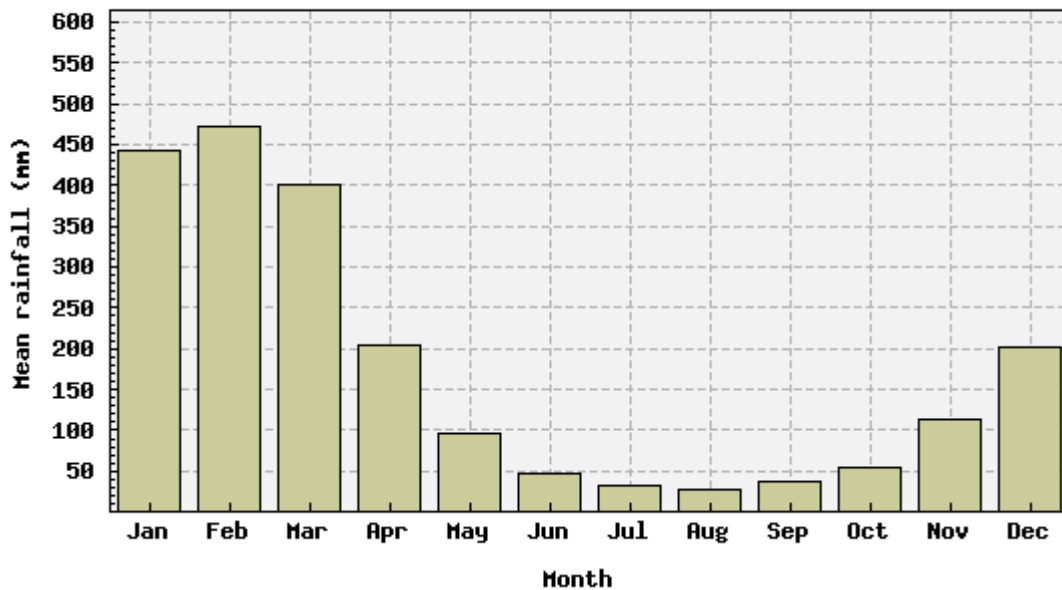


Figure 5: Mean monthly rainfall per annum for Cardwell Marine Parade

5.1.2 Extreme rainfall projections

The following insights are drawn from the extreme precipitation indices table and wetness indices tables identified in the Queensland Future Climate Dashboard⁴ relative to extreme (heavy) rainfall and flooding for the Cassowary Coast LGA.

- The mean maximum 1-day precipitation is projected to decrease in the Cassowary Coast LGA with a greater decrease expected by 2090
- The mean maximum 5-day precipitation is projected to decrease by 2050 and then further decrease by 2090
- Mean extremely wet day precipitation is projected to decrease by 2050 and further decrease by 2090; and
- Mean duration of wet (percentage of time) is projected to increase by 2050 and then decrease by 2090.

The spatial distribution of extreme rainfall projections is shown in **Figure 6** below. The below data Table 18) represent change relative to reference period 1995-2014.

⁴ Queensland Government, 2025, 'Queensland Future Climate Dashboard', Available at <https://www.longpaddock.qld.gov.au/qld-future-climate/>

Table 18: Extreme rainfall projections in the Cassowary Coast LGA

Precipitation variable	Cassowary Coast LGA						
	SSP3-7.0 (2050)				SSP3-7.0 (2090)		
	Reference	Mean	Min	Max	Mean	Min	Max
Max 1-day precipitation (mm)	181.7	-6	-52.7	42.3	-16.5	-55.7	27.3
Max 5-day precipitation (mm)	380.6	-0.6	-103.9	67.3	-19.4	-98.6	72.6
Extremely wet day precipitation (mm)	296.3	-9	-172.4	103.8	-58	-144.3	62.4
Duration of wet (% time)	16	0.4	-23.3	21.6	-3.3	-13.7	5.4

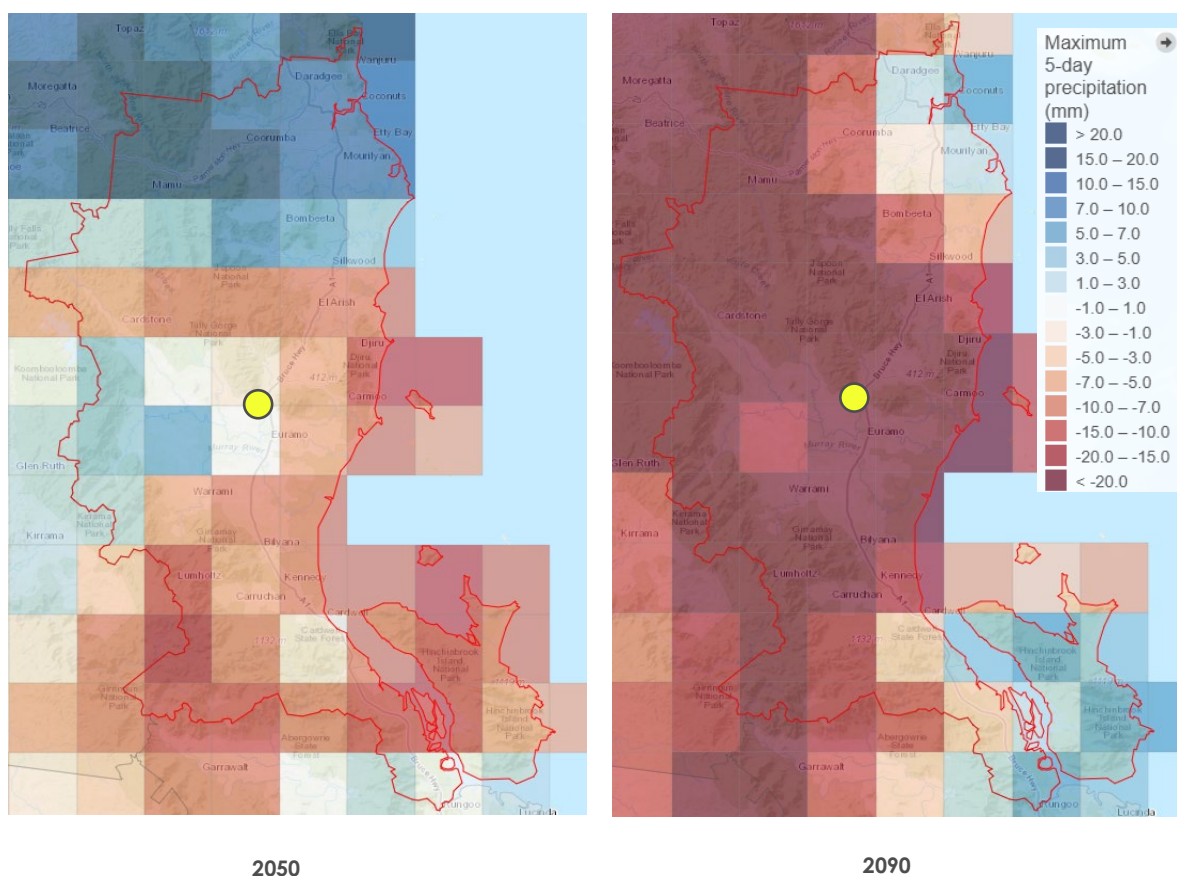


Figure 6: Maximum 5-day precipitation under SSP3-7.0 in 2050 and 2090 for the Cassowary Coast LGA

Note: Subject site denoted by the yellow dot in the Figure above.

5.2 Extreme Temperature

5.2.1 Present and Historical data

Historically, the mean highest temperatures occur in January for the Cassowary Coast LGA which has an average maximum temperature of 31.5 degrees (measured from the Cardwell

Marine Parade weather station, with measurements dating back to 1871).⁵ It is noted that the Cardwell Marine Parade weather station is located on the coast and the climate data may not be fully representative of the inland location of Tully.

Table 19 below includes the official highest temperature records for Cardwell Marine Parade (as one of the closest weather stations to the subject site), located approximately 36km south of the proposed development in the Cassowary Coast LGA.⁶

Table 19: Historical extreme temperature for the Cassowary Coast LGA (Cardwell Marine Parade weather station)

Value (degrees Celsius)	Date	Station location
42.6	20 December 1995	Cardwell Marine Parade
41.8	30 December 1984	Cardwell Marine Parade
41.8	21 February 2019	Cardwell Marine Parade
41.7	29 January 1967	Cardwell Marine Parade
41.4	21 December 1995	Cardwell Marine Parade

5.2.2 Future maximum temperature projections

Per **Table 20** below, the climate projections for maximum temperature in the Cassowary Coast LGA are projected to increase by 2050 and further increase by 2090. The below data represents change relative to reference period 1995 – 2014.⁷

Table 20: Extreme maximum projections in the Cassowary Coast LGA

	Reference	SSP3-7.0 (2050)	SSP3-7.0 (2090)
Mean (° Celsius)	26.1	1.24	2.78
Minimum (° Celsius)		0.99	2.24
Maximum (° Celsius)		1.48	3.42

5.2.3 Future increased average temperature

Increased average or mean temperature is different to changes to maximum temperatures, and relates to general, long-term temperature increases across seasons. It is an important measure of climate change.

⁵ Bureau of Meteorology, 2025, 'Climate Data Online'. Available online at <https://www.bom.gov.au/climate/data/index.shtml>

⁶ Bureau of Meteorology, 2025, 'Australian Climate and Weather Extremes Monitoring System', Available online at <http://www.bom.gov.au/climate/extremes/>

⁷ Queensland Government, 2025, "Queensland Future Climate Dashboard". Available online at <https://www.longpaddock.qld.gov.au/qld-future-climate/dashboard-cmip6/#responseTab1>

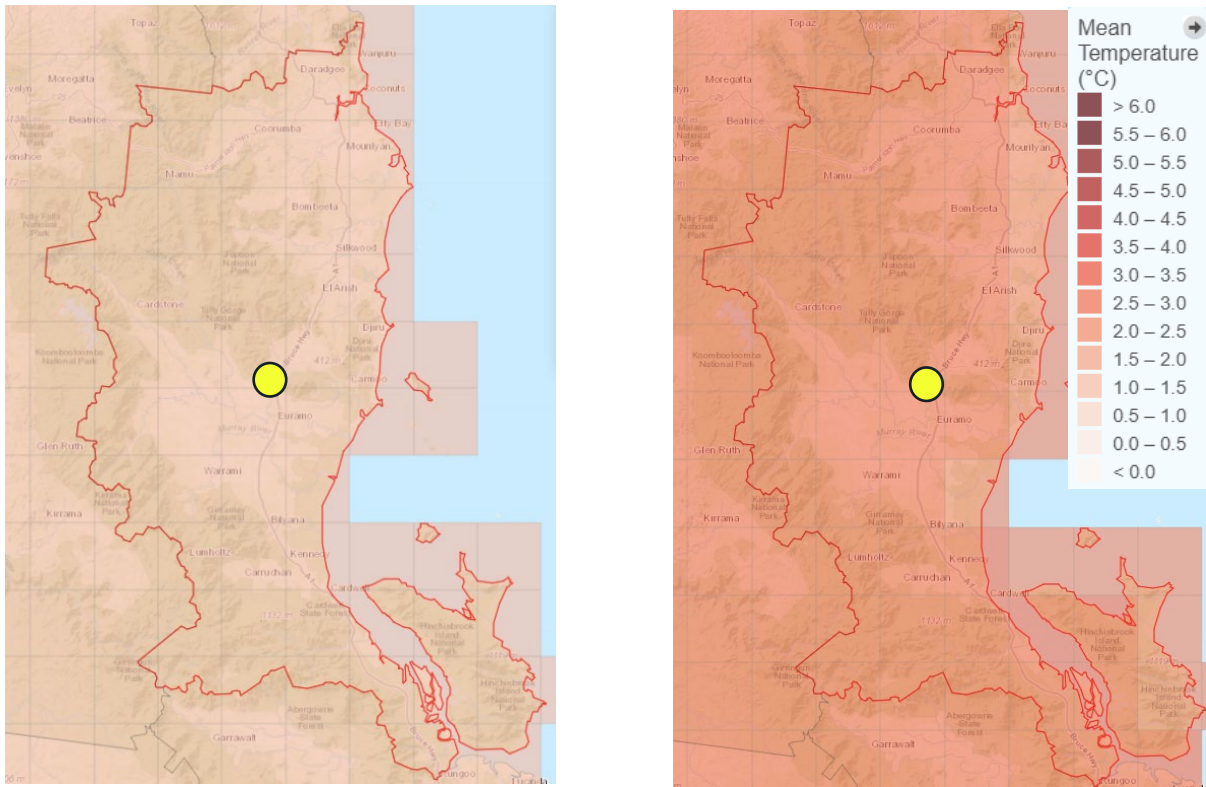


Figure 7: Mean Temperature under SSP3-7.0 in 2050 (left) and 2090 (right) within the Cassowary Coast LGA

Note: Subject site location is denoted by the yellow dot.

As outlined in **Figure 7** above, the mean temperature in the Cassowary Coast LGA is projected to increase consistently across the LGA in 2050 and further increase by 2090.

The below data at **Table 18** represents change relative to reference period 1995 - 2014.

Table 21 : Average temperature projections for the Cassowary Coast LGA

	Reference	SSP3-7.0 (2050)	SSP3-7.0 (2090)
Mean (° Celsius)	22.8	1.22	2.69
Minimum (° Celsius)		0.92	2.09
Maximum (° Celsius)		1.43	3.27

5.3 Drought

Whilst drought does not directly affect BESS facilities or their operations, drought climate indices can provide further insights for extreme temperature and fire weather. For this variable a 'moderate drought' scenario (SPI-12 \geq 1.5) was used.

The below drought climate indicators in **Table 22**, shows a projected average increase in duration and frequency of drought conditions, as well as percentage of time in drought for the Cassowary Coast LGA. It is noted that the projected increases to the indicators show an increase by 2050 and a further increase by 2090, per the Future Climate Dashboard datasets.

Table 22: Drought climate indicators

Drought variable	SSP3-7.0 (2050)				SSP3-7.0 (2090)		
	Reference	Mean	Min	Max	Mean	Min	Max
Duration of drought (months)	6.1	0.2	-4.2	4	0.9	-5.8	6.8
Frequency of droughts (number of events)	6.6	1	-4.1	6.1	1.2	-3.4	3.9
Percent time in drought (%) (moderate drought)	15.3	4.1	-9.7	21.4	7.3	-4.9	33.4

The percent time in droughts/wetness variable is expressed as the percentage of the number of months in drought/wetness relative to the total number of months in the 20-year time-slice (1986-2005) (i.e.15 % of the months between 1986-2005 were classified as being in 'moderate' drought).

While formal drought declarations in the Cassowary Coast LGA are rare, extremely dry periods are more common.

Changes in this variable represent an absolute increase in the percentage of months that are classified as droughts/wetness months, rather than a relative percentage increase.

This means that Cassowary Coast is expected to experience a mean increase in the number of moderate standardised precipitation index (SPI) drought months of 7.3% by 2090. This represents an increase from the reference value of 15.3% to a total project percent time in drought of 22.6% (15.3% + 7.3% =22.6%).

(Note: SPI is a rainfall-based index, calculated from accumulated rainfall over a set number of months).

6 Hazards

This section examines how changes in climate indicators (Section 5) may impact the frequency or intensity of natural hazards to which the proposed BESS is exposed, into the future.

6.1 Cyclone / strong winds

*'Tropical cyclones are low pressure systems that form over warm tropical waters, rotating around a single point or 'eye'. Tropical cyclones can vary considerably in their size and intensity and typically form when the sea-surface temperature is above 26.5°C. Tropical cyclones can persist and change intensity over many days, even weeks, and may follow quite erratic paths.'*⁸ Additional hazards associated with the passing of a tropical cyclone include storm tide inundation and riverine flooding.'

Forming over warm tropical waters, a cyclone will dissipate once it moves over land. However, conditions may be present that allow cyclones to maintain their intensity much further inland than expected.

6.1.1 Present and historical data

The Cassowary Coast LGA has received Disaster Recovery Funding for multiple tropical cyclone events and associated rainfall events since 2013. These include Tropical Cyclone Oswald and the associated flooding (21 – 29 January 2013), Tropical Cyclone Ita and associated rainfall and flooding (11 – 14 April 2014), Tropical Cyclone Nora and associated rainfall and flooding (24 – 29 March 2018), Tropical Cyclone Niran and associated low pressure system (25 February – 3 March 2021), Tropical Cyclone Imogen and associated low pressure system (2 - 12 January 2021), Tropical Cyclone Jasper and associated rainfall and flooding (13 – 28 December 2023).

Some of the more significant cyclonic events that have directly impacted Tully and the surrounding area include:

- On 27 January 1986, Tropical Cyclone Winifred developed in the Coral Sea before eventually crossing the coast just south of Innisfail at Mourilyan Harbour at 9am on 1 February as a Category 2 system. Significant 24-hour rainfall totals were recorded with Tully receiving 212mm. There were three deaths attributed to the Cyclone with the estimated damage being between \$130 – \$150 million (most of this being cropping losses to bananas and sugar cane to the value of approximately \$90 million).⁹
- Severe Tropical Cyclone Larry crossed the coast near the town of Innisfail (approximately 50km north of Tully) in the morning of 20 March 2006. While no lives were lost, Tully sustained significant damage from the event both to private and community infrastructure, as well as significant sugar and banana crop losses. The total damage bill estimated to have been approximately \$500 million.¹⁰
- Severe Tropical Cyclone Yasi formed as a low north-west of Fiji on 29 February 2011. The system intensified tracking south-west towards the Queensland coast, being upgraded to a Category 5 system at 4am on 2 February. Yasi maintained this intensity before making landfall at Mission Beach (approximately 20km east of Tully) at 1am on Thursday, 3 February. Yasi was one of the most powerful cyclones to have impacted Queensland since records began. The Tully Sugar Mill recorded gusts of

⁸ Queensland Fire and Emergency Services, 2023, 'Queensland 2023 State Disaster Risk Report', Available online at https://www.disaster.qld.gov.au/_data/assets/pdf_file/0020/436070/2023-State-Disaster-Risk-Report.pdf

⁹ Bureau of Meteorology, 2025, 'Tropical Cyclone Winifred'. Available online at <https://www.bom.gov.au/cyclone/history/winifred.shtml>

¹⁰ Bureau of Meteorology, 2025, 'Severe Tropical Cyclone Larry'. Available online at <https://www.bom.gov.au/cyclone/history/larry.shtml>

285km/hr and South Mission Beach recorded 471mm of rain in a 24-hour period.¹¹ Disaster Recovery Funding Arrangements were activated following Severe Tropical Cyclone Yasi for the Cassowary Coast LGA.

6.1.2 Future projections

The Queensland State Disaster Risk Report provides probability variables for any tropical cyclone event under RCP 8.5 across the state based upon data from the Queensland Future Climate Dashboard.¹² The Cassowary Coast LGA forms part of the Far North Queensland region. The Cassowary Coast LGA has a hazard probability value of 4 for 2021 - 2040. This value is expected to decrease to 3 from 2041-2060, as shown in **Figure 8** below.

Probability variables for any TC event under RCP8.5			
Region	1981 – 2010	2021 – 2040	2041 – 2060
Cape York	5	4	4
Central Queensland	2	2	2
Central West	0	0	0
Darling Downs	1	1	1
Far North Queensland	3	4	3
Gulf of Carpentaria	2	2	2
Mackay, Isaac and Whitsunday	3	3	3
Maranoa-Balonne	1	1	1
North Queensland	3	3	3
North West	1	1	1
South East	2	1	1
South West	0	0	0
Wide Bay Burnett	2	2	2

Figure 8: Projected changes in the probability of tropical cyclones for each Queensland region from 1981-2060

The Queensland Future Climate Tropical Cyclone Hazard Dashboard shows the projections for tropical cyclones based on varying recurrence intervals for wind speed and modelled under RCP4.5 and RCP8.5 scenarios. For consistency with different climate scenarios, RCP8.5 has been adopted for the tropical cyclone assessment. The spatial distribution of tropical cyclone projections is shown in **Figure 9** below.

¹¹ Bureau of Meteorology, 2025, 'Severe Tropical Cyclone Yasi'. Available online at <https://www.bom.gov.au/cyclone/history/yasi.shtml>

¹² Queensland Fire and Emergency Services, 2023, 'Queensland 2023 State Disaster Risk Report', Available online at https://www.disaster.qld.gov.au/_data/assets/pdf_file/0020/436070/2023-State-Disaster-Risk-Report.pdf

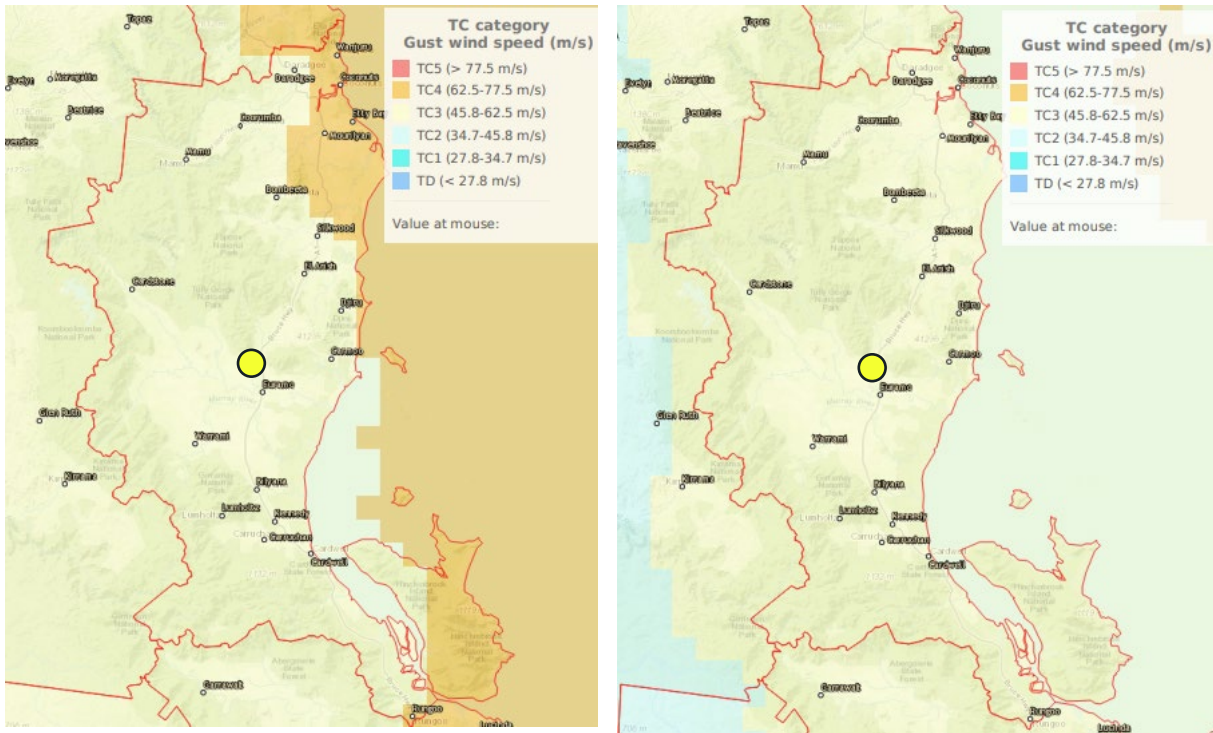


Figure 9: Tropical Cyclone projections 1%AEP RCP8.5 2050 (left) and 2090 (right) within the Cassowary Coast LGA

Note: Subject site denoted by the yellow dot.

As shown in **Table 23** below, the gust wind speed is projected to decrease across the Annual Exceedance Probabilities (AEP's) from 2050 to 2090 indicating that the likelihood of severe cyclones is decreasing. For example, a TC3 event is projected for the 5% AEP in 2050, however this is decreasing to a projected TC2 event for the 5% AEP in 2090.

Table 23: Tropical Cyclone projections (gust speed) under RCP8.5 2050 and 2090

ARI	AEP	RCP8.5 (2050)		RCP8.5 (2090)	
		CATEGORY	Gust wind speed (m/s)	CATEGORY	Gust wind speed (m/s)
2-year	50	Tropical depression	3.78	Tropical depression	7.17
5-year	20	Tropical depression	17.38	Tropical depression	7.57
10-year	10	TC1	31.66	Tropical depression	19.93
20-year	5	TC3	50.36	TC2	40.28
50-year	2	TC4	67.94	TC3	58.62
100-year	1	TC5	80.19	TC4	71.22
200-year	0.5	TC5	90.13	TC5	82.91
500-year	0.2	TC5	95.44	TC5	90.45

6.2 Severe storms

Thunderstorms are associated with very tall cumulonimbus clouds that produce turbulence, lightning and thunder. Lightning is a spark created when an enormous imbalance of positive and negative charge occurs. It greatly heats the surrounding air to many thousands of degrees, causing the air to expand violently, resulting in the crashing noise known as thunder.

Thunderstorms form when moist air rapidly rises through the atmosphere. For this to occur, three main elements are required:

- 1. Unstable atmospheric conditions that provide a favourable environment for strong vertical atmospheric motions*
- 2. A lifting mechanism to initiate the rising movement, such as the convergence of airstreams, a frontal system or air movement over rising terrain*
- 3. Sufficient moisture in the low levels of the atmosphere, which condense and release heat as they rise, fuelling further cloud growth.*

While Queensland experiences many thunderstorms, more intense thunderstorms are referred to as severe thunderstorms.

Thunderstorms are defined as severe when they produce any of the following:

- large hail (2cm in diameter or larger)*
- giant hail (5cm in diameter or larger)*
- damaging or destructive wind gusts (generally wind gusts exceeding 90 km/h)*
- heavy rainfall which may cause flash flooding*
- tornadoes.¹³*

6.2.1 Present and historical data

As shown in Figure 10, the Cassowary Coast LGA experiences 3 – 4 lightning flashes per km² per year.

¹³ Queensland Fire and Emergency Services, 2022, 'Queensland 2021/22 State Disaster Risk Report', Available online at https://www.qld.gov.au/data/assets/pdf_file/0029/369443/QFES-State-Disaster-Risk-Report-2022.pdf

This is consistent with much of the State of Queensland. The only areas that receive higher are in the north-west of the State towards Normanton and south-east of the State towards Brisbane (see **Figure 10**).¹⁴

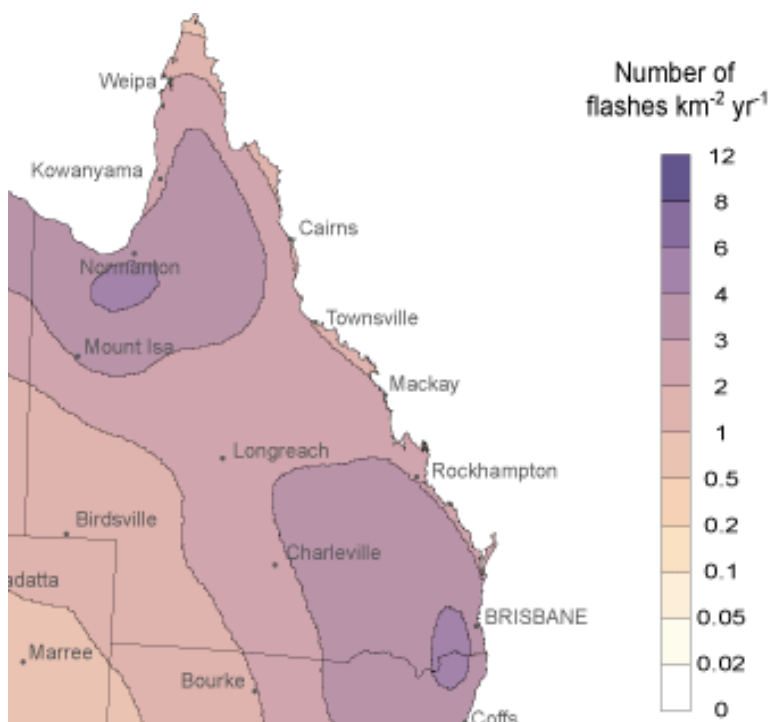


Figure 10: Lightning-ground flash density

(Source: Bureau of Meteorology)

The occurrence of severe thunderstorms in the Cassowary Coast LGA (Far North Region) is 7th out of the 13 Queensland Regions in terms of total events (see **Figure 11** below).¹⁵

With respect to the BESS, in addition to lightening the risk of severe storms includes hail, flash flooding and severe wind. Severe wind is otherwise addressed as part of tropical cyclones.

Hail can cause significant damage to built assets, as well as outdoor workforces.

¹⁴ Bureau of Meteorology. Average annual thunder-day and lightning flash density. <http://www.bom.gov.au/climate/maps/averages/thunder-lightning/?maptype=otdg>

¹⁵ Queensland Fire and Emergency Services, 2022, 'Queensland 2023 State Disaster Risk Report', Available online at https://www.qld.gov.au/data/assets/pdf_file/0029/369443/QFES-State-Disaster-Risk-Report-2022.pdf

Planning region	Rain	Hail	Lightning	Tornado	Wind	Total
Cape York	3	0	0	0	0	3
Central Queensland	79	77	2	10	99	267
Central West	20	4	0	4	68	96
Darling Downs	125	222	3	21	189	560
Far North	94	22	0	5	8	129
Gulf Regional	6	0	0	2	9	17
Mackay, Isaac and Whitsunday	77	22	1	3	34	137
Maranoa - Balonne	13	22	1	1	40	77
North Queensland	80	8	1	4	12	105
North West	19	12	0	3	118	152
South East Queensland	618	548	14	41	454	1675
South West	24	7	0	2	34	67
Wide Bay Burnett	127	152	2	25	139	445
Total	1,285	1,096	24	121	1,204	3,730

Figure 11: Severe storm events from 1 January 1921 to 1 March 2021. Source: State Disaster Risk Report.

6.2.2 Future projections

It is noted that there are no future indicators of severe storms, however extreme rainfall projections can provide insight into future rainfall events.

6.3 Fluvial (riverine) flooding and overland flow

'A flood is an overflow of water beyond the normal limits of a watercourse. Flooding occurs when water extends over what is usually dry land. This can happen when it escapes from a natural watercourse, such as a lake, river or creek. It can also happen when water is released from a reservoir, canal or dam.

There are two types of flooding, riverine (fluvial) and flash (pluvial), also known as overland flow.

Riverine flooding is where rivers break their banks and water covers the surrounding land. It's mostly caused by heavy rainfall, but can also be caused by king tides, storm surge, snowmelt and dam releases.

Heavy, intense rainfall can occur suddenly, and quickly rising floods can occur in this in the minutes or hours after the rainfall are known as flash floods.¹⁶

Flash floods (pluvial) are typically defined as flooding that peaks within six hours of a causative rain event and are associated with relatively small catchment areas where there may be little or no permanent flow of water. As there is little time to react, flash floods are particularly difficult to predict and manage in real time.'¹⁷

¹⁶ Bureau of Meteorology, 2023, Flood Knowledge Centre - Understanding Floods, Available online at <http://www.bom.gov.au/australia/flood/knowledge-centre/understanding.shtml>

¹⁷ Queensland Fire and Emergency Services, 2022, "Queensland 2021/22 State Disaster Risk Report", Available online at https://www.qld.gov.au/_data/assets/pdf_file/0029/369443/QFES-State-Disaster-Risk-Report-2022.pdf

6.3.1 Present and historical data

The subject site is located within the Tully River Catchment. The Tully River catchment covers an area of approximately 1,475 km².

Flooding in the Tully River frequently inundates cane lands with larger floods isolating properties and causing significant damage to infrastructure. The Cassowary Coast LGA has experienced several large flood events in recent history with significant floods occurring in 1967, 1999, February 2009, March 2018, and more recently December 2023, February 2024, and February 2025.¹⁸ An extract of the partial extent Tully River catchment is included in Figure 12 below.

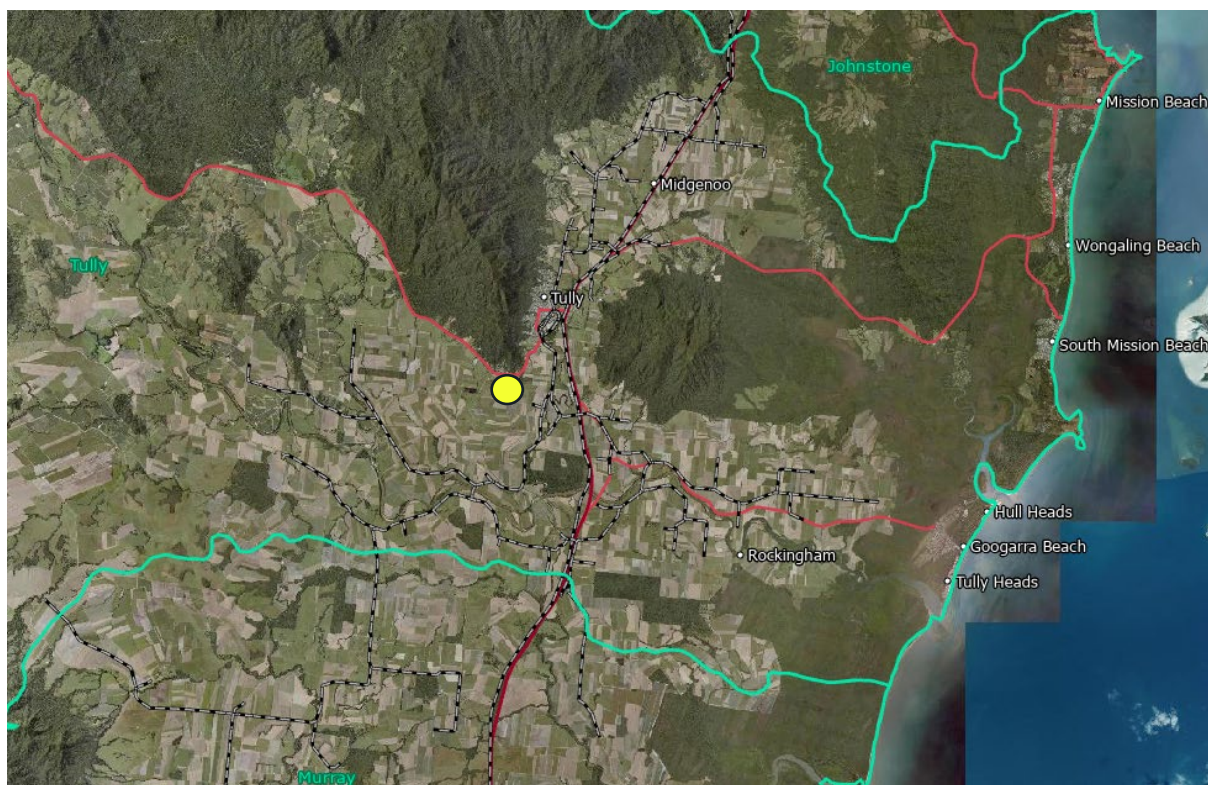


Figure 12: Extract of Tully River Extent Mapping

(Source: Queensland Globe)

Note: Subject site's approximate location is denoted by the yellow dot.

The largest flood of the Tully River on record occurred March 2018 reaching a height of 8.93 as a result of flooding from Ex-Tropical Cyclone Nora.¹⁹

The subject site is located within the mapped Flood hazard overlay area in the Cassowary Coast Planning Scheme 2015, with portions of the site being located within the low, high and extreme flood hazard areas (**Figure 13**).

This mapping was created through the Queensland flood mapping program flood investigation, Tully-Murray Basin 2015 through the Queensland Flood Mapping Program in response to the Queensland Floods Commission of Enquiry, undertaken by Kellogg Brown & Root Pty Ltd (KBR).

¹⁸ Bureau of Meteorology, (n.d.), "Tully and Murray Rivers". Available online at <https://www.bom.gov.au/qld/flood/brochures/tully/tully.pdf>

¹⁹ Ibid.

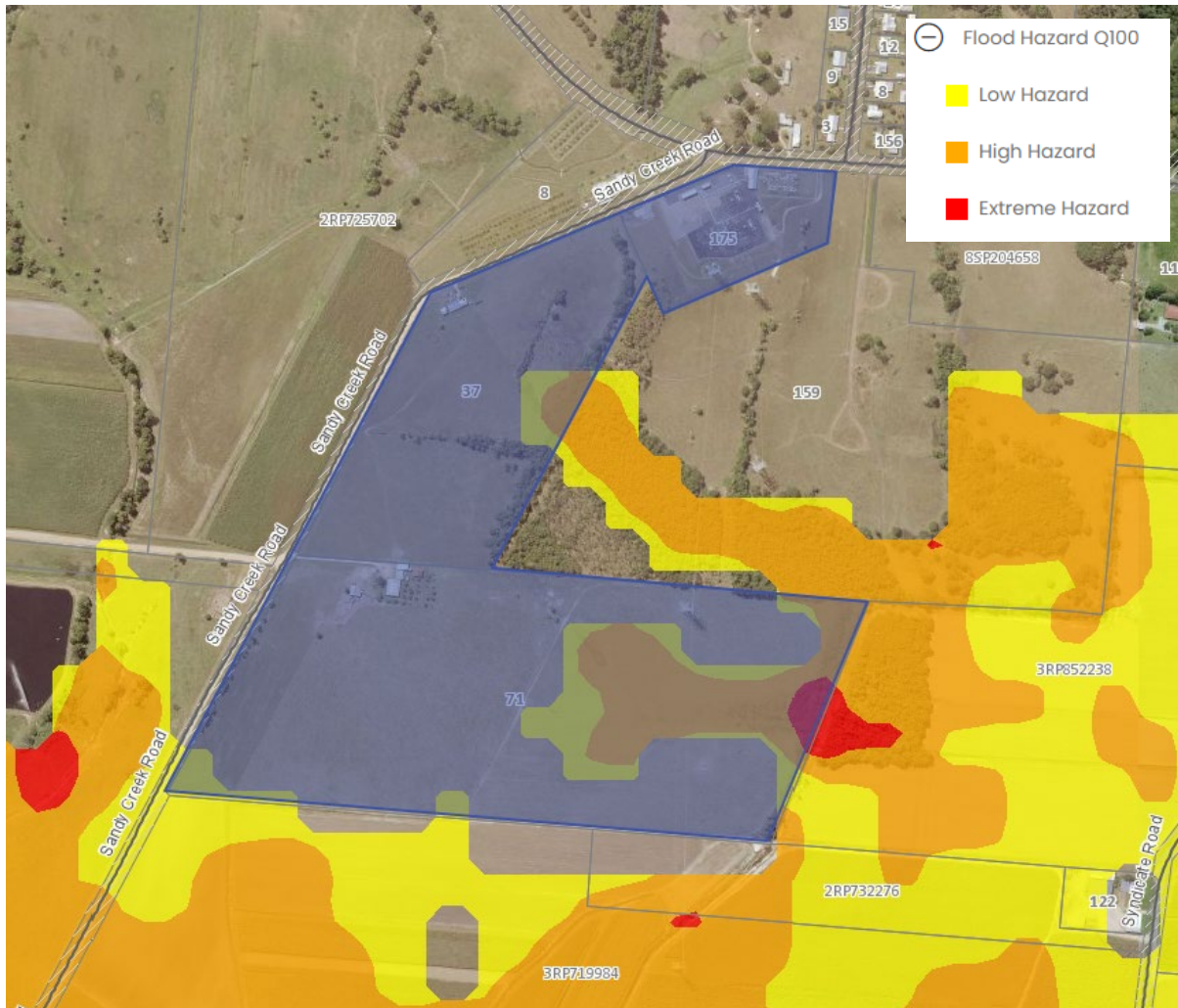


Figure 13: Flood Hazard Overlay Mapping extent Q100 (or 1%AEP)

In September 2025, Water Technology Pty Ltd was engaged to prepare a Stormwater Management Plan and Flood Assessment Report in support of the application for the subject site. Results from the report found that:

- Overland flows from the North (towards Mt Tyson) and the west do not pose a flood risk to the subject property
- Flood modelling indicates the presence of shallow overland sheet flow across portions of the subject site (with depths generally less than 0.15m, which can be mitigated through site development works (i.e. fill, grading, re-leveling of affected areas) and stormwater infrastructure; and
- Flow velocities across the proposed infrastructure areas of the site are generally low, remaining below 0.5 m/s.

Based on the regional flood modelling undertaken with data obtained from Cassowary Coast Regional Council, the site is only minimally affected by the 1% AEP event, with minor flood fringe inundation observed along the southern boundary (with data consistent with the local modelling). 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. An image of the flood extent mapping at the 1% AEP flood event with inundation depth is included in **Figure 14**.

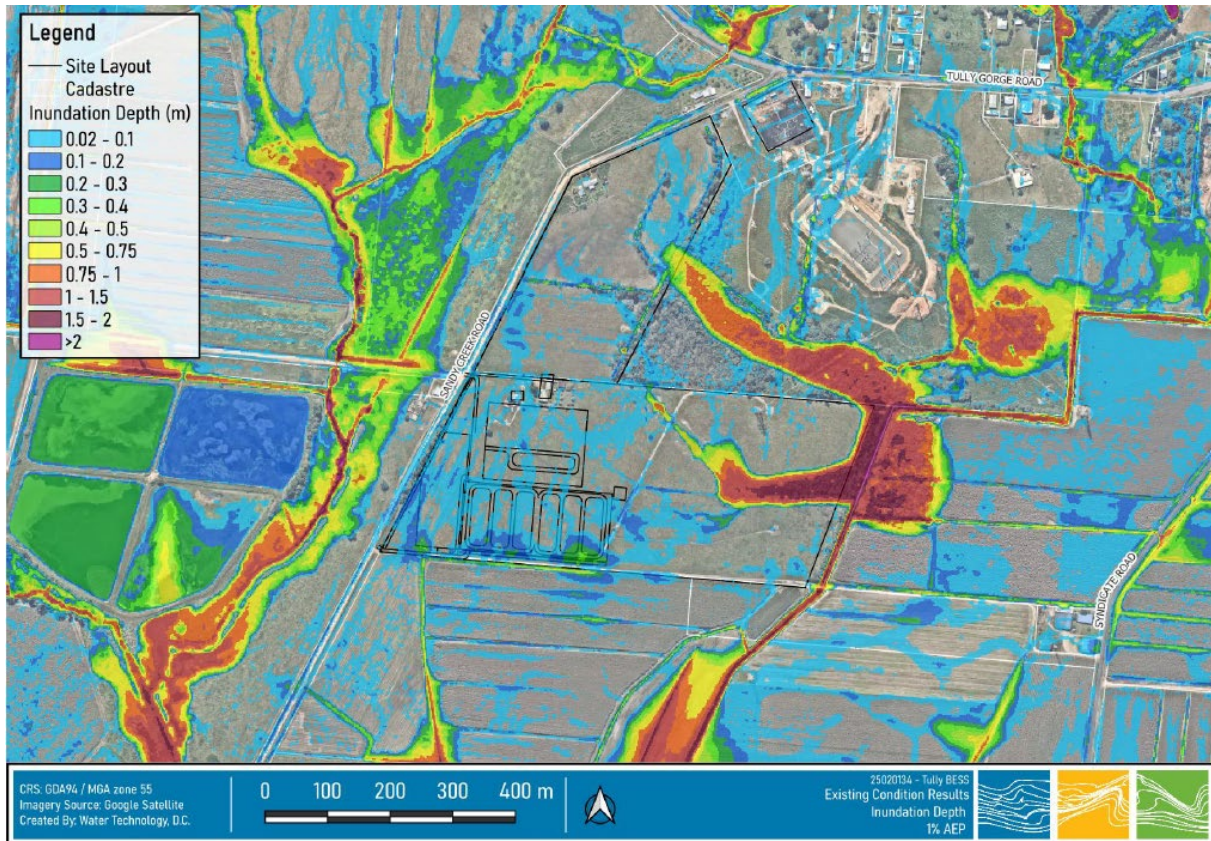


Figure 14: 1% AEP modelled flood event for the subject site

6.3.2 Future projections

Based on future climate projections for rainfall (Section 5.1 above), maximum 1-day precipitation and extreme wet day precipitation are both projected to decrease by 2050, and further decrease by 2090.

6.4 Extreme heat and heatwave

'The BoM definition for heatwave is "when the maximum and the minimum temperatures are unusually hot over a three-day period at a location".²⁰

Heatwaves are measured relative to the usual weather in the area, and relative to normal temperatures for the season in that area. Therefore, temperatures that people from a hotter climate consider normal can be termed a heatwave in a cooler area if they are outside the normal climate pattern for that area.²¹

The minimum (or overnight) temperature is also an extremely important contributor to the calculation. If the minimum remains high, then the subsequent maximum will occur earlier in the day and remain near that high temperature for a longer period. A higher minimum temperature also reduces the period of respite from the heat and provides less opportunity for both people and the environment to discharge heat.'²²

²⁰ Queensland Fire and Emergency Services, 2022, 'State Disaster Risk Report', Available online at https://www.qld.gov.au/data/assets/pdf_file/0029/369443/QFES-State-Disaster-Risk-Report-2022.pdf

²¹ Ibid

²² Ibid

6.4.1 Present and historical data

Since 1958, there has been an observable increase in the occurrence rates of all heatwave severities.²³ Through the BoM Heatwave Service, the geographic distribution of these changes has been mapped as part of the Queensland State Heatwave Risk Assessment (see **Figure 15** below). Between the 30 years 1986 to 2015, a substantial proportion of the State has experienced an average of three heatwave events per year.²⁴

The heatwave frequency has increased for the Cassowary Coast LGA between the 1958 – 1968 period and the 1978-1988 period, with a further slight increase for the 1988-2008 period for parts of the LGA.

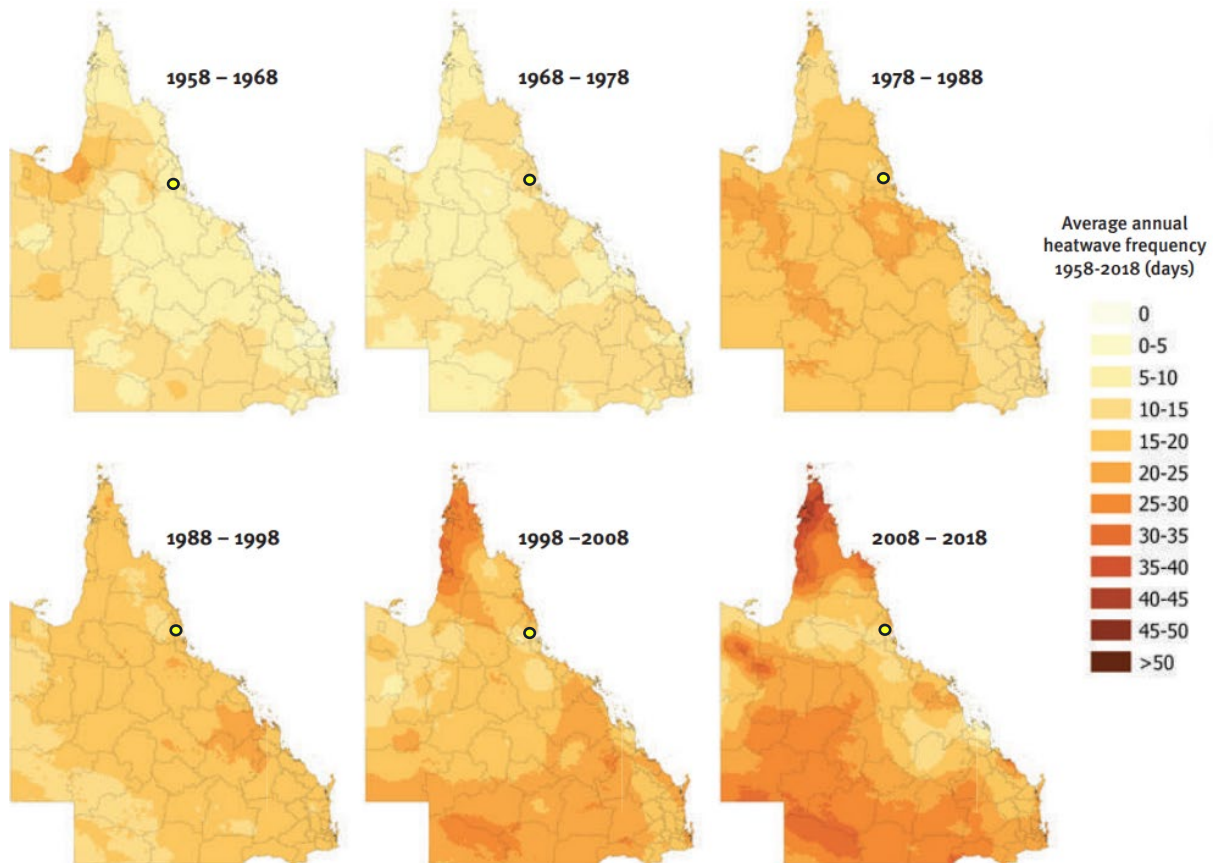


Figure 15: Historical heatwave frequency counts by decade, 1958 - 2018.

Source: QFES 2019.

Note: Subject site's approximate location is denoted by the circled area.

6.4.2 Future projections

The Queensland Future Climate Dashboard provides detailed heatwave variables which provide clear projections for 2050 and 2090 under SSP3-7.0 scenario. The following observations are identified from the data table (see **Table 24** below):

²³ Queensland Fire and Emergency Services, 2019, 'Queensland State Heatwave Risk Assessment', Available online at: https://www.disaster.qld.gov.au/_data/assets/pdf_file/0026/339308/QFES-Heatwave-Risk-Assessment.pdf

²⁴ Queensland Fire and Emergency Services, 2019, 'Queensland State Heatwave Risk Assessment', Available online at: https://www.disaster.qld.gov.au/_data/assets/pdf_file/0026/339308/QFES-Heatwave-Risk-Assessment.pdf

- All heatwave indicators are projected to increase, with an increase by 2050, and then a further increase by 2090; and
- An increase in hot days and hot nights is projected by 2050, with a further increase by 2090. Most notably, the projected increase in hot nights is significant with a projected increase of 47.4 additional hot nights by 2050 and an additional 102.4 hot nights by 2090.

Table 24: Heatwave future projections under Scenario SSP3-7.0 2050 and 2090.

Heatwave variable	SSP3-7.0 (2050)				SSP3-7.0 (2090)		
	Reference	Mean	Min	Max	Mean	Min	Max
Heatwave peak heat index (° Celsius)	33.9	2.5	1.4	3.4	4.7	3	6.8
Heatwave frequency (days)	3	8.7	4.3	13.7	35	26.3	41.6
Hot days (days)	5	8.1	1.7	13.2	46.6	21.5	76.2
Hot nights (days)	166.2	47.4	31.6	60	102.4	82	121.4
Very hot days (days)	0.1	0.1	-0.2	0.9	0.7	0	1.7
Heatwave duration (days)	4.4	3.5	1.6	5.8	25.3	11.5	37.6

6.5 Landslide

Landslide mapping is available for the Cassowary Coast LGA however, the subject site is not located within an identified landslide hazard area (see **Figure 16** below). Landslide is therefore not considered further by this assessment.

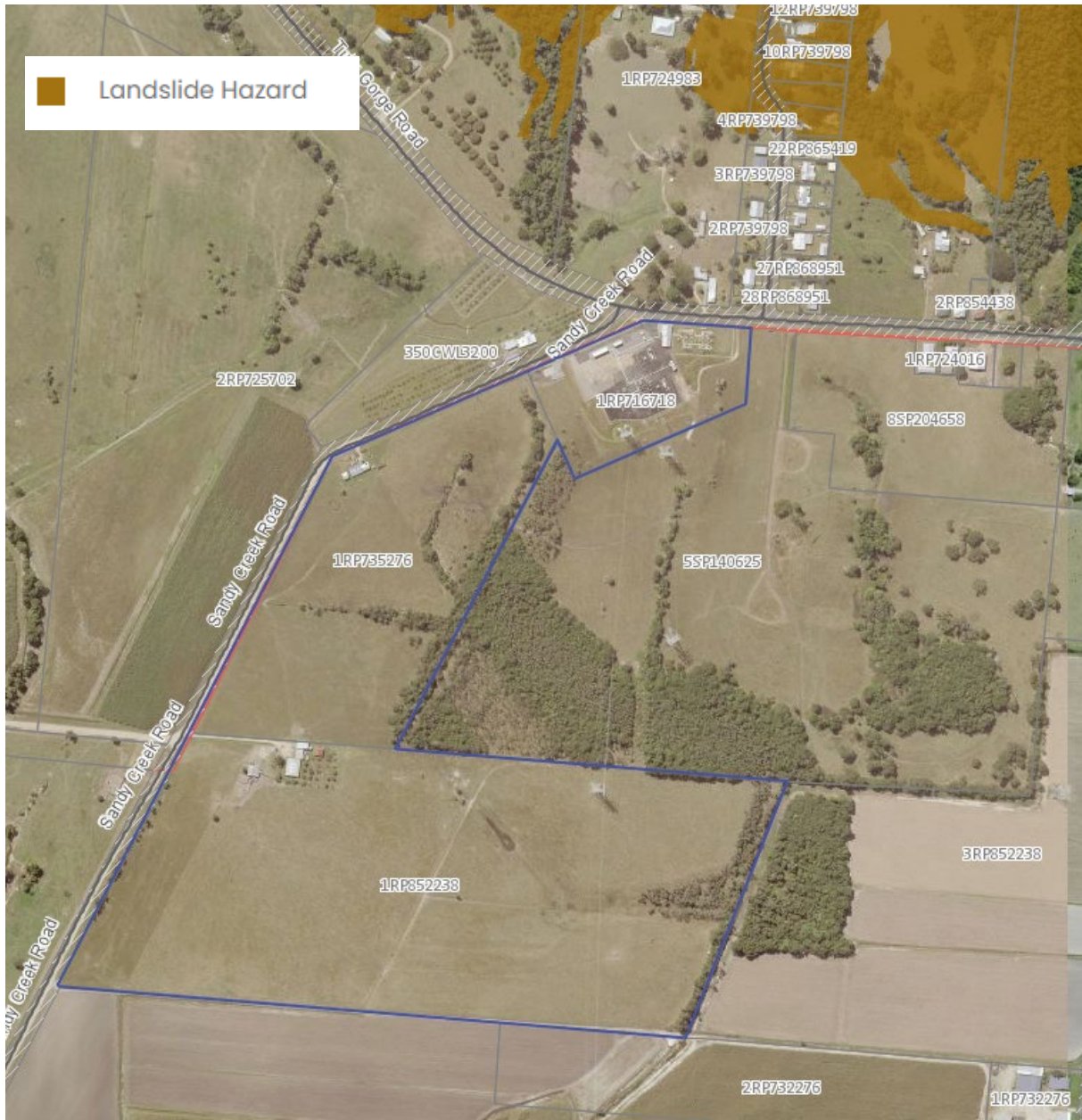


Figure 16: Landslide Hazard Overlay mapping in the Cassowary Coast Planning Scheme

Note: Subject site denoted by the blue outline.

6.6 Earthquake

6.6.1 Present and historical data

The Queensland State Earthquake Risk Assessment identifies that Queensland has the lowest forecast earthquake hazard in Australia, compared with other States and Territories (see Figure 17).²⁵

Geoscience Australia develops the National Seismic Hazard Assessment (NSHA) for Australia completed in 2018. The NSHA defines the level of earthquake ground shaking across Australia that has a likelihood of being exceeded in a given time period. Knowing how the ground-

²⁵ Queensland Fire and Emergency Services. 2024. Queensland 2024 State Earthquake Risk Assessment. https://www.disaster.qld.gov.au/data/assets/pdf_file/0021/339303/QFES-State-Earthquake-Risk-Assessment.pdf

shaking hazard varies across Australia allows higher hazard areas to be identified for the development of mitigation strategies so communities can be more resilient to earthquake events.

The NSHA18 outputs contains uniform probability hazard maps for a 10% and 2% chance of exceedance in 50 years as a primary metric for assessing seismic risk across the Australia. The subject site is identified as 0.005 – 0.01 units of g (the second lowest measure) at NSHA18 peak ground acceleration with a 10% chance of exceedance in 50 years. The subject site is identified as 0.02 – 0.04 units of g (the second lowest measure) at NSHA18 peak ground acceleration with a 2% chance of exceedance in 50 years. ²⁶

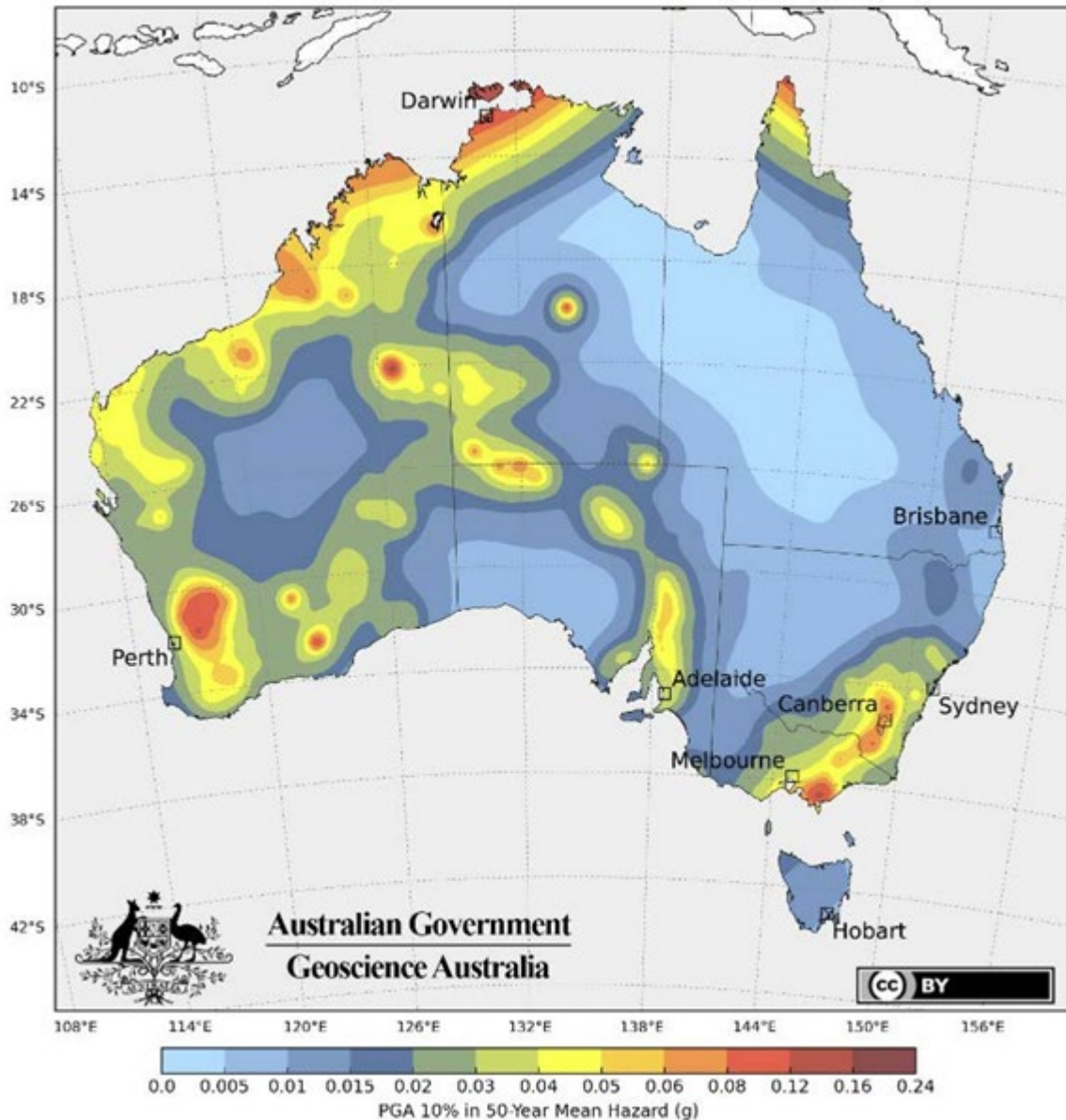


Figure 17: National Seismic Hazard Assessment (NSHA) hazard map

Note: Subject site's approximate location is denoted by the yellow dot.

²⁶ Geoscience Australia, (2021). 'Earthquakes@GA'. Available online at: <https://earthquakes.ga.gov.au/>

6.7 Bushfire

'A bushfire is a fire involving grass, scrub or forest. A bushfire can cause injury, loss of life and/or damage property or the natural environment.

Bushfires are unplanned, and can include grass fires, forest fires and scrub fires. Bushfires occur in both managed and unmanaged areas of vegetation such as reserves, national parks, private property and urban corridors.

Bushfires are a common part of the Australian landscape and frequently occur. Factors that create favourable environments for bushfires include:

- *fuel load – the amount fine fuels such as leaves, grass, fallen bark, leaf litter and small branches accumulating in the landscape; fuel which is concentrated but loosely compacted will burn faster than heavily compacted or scattered fuel sources*
- *fuel moisture*
- *wind speed*
- *ambient temperature*
- *relative humidity*
- *slope angle – fires accelerate when travelling uphill and decelerate travelling downhill, therefore, the steepness of the slope plays an important role in the rate of fire spread*
- *ignition source.*

*Weather conditions that lead to significantly elevated bushfire risk include a combination of high temperatures, low humidity and strong winds. This type of 'fire weather' can be identified and measured using the Fire Behaviour Index (FBI). Heat and dryness are two of the biggest drivers of the weather-related components of bushfire risk. The drier and hotter the weather, the less bushfires require, from a thermodynamic perspective, to spread faster and become increasingly dangerous.'*²⁷

Weather and climate have a significant role in the intensity to which grassfire and bushfire may occur, and how easily fuels may burn. For the purposes of this report, bushfire is taken to include grassfire.

Drought conditions along with extreme temperatures and decreased average rainfall can each drive increase fire weather and susceptibility. Dry lightning can also cause ignitions.

NOTE: The separate bushfire management plan for the site, whilst including climate change impacts in terms of fire weather severity, does not consider the climatic elements addressed by this assessment which is more long term. The purpose of the separate bushfire management plan is to articulate site-based mitigations. These mitigations are acknowledged by this report.

6.7.1 Present and historical data

Fire scar mapping, available on Queensland Globe, shows the fire history across Queensland by detecting the visibly blackened land surface after a fire has been burned through vegetation. Fire scar mapping is useful to see where a fire has previously occurred to understand fire history. However, it is noted that the mapping shows all fire history, including controlled/planned burns, and therefore doesn't show a true depiction of bushfire and grass fire hazard history.

²⁷ Queensland Fire and Emergency Services, 2022, 'Queensland 2021/22 State Disaster Risk Report', Available online at https://www.qld.gov.au/data/assets/pdf_file/0029/369443/QFES-State-Disaster-Risk-Report-2022.pdf

The fire scar mapping using the Queensland Globe platform identifies wildfire or hazard reduction burns on the site and in the immediate area over the last 20 years, including an event to the north east in 2010 (see **Figure 18** below).

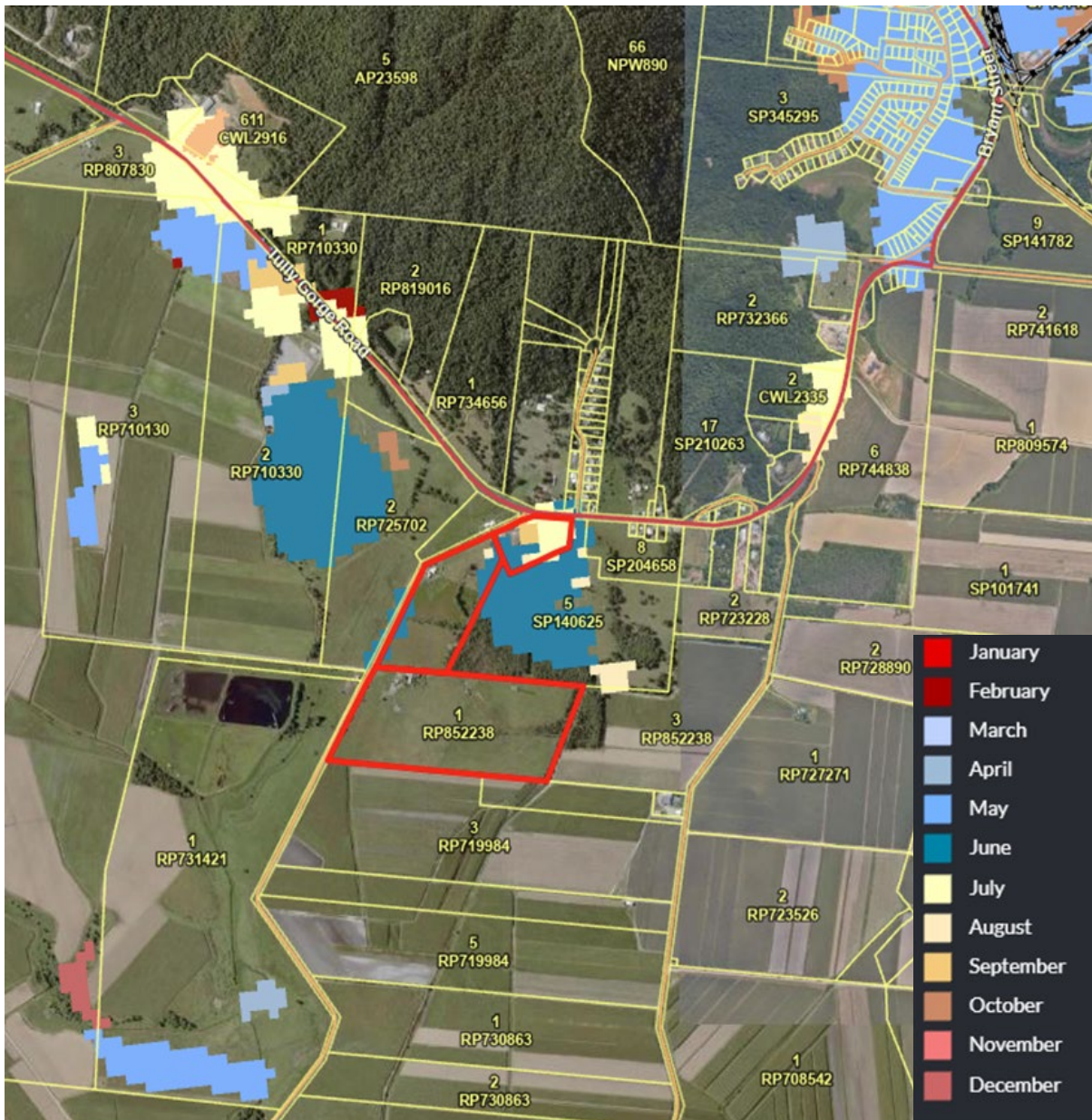


Figure 18: Historical fire scar mapping shown for the site.

Source: Queensland Globe.

The State Planning Policy July 2017 (SPP) identifies and maps bushfire prone areas, with categories of Medium, High and Very High potential bushfire intensity with an additional 100 metre potential impact buffer, where exposure to bushfire attack most often occurs. The mapping has been prepared across Queensland and identifies parts of the landscape that could support a significant bushfire or subject to significant bushfire attack.

The majority of the BESS site is outside the mapped bushfire hazard area (see **Figure 19**), with only the far western portion of the footprint within the Potential impact buffer. The broader area contains patches of High potential bushfire intensity towards the north-east and east, associated with the vegetated waterway / drainage areas in this location. The transmission connection also crosses the Potential impact buffer area and a patch of High potential bushfire intensity to the north of the BESS site.

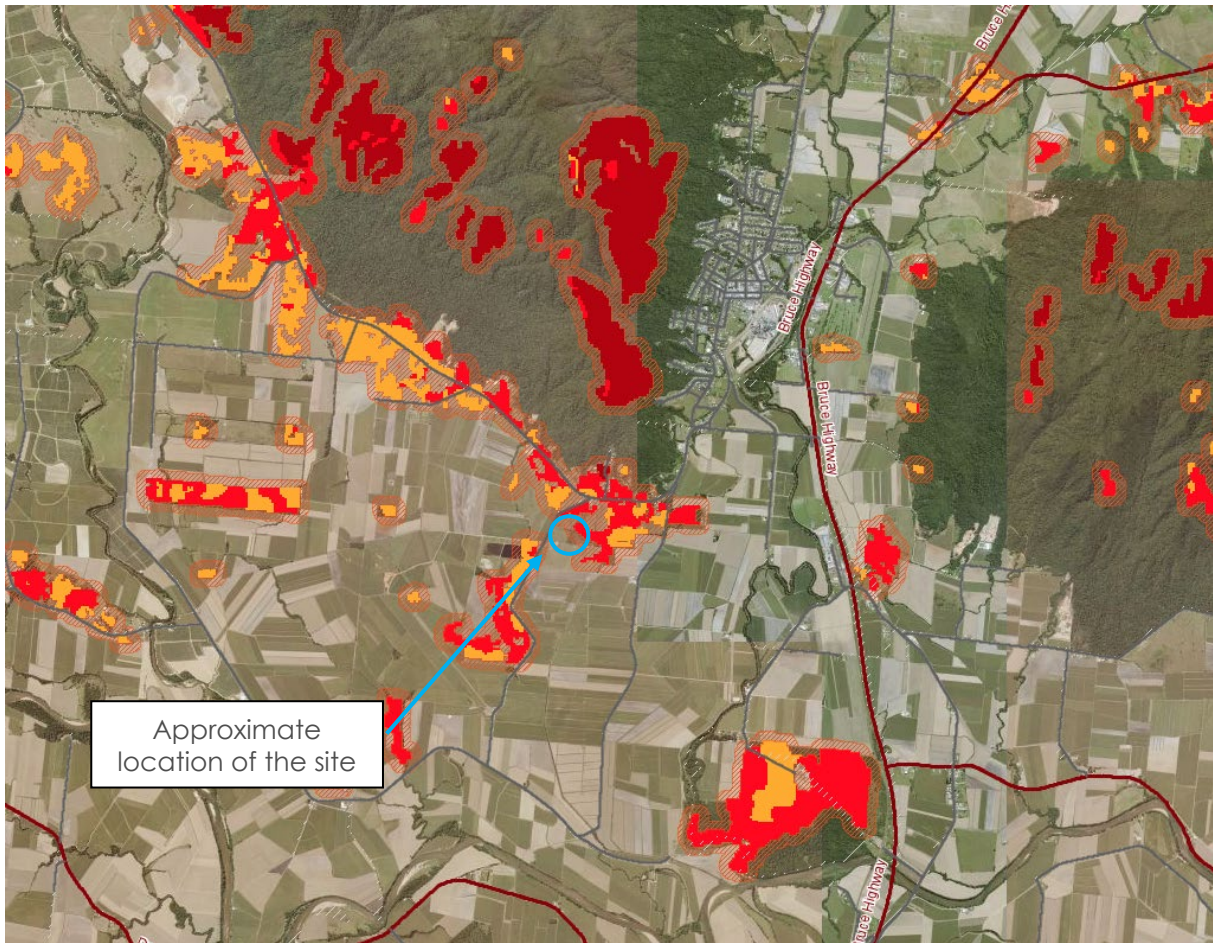


Figure 20: Bushfire Hazard in the Wider Locality
Source: Cassowary Coast Planning Scheme 2015

The BoM report 'Changes to Fire Weather in Queensland' released in 2019 identifies the Cassowary Coast LGA within the North Coast subregion. The BoM report provides that the time series of annual accumulated FFDI analysed by the BoM study identifies an increase of 14% for the North Coast subregion from 1950 to 2018. Annual highest daily FFDI from 1989 to 2018 shows increasing FFDI in the North Coast subregion (see **Figure 21** below).

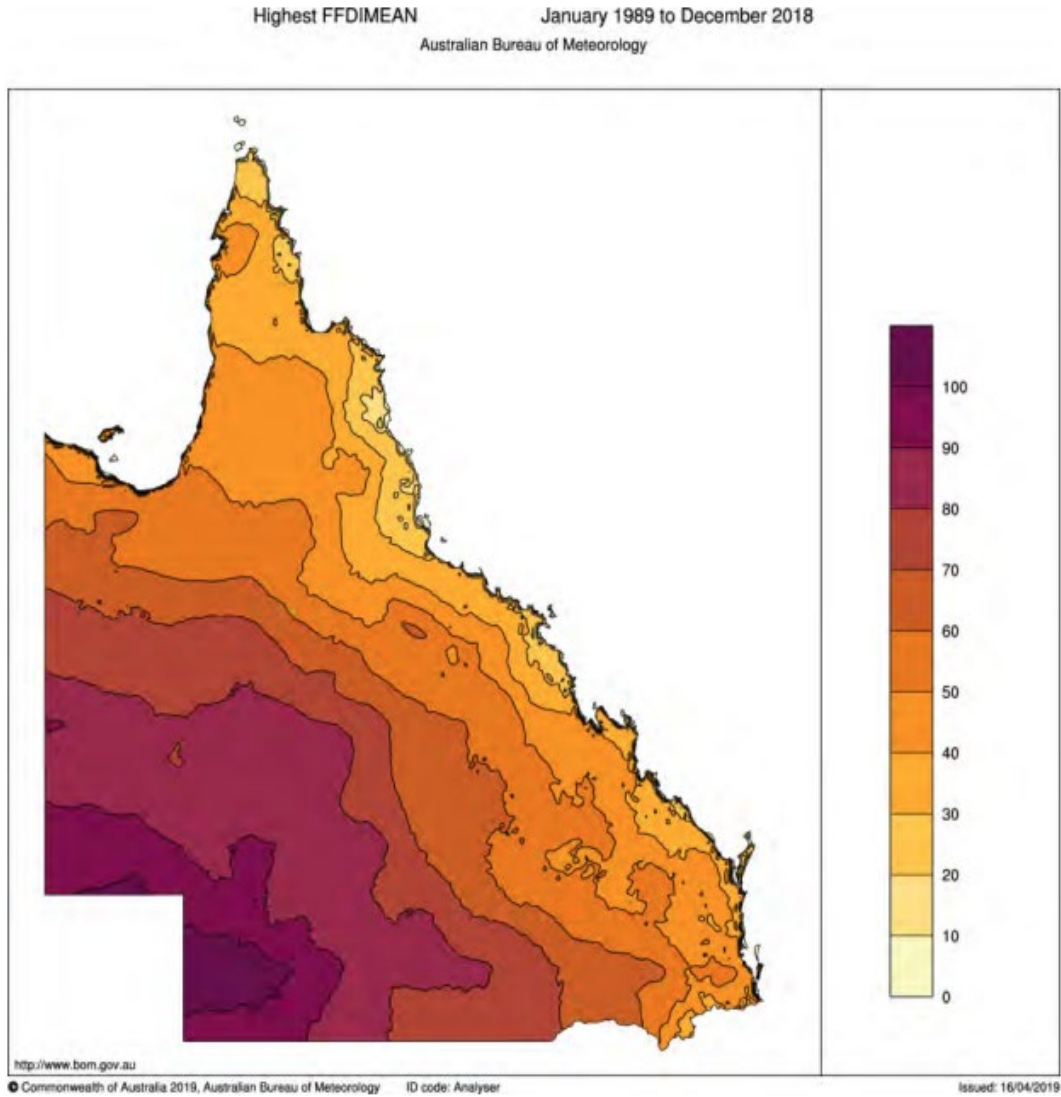


Figure 21: Climatological annual highest daily FFDI across Queensland for the period 1989 - 2018

6.7.2 Future projections

The Queensland Future Climate Dashboard provides detailed fire weather variables which provide clear projections for 2050 and 2090 under SSP3-7.0 scenario. As identified in Section 5 of this report, the LGA is projected to experience a changing climate resulting in:

- A projected decrease in precipitation indicators by 2050, and 2090
- A projected increase in average temperature and maximum temperature by 2050 with further projected increases by 2090, including hot days and hot nights and heatwave duration; and
- A projected increase in duration and frequency of drought as well as percent time in drought demonstrating prolonged periods of dry weather and heat conditions.

In addition to changing extreme weather climate variables, the following observations are identified from the data table (see **Table 25**) below:

- Extreme fire weather days are projected to remain consistent
- 95th percentile fire days are projected to slightly increase in 2050 with a further increase by 2090; and
- Relative humidity is projected to slightly increase by 2050 with a further slight increase in 2090.

Table 25: Fire weather future projections under Scenario SSP3-7.0 2050 and 2090.

Fire Weather variable	SSP3-7.0 (2050)				SSP3-7.0 (2090)		
	Reference	Mean	Min	Max	Mean	Min	Max
Extreme fire weather days (days)	0	0	0	0.1	0	0	0
95 th percentile fire days (days)	16.9	0.1	-6.9	8.6	1.9	-7.9	11.8
Relative humidity (%)	88.7	0.2	-0.6	0.6	0.4	-0.2	1

In addition to the climate projection data drawn from the future climate dashboard, the CSIRO (in partnership with QFD) climate-adjusted potential fire weather severity mapping for Queensland can also be used to understand future fire weather projections. Whilst this data is currently understood to be under review, the 2014 mapping across the state (see **Figure 22** below) may be used to identify fire weather based on a 1:20 annual return interval (ARI) event climate adjusted to 2050. The climate-adjusted (1:20 year ARI at 2050) Forest Fire Danger Index (FFDI) applicable to the site is 50. ²⁸

²⁸ Queensland Fire Department, Bushfire Resilient Communities MapViewer, Available at: <https://www.fire.qld.gov.au/compliance-and-planning/bushfire-planning/brc>

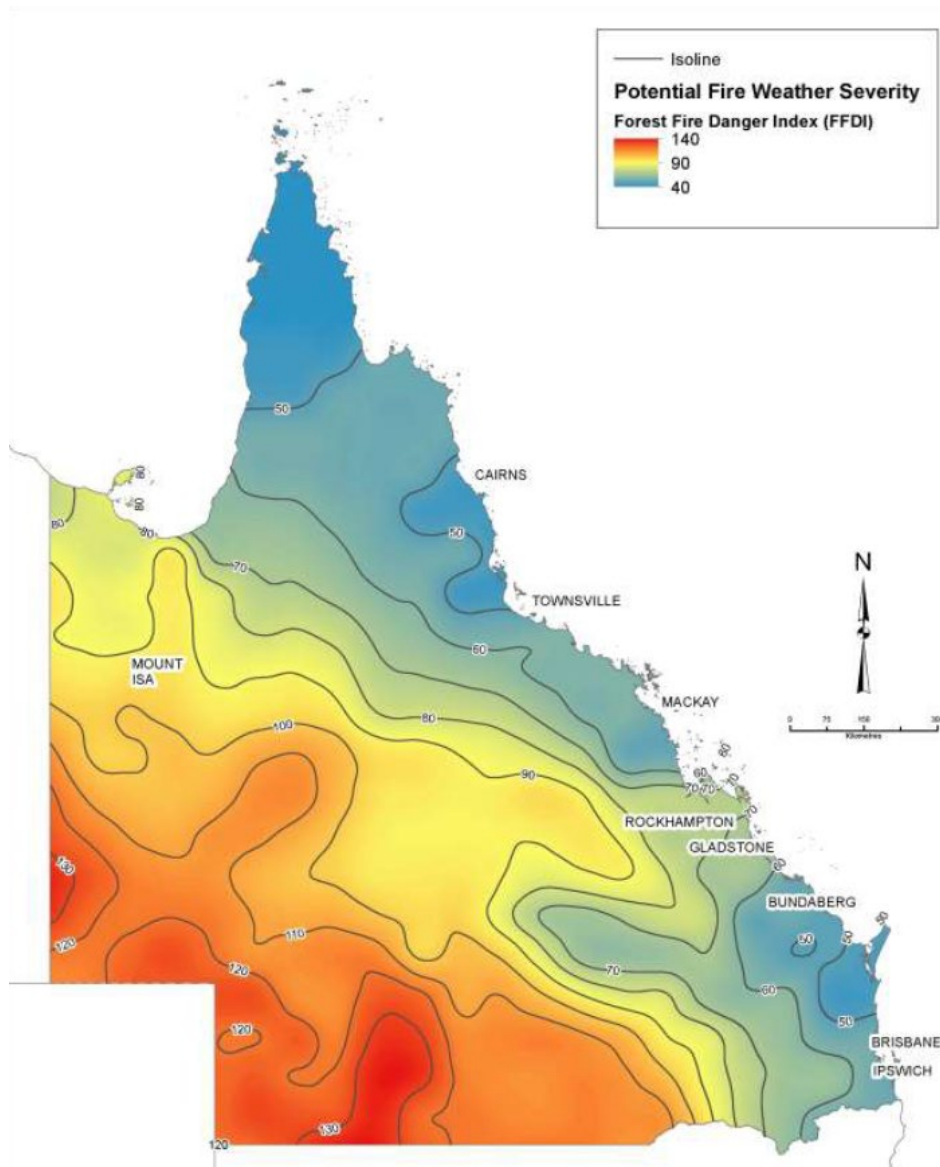


Figure 22: Climate-adjusted potential fire weather severity for Queensland

7 Risk Assessment

This section assesses the nature of natural hazard risks and extreme weather, as relevant to the proposed Tully BESS, in accordance with the methodology outlined at Section 3.

This section considers the likelihood, consequence and resultant unmitigated risk level across each hazard.

7.1 Hazard: Extreme Heat and Heatwave Events

7.1.1 Likelihood assessment

Table 26: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Extreme heat and heatwave	Likely	Almost Certain	Extreme heat events and heatwaves have occurred several times in the past year and is projected to increase.

7.1.2 Consequence assessment

Table 27: Unmitigated consequence assessment table, extreme heat and heatwave events

Asset	Consequence descriptor
Operational Infrastructure	<p>Major</p> <p>Extreme heat and heatwave events may cause localised service disruption to the BESS. Overheating of the BESS may result in localised infrastructure damage and loss of services. Specific consequences of exposure to extreme heat and heatwave may include:</p> <ul style="list-style-type: none"> Accelerated chemical degradation Heat sensitivity may reduce lifespan of battery and capacity fade Reduced efficiency and power output Increased demand on cooling systems Increased operating costs Overheating, leading to thermal runaway risk involving fire, explosion and toxic gas release. <p>Exposure to UV can lead to:</p> <ul style="list-style-type: none"> Degradation of components Acceleration of corrosion Increased thermal load. <p>Combined heat and UV exposure can lead to synergistic damage.</p>
Operational workers	<p>Moderate</p> <p>Extreme heat and heatwave events, particularly the projected increase in hot days and very hot days may cause disruption to employees and contractors being able to undertake their everyday roles, particularly manual roles involving outdoor work.</p>

	Adverse human health effects such as heatstroke, or hospitalisation.
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7.1.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of heat and heatwave for operational infrastructure and for operational workforce may increase into the future, as a result of frequency of days of 35 degrees Celsius (**Table 28**).

Table 28: Extreme heat and heatwave risk level. Present day and 2050 scenario.

Asset	Present Day			2050		
	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Operational Infrastructure	Likely	Major	High	Almost certain	Major	Extreme
Operational workers	Likely	Moderate	Medium	Almost certain	Moderate	High

7.2 Hazard: Cyclone / strong winds

7.2.1 Likelihood assessment

Table 29: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Cyclone / strong winds	Possible	Possible	Severe Tropical Cyclone Larry in 2006 and Severe Tropical Cyclone Yasi in 2011 significantly affected Tully and surrounding areas. State Disaster Risk Report identifies probability value of 4 for the Far North Region.

7.2.2 Consequence assessment

Table 30: Unmitigated consequence assessment table, cyclone / strong winds

Asset	Consequence descriptor
Operational Infrastructure	<p>Major</p> <p>Cyclonic winds may cause material fatigue, water ingress and component damage. Flying debris from other infrastructure can also cause damage. Consequences can include:</p> <ul style="list-style-type: none"> • Structural failure • Water damage • Increased corrosion • Thermal runaway including fire, explosion and release of toxic gases • Electrical hazards • Power disruptions.

Operational workers	<p>Minor</p> <p>Sufficient warning time is generally available for tropical cyclones to ensure the facility is secured. Workers are not expected to be on site during these conditions, but immediately after.</p> <p>Strong gusting winds may occur when operational workers are on-site. Workers may risk being struck by debris, or experience increased risk of falls during such conditions.</p>
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7.2.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of cyclone and strong wind events likely to remain stable into the future (**Table 31**).

Table 31: Cyclone / strong winds risk level. Present day and 2090 scenario.

Asset	Present Day			2050		
	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Operational Infrastructure	Possible	Major	High	Possible	Major	High
Operational workers	Possible	Minor	Low	Possible	Minor	Low

7.3 Hazard: Severe storms

7.3.1 Likelihood assessment

Table 32: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Severe storms	Almost Certain	Likely	<p>2 – 3 lightning flashes per km² per year and 129 severe storm events from 1921 to 2021 in the Far North Region.</p> <p>Severe thunderstorms rank 7th out of the 13 Queensland Regions in terms of total events.</p>

7.3.2 Consequence assessment

Table 33: Unmitigated consequence assessment table, severe storms

Asset	Consequence descriptor
Operational Infrastructure	<p>Moderate</p> <p>Severe storms may cause disruption to power storage and broader transmission networks from strong winds and lightning strikes. Lightning can cause damage to BESS facilities, and can cause fire, explosion and thermal runaway. Severe storms may also impact supporting infrastructure such as overhead transmission lines, causing pylons and/or transmission lines to fall.</p>

Asset	Consequence descriptor
	Severe storms may cause extensive infrastructure damage requiring repair, and the BESS may not be operational for a period of time.
Operational workers	Moderate Severe storms can cause injury or loss of life through flash flooding, lightning strike or large hailstones.

7.3.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of severe storm is high for both operational infrastructure and operational workers (**Table 34**).

Table 34: Severe storms risk level.

Asset	Likelihood	Consequence	Risk Rating
Operational Infrastructure	Almost certain	Moderate	High
Operational workers	Almost certain	Moderate	High

7.4 Hazard: Flooding

7.4.1 Likelihood assessment

Table 35: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Flooding	Possible	Possible	Based on flood modelling the site is only minimally affected by the 1% AEP event, with minor flood fringe inundation observed along the southern boundary. 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.

7.4.2 Consequence assessment

Table 36: Unmitigated consequence assessment table, flooding

Asset	Consequence descriptor
Operational Infrastructure	Moderate The BESS site is subject to the 1% AEP, with a small amount of potential flood inundation possible under this scenario. Flooding can lead to corrosion, damage to equipment, electrical hazards and power disruptions. Internal access roads may be impacted as a result of rain and flood events and therefore accessibility issues may disrupt operations.

Asset	Consequence descriptor
	Sufficient warning time is generally available for flooding to ensure the facility is secured. Workers are not expected to be on site during these conditions, but immediately after.
Operational workers	Minor Internal access roads may be impacted by rain and flooding which may disrupt employees undertaking their roles.

7.4.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of flood is medium for operational infrastructure, noting part of the BESS site is exposed to the 1% AEP flood event, capable of being mitigated, and low risk for operational workers noting the limited extent and depth of inundation involved (**Table 37**).

Table 37: Flooding risk level.

Asset	Likelihood*	Consequence	Risk Rating
Operational Infrastructure	Possible	Moderate	Medium
Operational workers	Possible	Minor	Low

*Based on 1% AEP event only.

7.5 Hazard: Bushfire

7.5.1 Likelihood assessment

Table 38: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Bushfire	Possible	Likely	Increasing fire weather is projected into the future, associated with increasing temperatures, increasing frequency and duration of extreme heat and low average rainfall.

7.5.2 Consequence assessment

Table 39: Unmitigated consequence assessment table, bushfire

Asset	Consequence descriptor
Operational Infrastructure	Major Bushfire may cause destruction and damage to the BESS facility and operational infrastructure. Bushfire may impact site access and disrupt operation of the BESS.

	The BESS and associate infrastructure are particularly vulnerable to extreme radiant heat flux which can cause cascading failure.
Operational workers	Major Bushfire can cause injury or loss of life.

7.5.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of bushfire events likely to remain stable into the future (**Table 40**).

Table 40: Bushfire risk level. Present day and 2050 scenario.

Asset	Present Day			2050		
	Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating
Operational Infrastructure	Possible	Major	High	Likely	Major	High
Operational workers	Possible	Major	High	Likely	Major	High

7.6 Hazard: Earthquake

7.6.1 Likelihood assessment

Table 41: Hazard likelihood present day and 2050

Hazard	Likelihood (present day)	Likelihood (2050)	Comment
Earthquake	Unlikely	Unlikely	Has not occurred in the past 5 years and is unlikely to occur during the next 50 years.

7.6.2 Consequence assessment

Table 42: Unmitigated consequence assessment table, earthquake

Asset	Consequence descriptor
Operational Infrastructure	Major Earthquake may cause the loss of infrastructure, and/or limit access to parts of the site.
Operational workers	Minor No earthquakes have occurred in Queensland above magnitude 6.0 in the past 50 years ²⁹ , and no significant injury or loss of life recorded. Therefore, if an earthquake was to occur in this region, it is likely to have minor consequences.

²⁹ <https://www.ga.gov.au/news/earthquake-near-kilkivan>

7.6.3 Unmitigated risk level

Having regard to likelihood and unmitigated consequence, the overall risk of earthquake for operational infrastructure is medium which is largely driven by potential consequence, noting likelihood is rare. Risk of earthquake to operational workers is low (**Table 43**).

Table 43: Earthquake risk level.

Asset	Likelihood	Consequence	Risk Rating
Operational Infrastructure	Rare	Major	Medium
Operational workers	Rare	Minor	Low

7.7 Summary of unmitigated risk rating assessment

Overall, the top ranked natural hazard related risks examined by this assessment and having regard to the Future Climate Dashboard indicators to 2090 include:

1. Extreme heat and heatwave
2. Severe storms
3. Bushfire
4. Cyclone and strong winds.

The risk management measures specified in Section 7.8 are required to achieve tolerable risk level.

The purpose of this risk assessment is to demonstrate, based on hazard-specific and climate projection evidence, those which may have increased aspects of likelihood and/or consequence that is relevant for design, construction, or operation to take forward for detailed facility planning purposes. The summary of risk rating assessment across all hazards is shown in **Table 44** below.

Table 44: Summary of unmitigated risk rating assessment across all hazards, incorporating climate change data where relevant

Aspect	Extreme heat and heatwave	Cyclone/strong winds	Severe storms	Flooding	Earthquake	Bushfire
Operational Infrastructure	High	High	High	Medium	Medium	High
Operational workers	Medium	Low	High	Low	Low	High

7.8 Recommended risk treatment options

Risk treatment options are recommended to help adapt to, manage, and reduce the consequences of risk, and reduce risk to a tolerable level. The National Emergency Risk Assessment Guideline (NERAG) identifies a series of options that can be considered to treat identified risks, they include:

- Avoiding the risk
- Removing a risk source
- Mitigating the risk, through:
 - Changing the likelihood of:
 - In initiating event or source of risk happening
 - A hazard affecting elements at risk
 - Changing the consequences
- Transferring / sharing the risk
- Accepting / retaining the risk (and understanding residual risk).

Table 45 details risk treatment options that can be put in place during the construction and operational phases of the wind farm development for each hazard. It must be noted that the nature of natural hazard risk cannot be reduced to zero, and some level of exposure must therefore be accepted or tolerated.

Table 45: Recommended risk treatment options

Hazard	Primary treatment pathway	Treatment options
Extreme heat and heatwave	Mitigation	<ul style="list-style-type: none"> • Active cooling systems for key components • Temperature sensors for key components • Controlled shut down systems • Install UV-rated housing for key components • Regular maintenance • Design to ambient heat temperatures of 50 degrees • Employ battery monitoring systems to monitor temperature.
	Avoidance	<ul style="list-style-type: none"> • Ensure operational health and safety policies for both temporary and permanent workers specify working hours and shut-down periods during times of extreme heat (to align with workplace health and safety requirements). • Incorporate extreme heat operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.

Hazard	Primary treatment pathway	Treatment options
Cyclones / strong winds and severe storm	Mitigation	<ul style="list-style-type: none"> • Lightning protection systems (receptors, grounding, etc.) • Implementation of weather and BESS monitoring systems • Surge protection • Battery enclosures/bays containing the battery modules/cells is IP66 rated • Ensure shut down and isolate procedures are in place for strong winds • Consider wind rated engineering for components • Secure the surroundings and anchor objects, including temporary equipment, shipping containers, etc. in the event of approaching strong winds, cyclones or severe storms • Identify protective / durable coatings and coverings for sensitive components to ensure they are not damaged by flying debris or hail • Undertake regular maintenance
	Avoidance	<ul style="list-style-type: none"> • Incorporate operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.
Flooding	Mitigation	<ul style="list-style-type: none"> • Achieve a minimum 0.2% AEP + climate change flood immunity • Drainage system designed for site specific rainfall and flooding • Cross drainage structures for access roads • Raised / elevated electrical and other system components • Waterproof housings and rust-proofing • Resilient foundation design • Undertake regular maintenance • Sufficient warning time is generally available for flooding to ensure the facility is secured. Workers are not expected to be on site during these conditions, but immediately after.
	Avoidance	<ul style="list-style-type: none"> • Incorporate operating procedures into the Safety and Emergency Management Plan (SEMP) and relevant workplace health and safety plans for the facility.

Hazard	Primary treatment pathway	Treatment options
Landslide	Mitigation	<ul style="list-style-type: none"> • Resilient foundation design • Any relevant slope stabilisation, subsurface and surface drainage systems, and minimisation of slope cutting per mitigations of separate erosion and sediment control plan • Reinforced access road embankments • Geotechnical certified retaining • Geotechnical assessment
Earthquake		
Bushfire	Avoidance Mitigation Transfer	Refer to the separate Bushfire Hazard Assessment and Bushfire Management Plan prepared by Meridian Urban for recommended treatment options relevant to design and layout and operational procedures.

7.9 Mitigated risk assessment, residual risk and risk tolerance

On the basis of implementation of the treatment options identified at Section 7.8, the following mitigated risk level are identified.

It is important to acknowledge that natural hazard risk can rarely be entirely avoided. Mitigation measures aim to reduce risk levels and lower the extent of residual risk. The mitigated risk levels are all reduced, save for those which are already ranked 'low'.

Table 46: Summary of mitigated risk rating assessment across all hazards, incorporating climate change data where relevant

Aspect	Extreme heat and heatwave	Cyclone/strong winds	Severe storms	Flooding	Earthquake	Bushfire
Operational Infrastructure	Medium	Medium	Medium	Low	Low	Medium
Operational workers	Low	Low	Medium	Low	Low	Medium
Risk tolerability	Tolerable	Tolerable	Tolerable	Acceptable	Acceptable	Tolerable
Residual Risk	Low	Medium	Medium	Low	Low	Medium

8 Statutory Assessment

This report seeks to respond to the relevant requirements of State Code 27: Battery Storage Facility Development.

State Code 27 is supported by Planning guideline State code 27: Battery Storage Facility Development (the Planning Guideline) (December 2025) which is intended to assist with responding to the State Code 27.

The Planning Guideline (section 4.7) requires a natural hazards risk assessment (NHRA) to be submitted at lodgement of the development application to respond to PO13, PO14 and PO15 of the State Code. It is noted that Safety and Emergency Management Plans and Bushfire Management Plans, also referenced by the guideline, are separate to the scope of this assessment.

Section 4.7 of the Planning Guideline identifies that:

- Site layouts should be informed by an assessment of natural hazard risk. A Natural Hazard Risk Assessment (NHRA) should be prepared and lodged with an application to demonstrate compliance with PO13–PO15.
- In addressing PO13, this assessment should demonstrate that all parts of the project layout are located outside of natural hazard areas and responsive to the risks posed by natural hazards that could affect the site.
- In addressing PO14, demonstrate that the development is designed to address impacts from natural hazards where there is no suitable alternative location, such as resilience-focused design and operational strategies.

8.1 Assessment

The following assessment (**Table 47**) against the relevant provisions of State Code 27 and the Planning Guideline is provided.

Table 47: Assessment of relevant State Code 23 performance outcomes

Performance outcomes	Assessment
<p>PO13</p> <p>Development is located and sited to avoid natural hazard areas including high erosion risk areas and bushfire prone areas.</p>	<p>This assessment has considered, based on the data available at the time of writing, the natural hazard risks associated with the location and siting of the proposed Tully BESS, relating to both assets and people relative to natural hazard risks.</p> <p>This includes not only a present-day assessment, but a long-range projection of risk based across near and far future climate indicator projections. Overall, this risk assessment identifies that, through the location, siting and a combination of treatment pathway options, a tolerable level of risk can be achieved via a suite of measures.</p>
<p>PO14</p> <p>Where development cannot be located and sited to avoid natural hazard areas (e.g. bushfire prone areas and high erosion risk areas), demonstrate that:</p> <ul style="list-style-type: none"> • There is no suitable alternative location • Infrastructure can function effectively during an after a natural hazard event 	<p>The site is not exposed to landslide or coastal hazards. Exposure to earthquake and flood hazard is limited, and capable of being satisfactorily mitigated.</p> <p>A moderate level of risk post mitigation is achieved for bushfire hazard, the proposed Tully BESS is appropriately separated from hazard to ensure a radiant heat flux exposure of no more than 10kW/m² is achieved. The facility is therefore well separated from potential bushfire hazard.</p>

Performance outcomes	Assessment
<ul style="list-style-type: none"> Mitigation measures are implemented to reduce the risk to people, property and the environment to a tolerable level. 	<p>Key exposures including heat and heatwave, and cyclone and severe wind, and to a lesser extent but elevated frequency for severe storms. It is recommended these risks are address by the facility's SEMP to ensure risk to managed to a tolerable level.</p>
<p>PO15</p> <p>Bushfire hazard is identified and risk is mitigated through strategies for vegetation management, landscape management, water supply, provision of appropriate access, identification of safe assembly or evacuation routes and establishing cleared and maintained asset protection zones around infrastructure that is wholly contained on site.</p>	<p>Refer to the separate Bushfire Hazard Assessment and Management Plan for the Tully BESS, also prepared by Meridian Urban. This report specifies the specific bushfire mitigations required to limit risk, noting the proposed facility is sited well away from potential bushfire hazard in a manner that limits radiant heat flux exposure to no more than 10kW/m². Other bushfire mitigation measures, including static water supply for bushfire fighting purposes, access and egress arrangements and operational procedures are set out in further detail in the separate Bushfire Hazard Assessment and Bushfire Management Plan.</p>

9 Conclusion

Having regard to the multiple natural hazards assessed by this risk assessment, incorporating climate change, those hazards which present the most significant risk include:

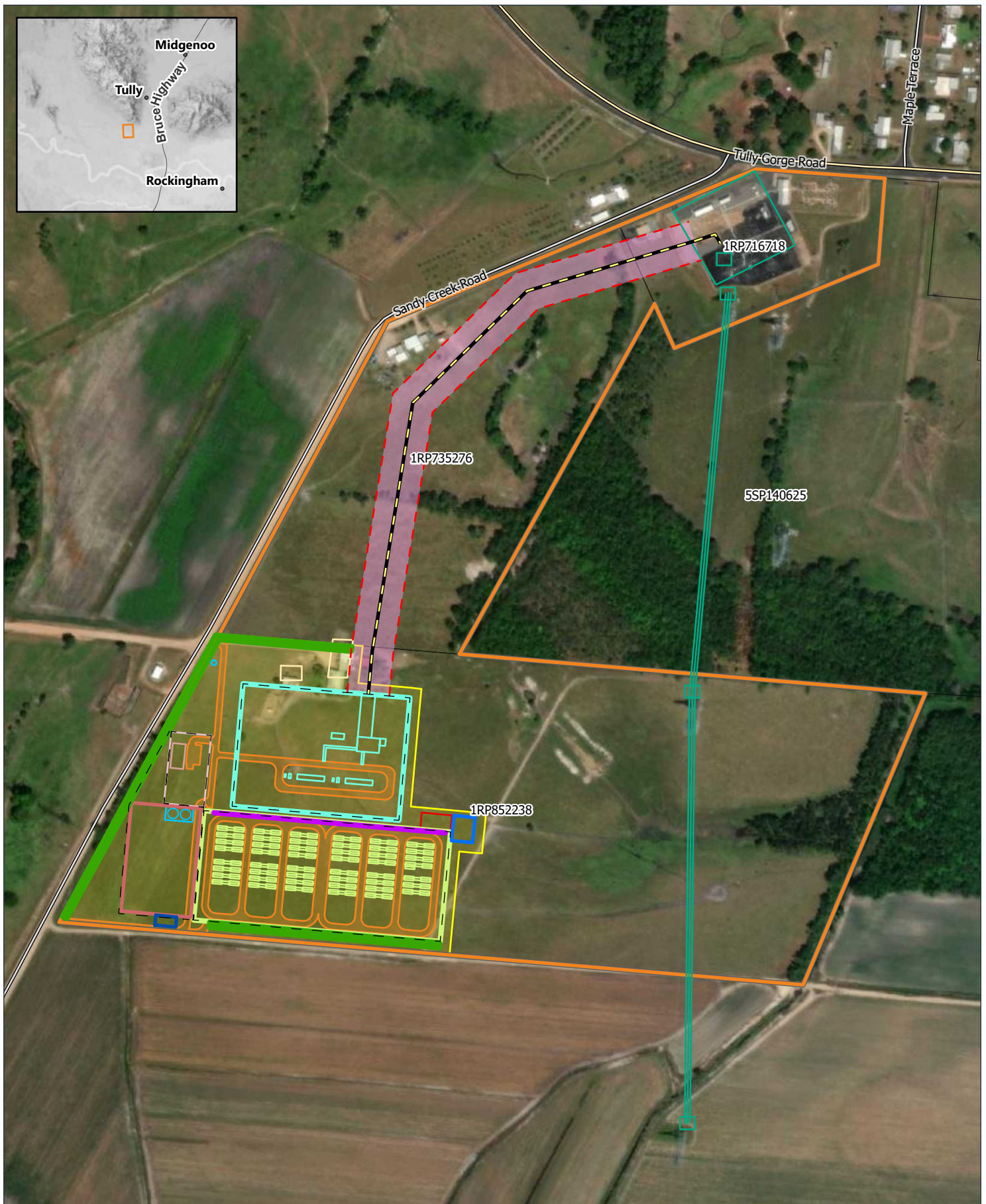
- Extreme heat and heatwave
- Severe storms
- Bushfire
- Cyclone and extreme winds.

Risk management and mitigation for all natural hazards is recommended. The purpose of this risk assessment is to demonstrate, based on hazard-specific and climate projection evidence, those which may have increased aspects of likelihood and/or consequence that is relevant for design, construction, or operation to take forward for detailed facility planning purposes.

Overall, this risk assessment identifies that, through a combination of risk mitigation and risk treatment options, compliance with PO13, PO14 and PO15 of State Code 27 can be achieved. The development is responsive to natural hazards and extreme weather events and able to protect the safety of people in the event of natural hazards and extreme weather, and the protection of assets within the limits of defined event analysis.

Operational aspects, including emergency management, will be the subject of further reporting as part of the Safety and Emergency Management Plan (SEMP) for the Tully BESS.

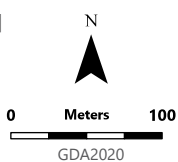
Appendix A – Proposed Development Plan



Project Layout Plan

Figure 1

DWG No: RWE-002-014 [D]
 DATE: 7/05/2026
 DRAWN: KB, JM
 REVIEWED: EJ
 SCALE (A4): 1:5,000



- | | | | |
|-------------------------------------|----------------------------|---------------------|-------------------------------|
| Project Area | Proposed Transmission Line | Noise Wall | Emergency Containment Storage |
| Development Footprint | 20m Exclusion Zone | Landscaping Area | Fence |
| Proposed Access Track Footprint | Substation Area | Existing 132kV Line | Main Road |
| Proposed Transmission Line Corridor | BESS Area | Existing Dwellings | Local Road |
| | Bioretention Basin A | Water Storage | Cadastral Parcels |
| | Bioretention Basin B | O&M Building | |
| | Construction Laydown Area | O&M Area | |

