2 CLIMATE AND CLIMATE CHANGE

Chapter 2 provides an overview of the existing climate and predictions of climate change in the area of the Gas Field Component of the Queensland Curtis LNG (QCLNG) Project. It describes the potential impacts of climate change on the Gas Field.

It does not describe the impact on climate change from the production of greenhouse gases by Gas Field development. Greenhouse gas emissions, and their impacts and mitigation strategies are discussed in detail in *Volume 7* of this Environmental Impact Statement (EIS).

2.1 CLIMATE

2.1.1 Project Environmental Objective and Values

The Project environmental objective for climate and climate change is to ensure that Project infrastructure design and proposed management strategies incorporate consideration for climatic extremes and future climate change.

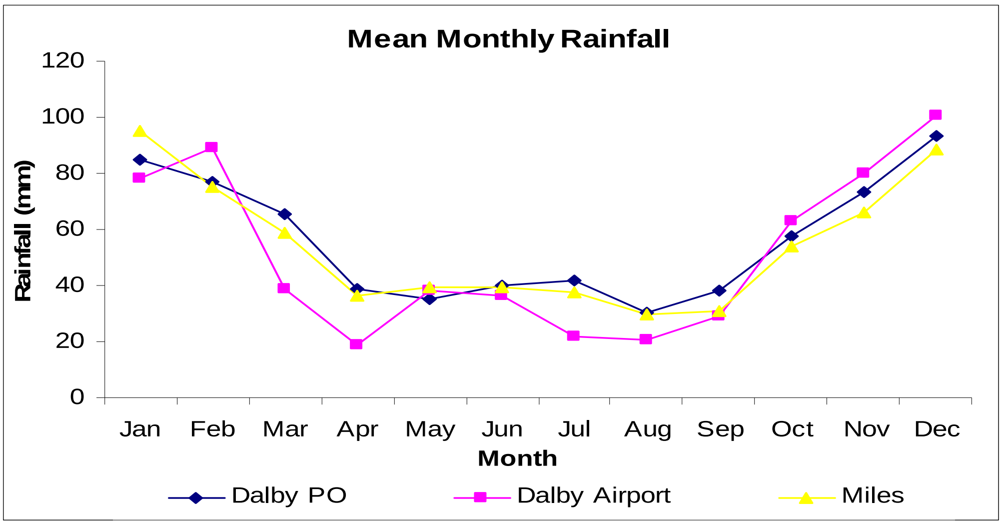
The sections that follow outline the existing environmental values related to climate.

The Gas Field Component is located in a subtropical climate zone of Australia, which is characterised by hot summers and dry to moderately dry winters. Climatic data provided by the Bureau of Meteorology (BoM) at the Miles and Dalby monitoring stations (BoM, 2008) is considered representative of conditions present in the Gas Field. Dalby is located approximately 25 km east of the southern section of the Gas Field and data has been collated from the Dalby Airport (1992 to 2008) and Dalby Post Office (1870 to 1992). Miles is located centrally to the Gas Field and data has been collected there from 1885 to 2008.

2.1.1.1 Rainfall

Rainfall data indicates the annual mean rainfall for the region is 647 mm. Consistent with the subtropical climate, the highest rainfall in the area occurs during the summer months (December to February) with mean monthly rainfall of 86.9 mm. The monthly distribution of rainfall is presented in *Figure* 3.2.1.

Figure 3.2.1 Mean Monthly Rainfall



2.1.1.2 Temperature

Temperatures in the region vary greatly over the year. The annual mean maximum daily temperature recorded is 26.7°C, with a mean minimum daily temperature of 12°C. The warmest month is January with an average maximum daily temperature of 32.6°C and a mean minimum daily temperature of 18.9°C (refer to *Figure 3.2.2*). The coolest month is July with an average maximum daily temperature of 19.3°C and a mean minimum daily temperature of 3.9°C (refer to *Figure 3.2.3*).

Figure 3.2.2 Mean Maximum Daily Temperature

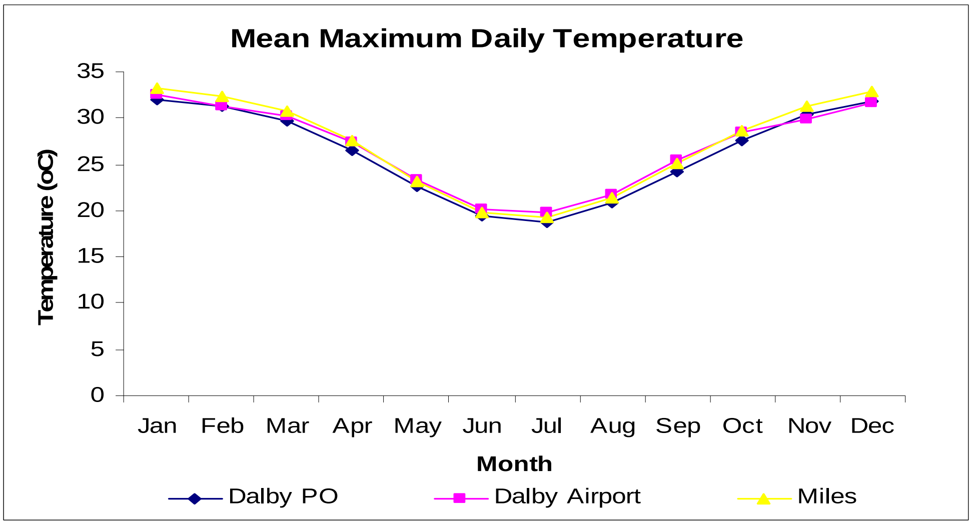
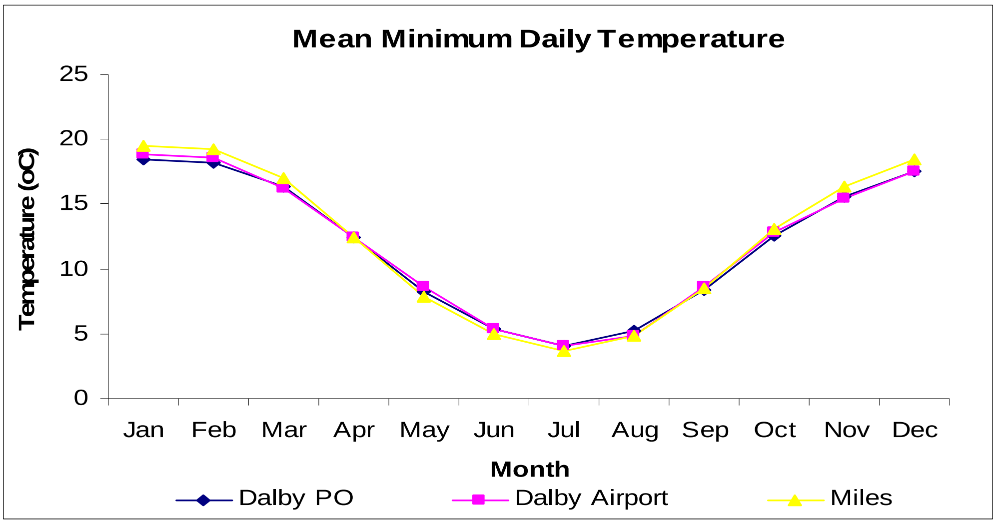


Figure 3.2.3 Mean Minimum Daily Temperature



2.1.1.3 Wind

An analysis of BoM data for Miles (refer to *Annex A*) indicates that the predominant annual wind flows at Miles are from the north to north-east with 38 per cent of winds blowing from this direction. A further 24 per cent of winds are from the east-north-east to east-south-east, while 18 per cent of winds are from the south to south-west sector.

The diurnal distribution of winds indicates that the evening, night-time and morning wind flows are dominated by winds from the northern and eastern sectors, with winds during the afternoon period more evenly distributed from all directions. The mean 9am and 3pm wind speeds for Miles and Dalby are illustrated in *Figure 3.2.4* and *Figure 3.2.5* respectively.

Seasonally, winds from the north-eastern quadrant tend to dominate spring, summer and autumn months, while the winter is dominated by winds from the opposite direction, the south-western quadrant.

Figure 3.2.4 Mean 9am Wind Speed km/hr

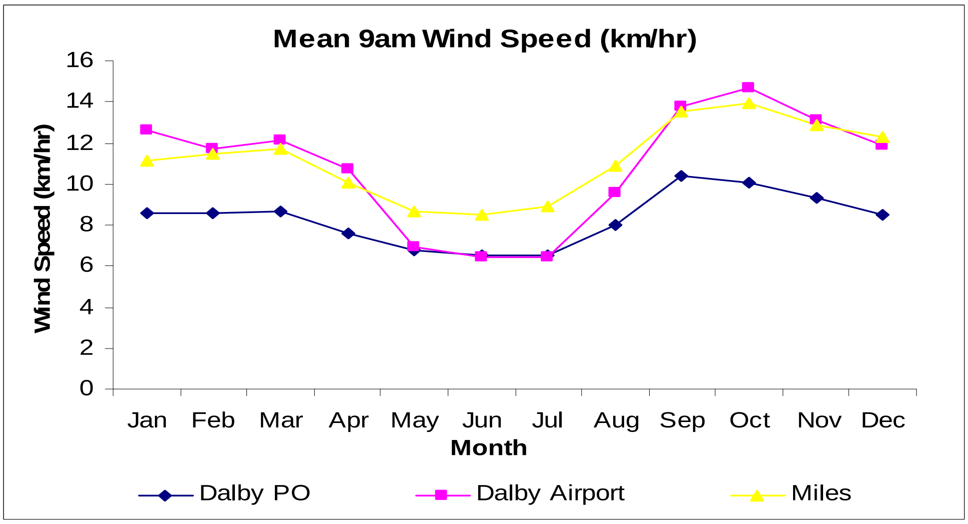
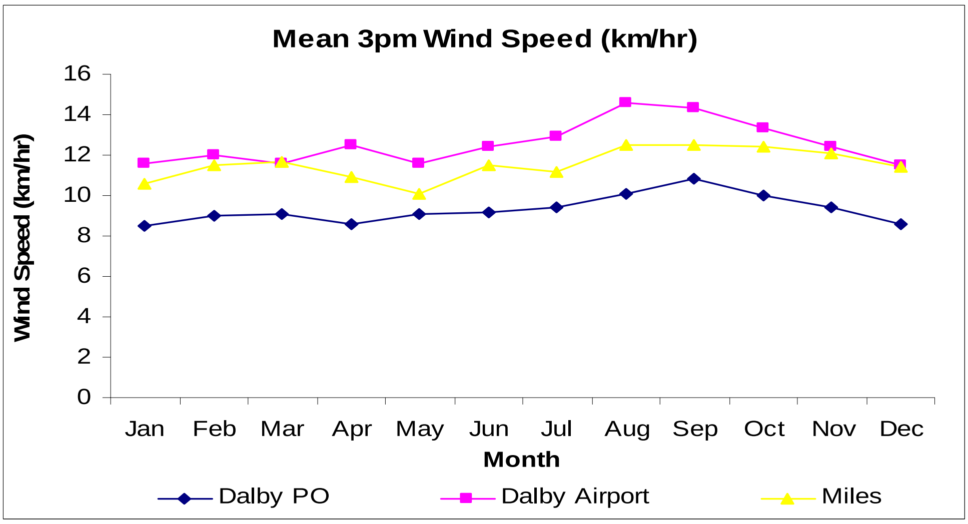


Figure 3.2.5 Mean 3pm Wind Speed



2.1.1.4 *Extreme Events*

The Condamine River is the main watercourse within the Gas Field study area, traversing tenements ATP632, PL211, PL201, PL179 and ATP676.

Major floods of the river system occur regularly, on average every two years with the worst flooding occurring in 1942, 1950, 1956, 1975, 1976, 1983 (twice), 1988 and 1996 (BoM, 2008). Flooding in this river system can result from rainfall in the headwater areas of the catchment as well as from heavy rainfall in any of the large tributaries which flow into the Condamine River.

Major floods generally only occur in the first half of the year although records indicate that they may also occur in late spring (BoM 2008). Refer to *Volume 3, Chapter 9* Surface Water Resources for additional information.

The Gas Field Component is located within a zone of least probability for the occurrence of a tropical cyclone.

Bushfire Risk Analysis Mapping produced by the Queensland Fire and Rescue Service (QFRS, 2008) indicates the Gas Field study area is a mix of low- and medium-bushfire risk, with isolated points of high risk. The medium-risk and high-risk areas are associated with vegetated areas and state forests.

2.1.2 *Potential Impacts and Mitigation*

The key effects of climate on the construction and operation of the Gas Field include:

- erosion due to wind and/or water
- heat stress for personnel
- variability of temperature ranges affecting functionality of infrastructure
- bushfires
- difficulties with construction access and vehicle operation due to wet-weather conditions
- dust due to dry windy conditions
- wind speed and direction affecting noise and air emission dispersion
- flooding of worksites leading to the collapse of the pipeline trenches, inundation of hardstand areas and risks to personnel
- subsidence due to water ingress
- overtopping of water storage dams.

Mitigation strategies will be adopted to avoid environmental impacts, delays during construction and process delays during the operational phase as a result of climate impacts. These strategies include:

- providing wet weather access to all construction sites
- reduction, where appropriate, of construction activities during wet weather
- sediment and erosion controls will be designed and implemented to cope with high rainfall events
- ensuring adequate dust, sediment and erosion management as described in the Gas Field Environmental Management Plan, *Volume 9* of this EIS
- monitoring short- and longer-term weather predictions
- designing all water storage areas to take into account significant wet-weather events
- ensuring gathering lines are buried deep enough to not be affected during flooding events
- training personnel in the risks to themselves and equipment from extreme temperature events

- developing and implementing emergency response plans for extreme events including fires and flooding
- ensuring that all personnel are aware of and have rehearsed emergency response measures in the event of flooding, fire and cyclones.

2.2 CLIMATE CHANGE

2.2.1 Climate Change Predictions

Localised climate change predictions for the Surat Basin are not available. The nearest source of localised climate change information is for Toowoomba, as provided by the CSIRO Technical Report 2007 – *Climate Change in Australia*[1] (the CSIRO Report).

Information is provided for Toowoomba for various future years, 2030, 2050 and 2070. The most appropriate future year to consider is 2030 as this coincides with the end of the 20-year life of the Project.

The CSIRO Report considers various emissions scenarios as a basis for prediction of climate change impacts. Scenario A1B assumes a world of rapid economic growth with global population stabilising mid-century and a balance between fossil-intensive and non-fossil-intensive energy sources. This scenario (i.e. Scenario A1B) is considered appropriate for the purposes of assessing localised climate changes.

Climate change predictions for each future year and each emissions scenario are considered for the 10th, 50th and 90th percentile, using five climate change models. These climate change models use different assumptions about climate change science in modelling the A1B scenario. For the purposes of determining the effect on the Project from the range of climate change scenarios, a range of possible climate changes from the 10th to the 90th percentile were reviewed, with the worst-case value from the range of models being adopted.

The relevant effects of climate change at the Gas Field include:

- mean temperature changes
- mean rainfall changes
- high-intensity rainfall events and cyclones.

Table 3.2.1 shows the predicted 2030, A1B, 10th, 50th and 90th percentile predicted percentage change in rainfall for Toowoomba.

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1 http://www.climatechangeinaustralia.com.au/resources.php

Table 3.2.1 Rainfall Change Percentages – Toowoomba 2030

Percentage Rainfall Change	Toowoomba 2030		
Development Scenario	A1B	A1B	A1B
Percentile	10	50	90
Climate Change Model 1	-9.6%	-2.7%	5.1%
Climate Change Model 2	-8.6%	-0.3%	9.2%
Climate Change Model 3	-11.9%	-2.8%	8.8%
Climate Change Model 4	-13.2%	-5.7%	3.5%
Climate Change Model 5	-13.5%	-5.1%	5.4%

For the purposes of sensitivity analysis, predicted rainfall changes will range between a decrease of 13.5 per cent and an increase of 9.2 per cent.

Table 3.2.2 shows the predicted 2030, A1B, 10^{th}, 50^{th} and 90^{th} percentile predicted change in temperature, in degrees Celsius, for Toowoomba.

Table 3.2.2 Temperature changes (degrees Celsius) – Toowoomba 2030

Temperature Change in °C	Toowoomba 2030		
Development Scenario	A1B	A1B	A1B
Percentile	10	50	90
Climate Change Model 1	0.7	1.0	1.4
Climate Change Model 2	0.6	0.9	1.4
Climate Change Model 3	0.6	0.9	1.4
Climate Change Model 4	0.6	0.9	1.3
Climate Change Model 5	0.7	1.0	1.5

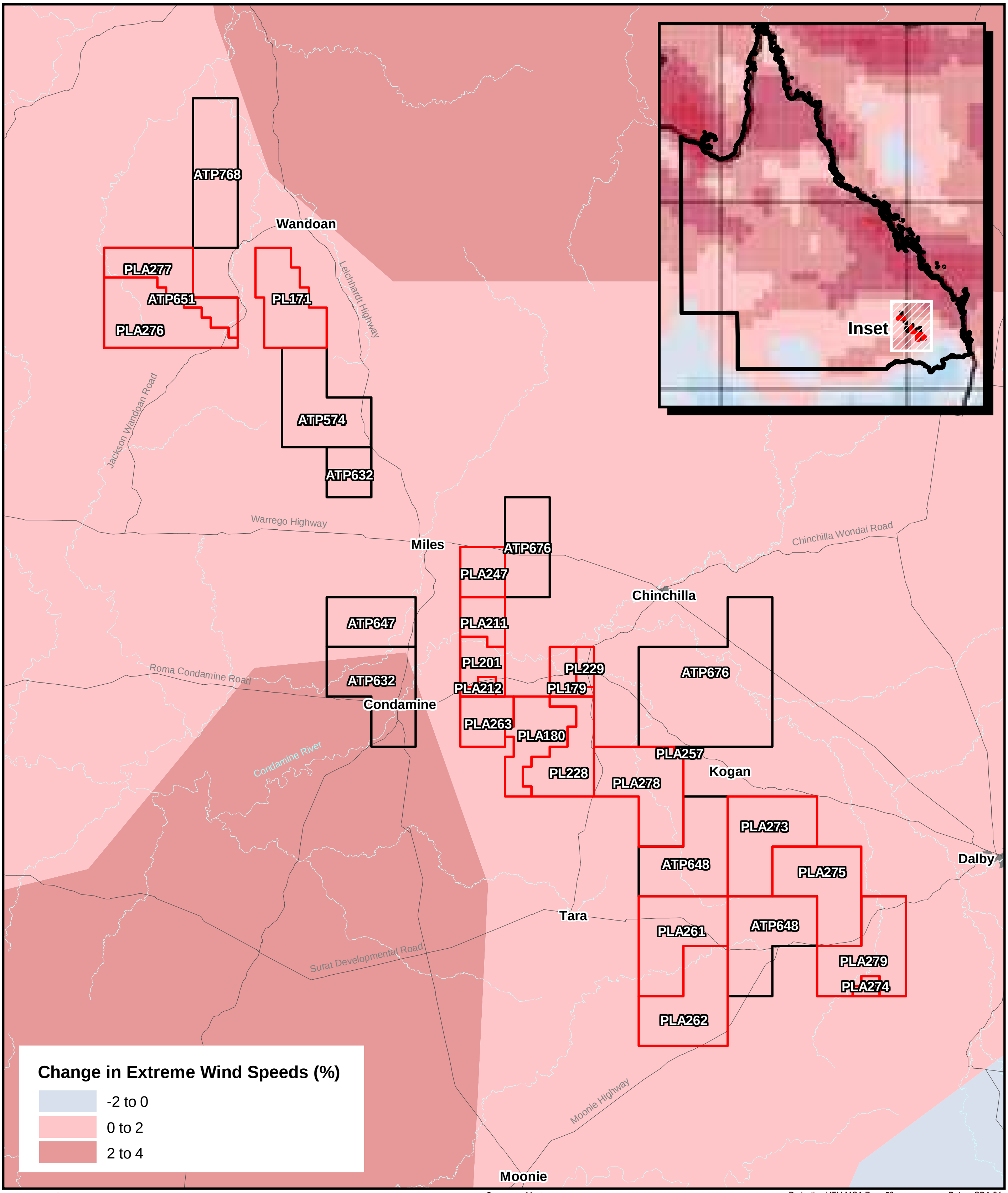
For the purposes of sensitivity analysis, predicted temperature changes will range between an increase of 0.6°C and 1.5°C.

Figure 3.2.6 shows, for Queensland and the Gas Field, the per cent changes in December to February extreme wind speeds (top one per cent each summer) between the period 1961 to 2000 and 2010 to 2050[2]. Extreme wind speeds at the Gas Field are expected to increase by between zero and 2 per cent.

Figure 3.2.7[3] shows the average annual number of tropical cyclones in Queensland and the Gas Field. The Gas Field is located within a zone of least probability for the occurrence of a tropical cyclone.

2 Acclimatise (2008) quoting from the CSIRO high resolution DAR125 climate model, K. Hennessy et al, 2004

3 http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/tropical_cyclone.cgi



Legend:

Gas Fields - Petroleum Lease/Petroleum Lease Application

Gas Fields - Authority to Prospect

Source Note:

1:250,000 Topographic Vector copyright Geoscience Australia
Mining Tenement Information copyright State of Queensland (Dept. Mines and Energy)
Percentage Changes in extreme wind speeds derived CSIRO high resolution DAR125 climate model

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40
Kilometres

N

QUEENSLAND CURTIS LNG
A BG Group business

ERM
Environmental Resources Management Australia Pty Ltd

Project	Queensland Curtis LNG Project		
Client	QGC - A BG Group business		
Drawn	Mipela	Volume 3	Figure 3.2.6
Approved	CDP	File No:	QC02-T-MA-00041
Date	10.06.09	Revision	A

Title **Predicted Change in Extreme Wind Speeds**

December-February (top 1% each summer)
between the period 1961-2000 and 2010-2050

Disclaimer:
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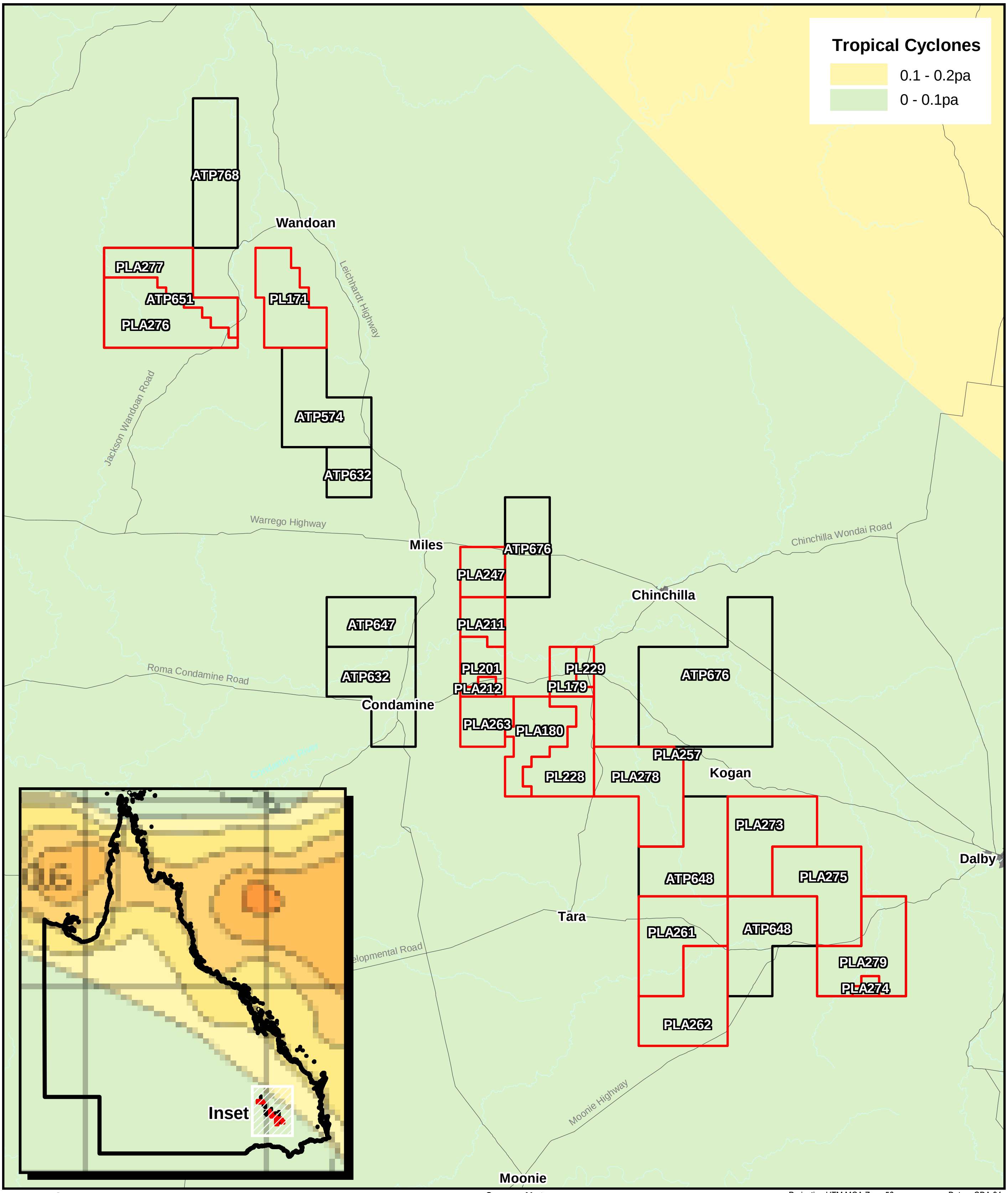

Legend:

Gas Fields - Petroleum Lease/Petroleum Lease Application

Gas Fields - Authority to Prospect

Source Note:

1:250,000 Topographic Vector copyright Geoscience Australia
Mining Tenement Information copyright State of Queensland (Dept. Mines and Energy)
Tropical Cyclone Information based on Bureau of Metereorology 30year study (2 x 2 degree resolution)

Projection UTM MGA Zone 56 — Datum GDA 94

0 10 20 30 40
Kilometres

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QUEENSLAND CURTIS LNG
A BG Group business

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Environmental Resources Management Australia Pty Ltd

Project	Queensland Curtis LNG Project		
Client	QGC - A BG Group business		
Drawn	Mipela	Volume 3	Figure 3.2.7
Approved	CDP	File No: QC02-T-MA-00042	
Date	10.06.09	Revision A	

Title **Average Annual Number of Tropical Cyclones**

2.2.2 *Potential Impacts and Mitigation*

QGC will develop a cooperative approach with government agencies, other industries and community members to understand the impacts of climate change and implement agreed adaptation strategies or innovations. This approach will be based on scientific data, community expectations and government policy.

Expected increases in average temperatures, rainfall and wind speed were assessed in terms on the possibility of Project infrastructure failing. It was determined that the design of infrastructure should cope with the extremes of the existing climate and would be sufficient to cover the relatively minor predicted changes in climate to 2030.

The principal items of infrastructure that need to be designed for potential climate changes are:

- compressors
- ponds
- water treatment facilities.

In addition, the impact of decreasing rainfall in the Surat Basin may impact on revegetation and the success of rehabilitation.

2.2.2.1 *Compressors*

Compressors are anticipated to be designed to function with the following specifications:

- ambient air temperature range of 10°C to 45°C, with 55°C for structures
- relative humidity of 100 per cent
- wind speed of 52 metres per second (187 km per hour (Kph)
- intermittent, but very heavy rain.

Final compressor specification will be determined during detailed engineering design, but will consider potential climate changes. The annual mean maximum daily temperature recorded for the area is 26.7°C and the monthly mean maximum temperature is 32.6°C. An increase in ambient temperature of 1.5°C will be accommodated in the technical design and specification of the Gas Field equipment and will not impact Gas Field components.

The site location is to be treated in accordance with AS1170.2, 2002 (Design Guide for Determining Wind Speed) and will be designed to withstand all wind loads in the appropriate category.

Severe tropical cyclones have wind speeds between 165 and 224 Kph, which is the band of wind speed containing the maximum at which a compressor can function. Severe tropical cyclones are not expected to occur within the Surat Basin.

2.2.2.2 Ponds

Ponds will be designed to cope with a 1:100 annual exceedence probability (AEP) rainfall event, with a 10 per cent increase for climate change. This is within the sensitivity of expected rainfall changes.

2.2.2.3 Water Treatment Facilities

Water treatment facilities will be designed to operate under the existing extremes of climate in the Surat Basin. This will ensure that these facilities will cope with predicted climate change.

2.2.2.4 Revegetation and Rehabilitation

Revegetation strategies will include the selection of drought-tolerant grass species for stabilisation purposes. While the Project is operational, treated Associated Water is available to help establish revegetated areas. However, the long-term success of any rehabilitated area will have to rely on natural systems.

2.2.3 Conclusion

Climate change projections in the lifespan of the Queensland Curtis LNG Project will be minor in the context of the extremes in climate already experienced within the Surat Basin.

Project infrastructure will be designed and constructed to cope with the existing climate and future potential climate change. A summary of the impacts outlined in this chapter is provided in *Table 3.2.3* below.

Table 3.2.3 Summary of Impacts for Climate and Climate Change

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	Likely

Overall assessment of impact significance: negligible.