

# 6.0 Climate

## 6.1 Introduction

This chapter provides a summary of the current climatic conditions and trends for the Ensham Life of Mine Extension Project (the proposed project, hereafter referred to as ‘the Project’). The main topics addressed include the identification of existing climate and the assessment of the vulnerability of the Project Site to natural and induced hazards such as drought, floods, cyclones and bushfires. This chapter also describes adaptation strategies based on climate change projections for the region to minimise the risk of impacts from extreme weather events on the Project.

### Environmental objectives and outcomes

The Project seeks to protect environmental values in the Project Site and adapt to a changing climate. The Project Site is located in Central Queensland, an area known to experience high temperatures and rainfall during the summer period and mild temperatures and low rainfall during the winter period. The region has historically experienced extreme weather conditions including droughts, severe storms and flooding. Given the Project activities are responsive to the climatic conditions, climatic impacts on the Project are not considered to be significant.

Ensham Mine currently undertakes a variety of activities to manage the impacts of extreme weather events as part of the existing operations. Ensham undertake preparedness activities, including continuous weather monitoring on site, emergency response planning and coordination with local authorities, and will continue to adapt management strategies in response to evolving climate change risks.

## 6.2 Legislation and policy

### 6.2.1 National Climate Resilience and Adaptation Strategy

In December 2015, the Commonwealth Government released the National Climate Resilience and Adaptation Strategy (NCRAS) to establish a framework for managing the risks of a variable and changing climate in Australia. The NCRAS identifies a set of principles to guide effective adaptation practice and resilience building, and outlines the Government’s vision for a climate-resilient future.

The climate assessment for the Project considers its vulnerabilities to climate change. Where required, adaptation strategies are proposed for the Project in accordance with the principles established under the NCRAS.

## 6.3 Methodology

A review of climatic data and literature was undertaken to characterise the climatic values of the Project Site. Desktop searches were undertaken in August 2020. The assessment draws on information available from the Bureau of Meteorology (BoM), who operate a network of monitoring stations around Australia that have long-

term climatic data available for analysis. The closest bureau station, Emerald Airport (035264), was selected and is approximately 38 kilometres (km) south-west of the Project Site.

A qualitative risk assessment has been undertaken for the Project to identify any new and increased risks at Ensham Mine. As part of this risk assessment, consideration has been given to natural and induced hazards in the Project Site, and their potential to introduce new risks to the operation of the Project. This assessment considers the relative frequency and magnitude of extreme weather events in the region and assesses the Projects vulnerability to these events. The method of assessment is further described in **Chapter 19** (Hazards and safety).

This chapter is informed by the following assessments undertaken for the Project contained within this EIS:

- **Chapter 10** (Surface water resources)
- **Chapter 11** (Flooding and geomorphology)
- **Chapter 15** (Air quality)
- **Chapter 19** (Hazards and safety).

## 6.4 Description of environmental values

### 6.4.1 Project Site characteristics

The Project Site is located within Central Queensland, approximately 35 km east of Emerald. Central Queensland is characterised by a humid sub-tropical climate.

Terrain features and land use can influence meteorological conditions on both a local and regional scale. The terrain in the area is generally flat, with the area to the west of Ensham Mine a floodplain of the Nogoia River, a tributary of the Fitzroy River (**Chapter 10** (Surface water resources)). The areas to the east and south are also mostly flat with elevations above sea level approximately 160 metres (m). The existing Ensham Mine sits within a small valley that runs north–south, with peaks either side at between 230 and 300 m. This valley extends past the northern boundary of the open-cut pits at Ensham Mine.

Land use surrounding the mine consists of agricultural uses to the east and south of Ensham Mine, in the areas of the Nogoia River floodplain. Scattered residential rural land is located to the north, west and south of the Mine. The surrounding land is primarily agriculture and dry land farming. The townships of Comet, Emerald, and Blackwater are located to the south, west and east, and are between 10 and 40 km from Ensham Mine.

### 6.4.2 Climate patterns

#### 6.4.2.1 Air temperature

The Central Queensland Region has a sub-tropical climate with a high variability in temperature. Mean minimum and maximum temperatures recorded at Emerald Airport averaged over the last 28 years (1992–2020) are detailed in **Table 6-1**. Overall the temperatures across the region are consistent with a sub-tropical climate.

**Table 6-1 Emerald Airport mean maximum and minimum temperatures**

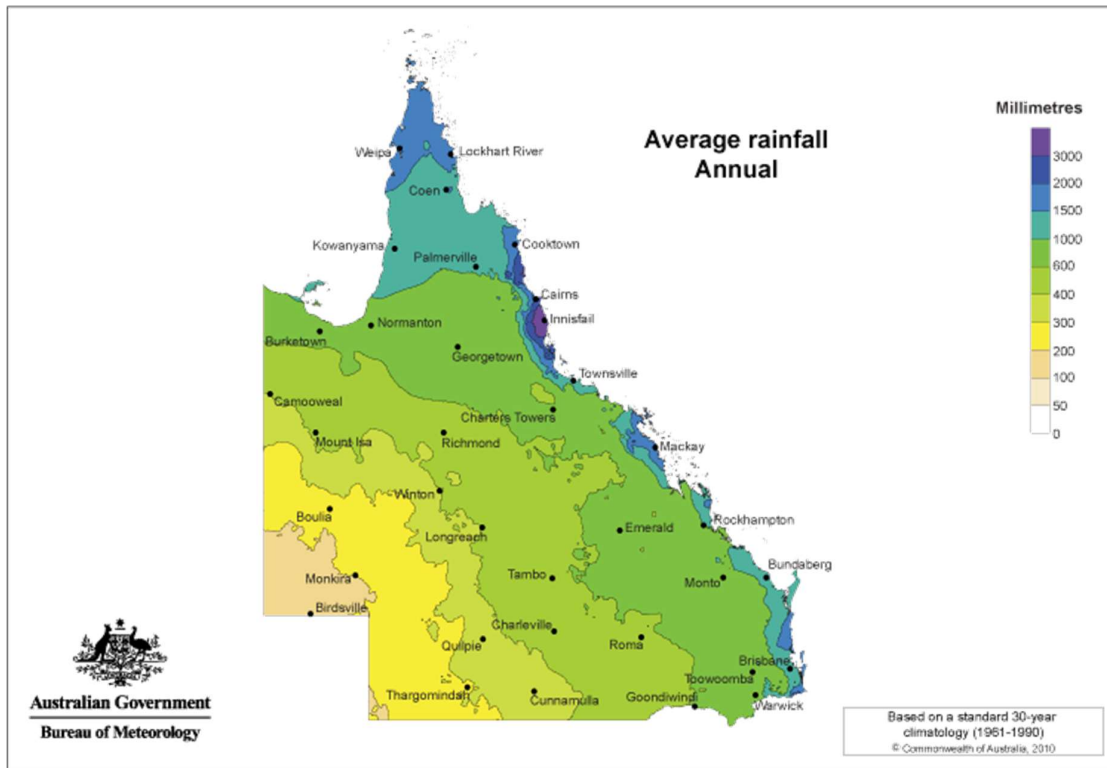
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Maximum	34.6	33.8	32.8	30.0	26.4	23.4	23.4	25.5	29.1	31.8	33.5	34.5	29.9
Minimum	22.3	22.1	20.5	17.0	13.1	10.3	9.1	10.0	13.5	17.1	19.5	21.4	16.3

**6.4.2.2 Rainfall**

The average rainfall values across the Project Site and surrounding region are detailed in **Table 6-2**. Highest rainfall occurs between December and February. The lowest rainfall occurs March to November, with May and July having the lowest rainfall average. The Emerald Airport annual mean rainfall is slightly less but is largely consistent with rainfall amount of 600 millimetres (mm) illustrated in **Figure 6-1**.

**Table 6-2 Emerald Airport mean rainfall**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Maximum	84.2	87.6	59.7	28.9	18.0	30.4	17.4	20.5	26.3	42.6	50.8	83.0	543.4

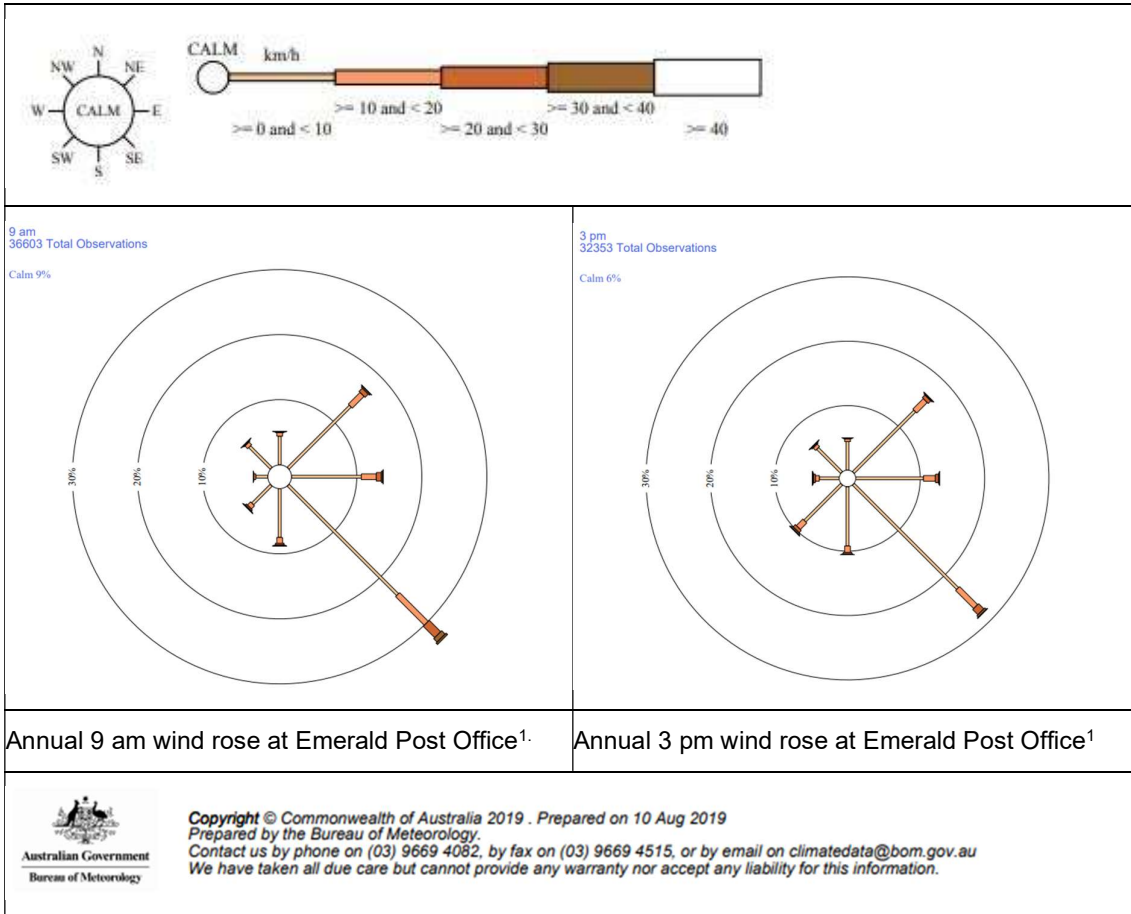


**Figure 6-1 Queensland mean rainfall (BoM, 2020)**

**6.4.2.3 Wind speed and direction**

Wind speed and direction are variable and are influenced by a range of factors, including terrain, time of day and weather patterns. **Figure 6-2** presents the distribution of winds measured at Emerald Post Office, which illustrates long-term annual morning and afternoon conditions.

Morning (9 am) winds at the Emerald Post Office are predominantly from the south-east, east and north-east, and are low to moderate strength when not calm. Winds at 3 pm at Emerald Post Office are similar to morning winds, with winds from the east of a similar strength.



**Figure notes:**

1. Annual wind rose of wind direction versus wind speed based on observations from 1896 to 1992

**Figure 6-2 Emerald Airport wind roses (BoM, 2020)**

## 6.5 Extreme weather

### 6.5.1 Climate change

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and BoM report 'Climate Change in Australia Technical Report' (QFES, 2020) gives projections on the potential changes to climate over the life of the Project. These climate projections show that the potential impacts of climate change in the region relate to temperature increases and either declining or increasing rainfall depending on the climate model. It is expected that the frequency and intensity of storms and cyclones will not change significantly in the area of the Project for the life of the Project.

The following sections describe the current trends with respect to the frequency and magnitude of extreme weather events in the Emerald region.

### 6.5.2 Drought

Droughts are an increasingly common occurrence in Australia with prolonged periods of water shortage having negative effects on vegetation growth, erosion and overall land quality. Historical data shows that Queensland experiences some of the highest rainfall variability in the world (DES, 2019a), and as such droughts at some stage have affected most of the state. A review of Queensland Drought Situation maps generated by DES indicates that, as of 1 May 2020, the Project Site is within a fully drought declared area.

### 6.5.3 Bushfire

The Project is located in an area with heightened bushfire risk (QFES, 2020). The bushfire season in the region extends from mid-late winter through to early summer. The threat of bushfires increases with periods of reduced rainfall and increased temperatures, which can increase the amount of dry grass available to burn.

The climate statistics from the BoM show the mean maximum temperature of 34.6 degrees centigrade (°C) (BoM, 2020a) at the Emerald Airport station in summer. Mean rainfall values also highlight the distinct wet (summer) and dry (winter) seasons experienced by the region, as well as the large variation in rainfall amounts received across the wider area. Climate modelling from the CSIRO projects a temperature rise of up to +2°C by 2030 (CSIRO, 2001). The primary determinant of bushfire in the Monsoonal North is fuel (vegetation) availability which varies mainly with rainfall.

The extreme heat and dry conditions experienced in the Project Site, both now and in the future, can be conducive for a bushfire event. The Project will not alter the current profile of this risk.

### 6.5.4 Cyclones

Rotating low-pressure systems that form over warm tropical waters are known as tropical cyclones. Tropical cyclones produce destructive gale force winds (sustained winds of 63 kilometres per hour (km/h) or more) which are generally strongest near the centre, but can extend for hundreds of kilometres.

In Queensland, tropical cyclones mostly form from lows within the monsoon trough and affect the northern areas of the state (BoM, 2020b). While relatively uncommon, these systems are generally formed during summer months and affect coastal areas most. Since the year 2000 there have been seven tropical cyclones of significance in Queensland. Of these, Severe Tropical Cyclone Debbie (25 to 29 March 2017) passed through to the east of Emerald.

Climate modelling from the CSIRO projects tropical cyclones to become less frequent, but with increases in the proportion of more intense storms.

The extended underground mining activity associated with the Project will not alter the current profile of this risk.

### 6.5.5 Thunderstorms

Severe storms typically occur throughout the year in the Central Queensland region, however, these tend to be more frequent during the summer months (QFES, 2017). Thunderstorms, or severe weather events, involve a combination of damaging or destructive winds, heavy rain, very large hail, dangerous surf, abnormally high tides and tornadoes.

According to the Sever Storms Archive (BoM, 2020c), nine severe weather events have been recorded in the vicinity of Emerald since January 2010. Of the nine events recorded, five were associated with intense rainfall, three involved damaging or destructive winds and one was a possible tornado. During a single event in January 2016, wind gusts of up to 85 kilometres per hour and 42 mm of rainfall was recorded in 25 minutes (BoM, 2020c).

### 6.5.6 Flooding

Ensham Mine is located within the floodplain of the Nogoa River. The Nogoa River has a catchment area of approximately 27,000 square kilometres (km<sup>2</sup>) upstream of the existing Ensham Mine. The catchment is sparsely populated outside of the towns of Clermont, Emerald, Springsure and Blackwater and land use is predominantly rural with substantial areas cleared for grazing.

Fairbairn Dam was constructed on the Nogoa River upstream of Emerald in 1973 and supplies water to various industrial, agricultural and residential users. The dam has significantly changed the flow regime in the downstream reaches of the Nogoa and Mackenzie Rivers. A flood event in December 2010/2011 event was the largest event to have been recorded since the Fairbairn Dam was commissioned.

The Department of Natural Resources, Mines and Energy (DNRME) records flows in the Nogoa River at the Duck Ponds gauging station (130219A) (DNRME, 2019). The BoM classifies flood levels at the Duck Ponds gauging station as minor, moderate and major for water level at respectively 9, 10 and 11 m above the riverbed. According to this classification, January 2008 and December 2010 have been two major flood events and January 2012 has been a moderate flood event. The latest flood event in July 2016 was minor (see **Figure 6-3**).

Ensham Mine has a number of flood protection measures in place as part of the existing mining operations. The Project will not alter the current profile of the risk of flooding as discussed in **Chapter 11** (Flooding and geomorphology).



Figure 6-3 Maximum monthly level for Nogoia River (DNRME, 2019)

## 6.6 Potential impacts and mitigation measures

An assessment of climate trends and extreme weather in the Project Site has been undertaken to predict climate impacts that may affect the Project. The risk assessment undertaken for the Project provided in **Chapter 19** (Hazards and safety) considers hazards associated with extreme weather events and proposes measures to minimise Project risks. This assessment ensures climate risks can be adequately managed and the Project’s vulnerability to a changing climate can be managed.

### 6.6.1 Climate change

Given the relatively short duration of the Project (i.e. an approximately nine year extension of the Ensham Mine life of mine (LOM)), it is not expected that changes in climate and the increased frequency of climatic events will impact the Project’s operations. In consideration of the nature and scale of the Project, the risk assessment undertaken for the Project has not identified any particular vulnerabilities of the Project to the impacts of climate change. Any impacts to the Project as a result of climate change are expected to be adequately addressed through Ensham Mine’s existing measures with respect to extreme weather events, such as bushfires, severe storms and flooding.



As part of ongoing mining operations, Ensham Mine will continue to monitor and review information from the BoM and CSIRO relating to observed changes in the region's climate. Should any emerging trends identify potential impacts of a changing climate on the Project, Ensham will review and monitor emerging risks with a view to implementing additional adaptation measures as required. Such measures may involve revising the mine water management system across Ensham Mine's operations in response to changing supplies and demands, or reviewing emergency response plans and bushfire management strategies in response to heightened risks. These measures would be considered as part of periodic reviews in line with the requirements of the Ensham Mine Integrated Management System.

The following sections describe the potential impacts of extreme weather events and a changing climate in the Emerald region, detailing the measures currently employed at Ensham Mine to address the potential impacts and risks.

### 6.6.2 Drought

The Project is located within a drought declared area. Decreased rainfall and drought experienced within the Project Site has the potential to:

- reduce the amount of mine water available to support Project mining operations
- reduce soil moisture content at the surface which may increase ground movement
- increase water demand to manage dust and maintain soil moisture within the Project Site.

Mine water management and supply has been considered as part of the water balance assessment undertaken for the Project (**Appendix E-2** (Mine water balance)). The existing Ensham Mine is expected to have sufficient supplies of water from groundwater inflow to meet the water demands for the project. Further detail on potential impacts and mitigation measures is provided in **Chapter 10** (Surface water resources).

### 6.6.3 Bushfire

The Project is located in an area where heat and dry conditions can be conducive for a bushfire event. Given the Project is located underground, it is not expected that Project activities will alter the current profile of this risk. Surface infrastructure is limited to four flares located in Zone 2 and Zone 3 in areas which are already cleared from mining activities. An exclusion zone of approximately 80 m by 20 m will be established around each flare and grass levels will be maintained to minimise fire risk. Therefore, bushfire risk would be managed in accordance with existing practices in place at Ensham Mine.

The occurrence of bushfires in the vicinity of the Project Site has the potential to disrupt Project operations as a result of:

- workforce isolation as a result of bushfires and smoke preventing access/egress to and from the Project
- impaired visibility due to smoke resulting in potentially hazardous work environments
- damage to infrastructure in operational areas associated with the Project (e.g. transportation and mining infrastructure within the existing Ensham Mine)
- a reduction in air quality in the Project Site.

Bushfire risk has been considered as part of the risk assessment undertaken for the Project. Further detail on potential impacts and mitigation measures is provided in **Chapter 19** (Hazards and safety).



#### 6.6.4 Cyclones

As discussed in **Section 6.5.4**, the frequency of cyclones is predicted to reduce over time, whilst the intensity of storm events are predicted to increase. As the Project Site is located approximately 250 km inland from the Queensland coast, the cyclone risk is considered low. Furthermore, the Project is not expected to increase the current risk attributed to cyclones.

The Project may be susceptible to the residual effects of cyclones such as thunderstorms. Severe storms events are not uncommon in the Emerald region, with nine severe weather events recorded in the past 10 years. The effects of severe weather, including damaging or destructive winds, heavy rain and/or very large hail, in the region has the potential to:

- disrupt Project operations as a result of damage to infrastructure servicing the underground mine
- restrict workforce access and egress to and from the Project
- impact on the health and safety of employees due to increased hazards from wind- and water-borne debris in the Project Site
- increase the volume of mine affected water on site needing to be managed prior to discharge.

Risks associated with cyclone activity has been considered as part of the risk assessment undertaken for the Project. Further detail on potential impacts and mitigation measures is provided in **Chapter 19** (Hazards and safety). **Chapter 10** (Surface water resources) provides further details on the measures proposed to manage mine affected water resulting from the Project.

#### 6.6.5 Flooding

A flood assessment has been undertaken for the Project as part of the Hydrology and Flooding Assessment (**Appendix E-3** (Hydrology and flooding)). No new surface disturbance other than the addition of the four flares is required for the Project and impacts to surface topography and hydrology as a result of subsidence are considered unlikely. Therefore, potential changes to surface water flow and flooding are not anticipated as a direct result of the Project.

Increased rainfall and flooding within the Project Site has the potential to disrupt Project operations as a result of:

- workforce isolation as a result of flood events blocking access to the Project
- disruption of surface infrastructure servicing the Project Site
- flooding of operational areas associated with the Project (e.g. transportation and mining infrastructure within the existing Ensham Mine)
- inundation of the underground workings (note that the underground mine is protected by a 0.1%AEP+0.5m levee).

Ensham Mine has a number of flood protection measures in place as part of the existing mining operations. Further details on the potential impacts as a result of the Project and measures proposed to reduce impacts are provided in **Chapter 10** (Surface water resources).

## 6.7 Summary and conclusions

A desktop assessment has been undertaken to identify climate conditions and trends within the Project Site, with particular regard to those conditions which affect the operation of the Project. The Project Site is known to experience high temperatures and rainfall during the summer period, with occasional extreme weather events such as droughts, severe storms and flooding. Given the relatively short duration of the Project (i.e. an approximately nine year extension of the Ensham LOM), it is not expected that changes in climate and the increased frequency of climatic hazards will impact the Project's operations.

A risk assessment undertaken for the Project considered the vulnerability of the Project operations to natural hazards, including floods, bushfires and severe storms. As the Project is an extension of existing operations, it is not expected to increase the current risk profile associated with these extreme weather events. Therefore, no additional measures are proposed to manage risks associated with climate. Measures currently in place at the existing Ensham Mine, including greenhouse gas abatement measures, are proposed for the Project to protect environmental values in and around the Project Site.