PROJECT CHINA STONE

Climate 14

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14 CLIMATE

14.1 INTRODUCTION

This section describes the climate and meteorological patterns relevant to Project China Stone (the project) and identifies climatic extremes in relation to natural and other hazards.

14.2 REGIONAL CLIMATIC PATTERNS

The project is located within the Galilee Basin in Central Queensland. Central Queensland has a sub-tropical continental climate characterised by high variability in rainfall, temperature and evaporation. The region can experience droughts, floods, heatwaves and frosts. In general, winter days are warm and nights are cool, while summer days are hot and nights are warm. Rainfall is summer dominant with almost half of the average annual rainfall occurring from December to February due to storms and tropical lows associated with cyclones.

Climate data has been collected from two Bureau of Meteorology (BoM) meteorological stations located in proximity to the project site. The closest weather station to the project site is located approximately 12 km to the south west on the Carmichael property (BoM Station Number 036122). This station has been operational since 2003 but only measures rainfall. Rainfall data presented in the following sections has been sourced from this station and dates from 2003 to 2013. The remaining climate data discussed in the following sections has been sourced from the Clermont Post Office meteorological station (BoM Station Number 035019) which, although being located approximately 180 km to the south-east of the project site, is the nearest weather station that records additional meteorological parameters. This station collected rainfall, temperature and humidity data from 1870 until 2011 when it was decommissioned. Climate data presented in the following sections dates from 1910 to 2011.

14.3 TEMPERATURE

Seasonal average minimum and maximum daily temperatures are shown in Table 14-1. These temperatures are typical of the tropical Queensland climate, with warmer summer months during December, January and February and cooler winter months in June, July and August.

The seasonal average maximum daily temperature at the Clermont Post Office weather station is 34.8 °C, recorded during the summer season. The seasonal average minimum daily temperature at the weather station is 6.7 °C, recorded during winter.

Table 14-1 Seasonal Average Maximum and Minimum Temperatures at Clermont Post Office BoM Site

SEASON	MINIMUM º C	MAXIMUM º C
Spring	12.1	33.9
Summer	21.6	34.8
Autumn	11.4	32.0
Winter	6.7	25.3

14.4 RAINFALL

Rainfall in the Central Queensland region is seasonal and extremely variable with 50% of annual precipitation occurring during the summer months. Evaporation rates in the region are also extremely high, and typically exceed annual and monthly rainfall.

Table 14-2 provides long-term averages and highest and lowest rainfall recorded at the Carmichael weather station. Average monthly rainfall ranges from 15 mm in May to 127 mm in January with an annual average rainfall of 525 mm. The highest monthly rainfall recorded was 291 mm in January 2004. The lowest recorded monthly rainfall was 0 mm in the months of March through to November.

Table 14-2 Monthly Average Climatic Conditions from 1910 to 2013

MONTH	AVERAGE RAINFALL (mm)	HIGHEST RAINFALL (mm)	LOWEST RAINFALL (mm)	RELATIVE HUMIDITY (%)	
Time				**9.00am**	**3.00pm**
January	127	291.0	2.4	66	42
February	122	241.8	25.4	71	47
March	55	192.4	0	69	42
April	33	105.0	0	67	41
May	15	50.0	0	68	42
June	24	181.8	0	69	41
July	16	70.4	0	66	37
August	12	41.8	0	61	33
September	21	161.2	0	55	29
October	18	41.4	0	54	30
November	62	150.0	0	57	34
December	65	158.8	6.0	60	38
Annual	**525**	**928.0**	**369.2**	**64**	**38**

Note: Rainfall data is sourced from the Carmichael weather station and relative humidity is sourced from the Clermont weather station.

14.5 RELATIVE HUMIDITY

Table 14-2 provides Relative Humidity (RH) values based on long-term average measurements collected daily at 9 am and 3 pm from the Clermont Post Office weather station. In regard to average daily variations, RH is approximately 20% higher in the morning in comparison to the afternoon. This is a result of the relatively low annual rainfall at the site and the drying effect of the sun as the day progresses. The highest monthly average RH value was recorded in February for both morning and afternoon values (71% and 47%, respectively).

14.6 WIND

As the closest BoM monitoring stations that collect wind speed and wind direction data are over 150 km away, wind speed and direction at the site was determined using the TAPM and CALMET meteorological models. The meteorological modelling methodology and detailed results are discussed further in the *Air Quality Report* (Appendix L).

Winds were found to be commonly from the north-east to the south-east. Light winds (speeds between 0 and 2m/s) were found to occur at the site for 32% of the time and moderate winds (characterised as between 2 to 5m/s) were found to occur 59% of the time. Strong winds (>5 m/s), occur only 9% of the year.

14.7 TEMPERATURE INVERSIONS AND EXTREMES OF CLIMATE

The project site is located approximately 250 km inland and the terrain is dominated by a ridgeline aligned roughly north-south along the western portion of the site. Mild to strong temperature inversions occur more than 40% of the time during autumn, winter and spring, and almost 30% of the time during summer. Cold air drainage flows associated with temperature inversions tend to run downhill from the north-west of the site to the lower-lying portion of the site in the south-east.

Central Queensland is prone to periodic droughts and the region, including the project site, is predicted to get drier due to global climatic changes (Hennessy et al. 2008). The impacts of variable rainfall, in particular drought, on the project's water supply and balance are assessed in Section 13 – Surface Water.

Cyclonic winds have not been identified in the region as they mainly affect Queensland's coastal areas. Given the distance to the coast of approximately 250 km, the project is unlikely to experience cyclonic winds. However, rain and flooding associated with cyclones, storms and low monsoonal troughs have previously affected the region. Flood hazards are described in Section 13 – Surface Water.

The greatest risk of bushfire usually occurs after the dry winter/spring period and before the onset of rains in the summer months, when lower relative humidity, high winds and lack of rain are common. Key strategies to minimise the risk of bushfire are described in detail in Section 22 – Hazard and Risk.

14.8 CLIMATE CHANGE

Queensland is expected to become hotter and drier, with current predictions of a reduction of 1-7% in rainfall across Central Queensland, increased temperatures and increased evaporation (Office of Climate Change 2011). The strength of extreme events are also predicted to increase, including cyclones, storms and droughts. Climate conditions that may affect the project site include:

- Increased temperatures and evaporation and associated changes to water availability; and
- Rain and flooding associated with a greater number of extreme events such as cyclones.

Management and mitigation measures will be put in place to ensure that the project is able to adapt to climate change. These measures will be in line with the Queensland government's *Climate Change: Adaptation for Queensland* (Office of Climate Change 2011) and will include:

- Robust design of the site drainage infrastructure and mine water management system to account for variability of mine water supply due to climate change (Section 13 – Surface Water);
- Designing the mine water management system to allow for extreme rainfall and flooding events (Section 13 – Surface Water);
- Designing and building mine infrastructure (such as the tailings storage facility) to engineering specifications to ensure safety during extreme events; and
- Following waste management procedures, including waste minimisation and storage and handling, to reduce the risk of disease.

The proponent will work with cooperatively with government and other industry sectors to address adaption to climate change, where practicable.