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TABLES

11. GREENHOUSE GAS EMISSIONS

11.1. CAUSES OF CLIMATE CHANGE

Climate change is defined as a change in the statistical properties of the earth's climate system when considered over long periods of time. The earth naturally absorbs and reflects incoming solar radiation and emits thermal radiation back into space, a portion of which is trapped in the atmosphere by gases known as greenhouse gases (GHG). Changes in concentration of the gases can alter the balance of energy transfer causing global warming. The major GHG gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The Intergovernmental Panel on Climate Change (IPCC) is a scientific intergovernmental body established in 1988 to provide comprehensive scientific assessments of current information about the risk of climate change caused by human activity, the impacts thereof and possible strategies for mitigating the effects. A key finding of their latest report (The Fourth Assessment Report in Climate Change 2007) is that global atmospheric concentrations of GHG have increased greatly as a result of human activities since 1750 causing an increase in global average temperatures since the mid-20th century.

11.2. FEDERAL LEGISLATION AND PROTOCOLS

11.2.1. Kyoto Protocol

The Kyoto Protocol to the United Nations (UN) Framework Convention on Climate Change was ratified by Australia in 2007. Its aim is to limit worldwide GHG emissions by governments setting individual mandatory GHG targets relative to their 1990 emissions. Australia has committed to meet a target of 108 percent (%) of 1990 emissions by 2008-2012.

11.2.2. Climate Change Policy

Australia's climate change policy is managed by the Department of Climate Change and Energy Efficiency (DCCEE) and sets out the government's focus on reducing emissions, encouraging low emission technology, adapting to climate change and responding to climate change within a global context.

11.2.3. Clean Energy Bill 2011 (Carbon Tax)

A key strategy to reduce emissions is to require significant emitters of CO_2 to pay for every tonne (t) of carbon they release into the atmosphere. The carbon tax scheme was introduced on 1 July 2012. On 28 August 2012, the Commonwealth Government announced that Australia and Europe will be linking their emissions trading systems to commence no later than 1 July 2018. Under this arrangement, businesses will be allowed to use carbon units from the Australian emissions trading scheme or the European Union Emissions Trading System for compliance under either system.

11.2.4. National Greenhouse and Energy Reporting Act 2007 (NGER Act)

The *NGER Act* requires Australian corporations to report Scope 1 and Scope 2 (refer to **Table 11-1**) GHG emissions and reductions together with the amount of energy consumed and produced. An NGER guideline is provided to calculate such emissions.

11.2.5. Energy Efficiency Opportunities Act 2006 (EEO Act)

The Australian Government's *EEO Act* encourages large energy-using businesses consuming greater than 0.5 petajoules (PJ) of energy consumption per year to improve their energy efficiency. It does this by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities.

11.3. QUEENSLAND INITIATIVES

To support federal initiatives, Queensland developed the ClimateSmart 2050 climate change strategy in 2007 aiming to reduce greenhouse emissions by 60 % from 2000 levels by 2050. An Office of Climate Change was established in 2007.

11.4. GREENHOUSE INVENTORY

11.4.1. Inventory Boundaries

The organisational boundary is the South Galilee Coal Project (SGCP) and associated infrastructure within Mining Lease Application (MLA) 70453.

The SGCP Terms of Reference (ToR) requires an inventory of projected annual emissions for each relevant GHG, with total emissions expressed in CO_2 equivalent (CO_2-e) terms for the following categories:

- Scope 1 emissions, meaning direct emissions of GHG from sources within the boundary of the facility and as a result of the facility's activities
- Scope 2 emissions, meaning indirect emissions of GHG from the production of electricity, heat or steam that the facility will consume, but that are physically produced by another facility
- loss of carbon sink capacity.

11.4.2. Factors

Factors provided in the DCCEE National Greenhouse Accounts (NGA) Factors (June 2011) workbook were used to calculate the Scope 1 and Scope 2 (GHG) emissions.

Table 11-1 Emission Factors Used to Calculate CO_2-e Emissions

Emission Source	Units	Emission Factor	Source
Scope 1 Emissions			
Fugitive coal seam gas (CH_4)	t CO_2-e/t Run of Mine (ROM)coal	0.017	NGA Factors Table 6/7 (production of coal, fugitive emissions)
Diesel combustion	t CO_2-e/kilolitres (KL)	2.7	NGA Factors Table 3 (fuel combustion for transport)
Explosives – ANFO	t CO_2-e/product	0.17	NGA Workbook
Clearing vegetation	36 t C/hectares (ha) cleared	3.67	NGA Workbook
Scope 2 Emissions			
Electricity purchased	kg CO_2-e/kWh (kilowatt hour)	0.88	NGA Factors Table 5 (purchased electricity)

11.4.3. Estimated Greenhouse Gas Emissions

It is expected that the SGCP construction phase will commence in 2013. The operations phase will commence in 2015, with production ramped-up over five years. Operations are anticipated to continue for 33 years.

The principal sources of Scope 1 GHG emissions will be the consumption of diesel by the mining fleet. CO_2, CH_4 and N_2O are emitted by vehicles consuming diesel. The direct Scope 1 emissions of CO_2 and equivalent emissions from CH_4 and N_2O were calculated using factors provided in the NGA workbook 2011.

- CH_4 otherwise known as coal seam gas (CSG) is released when coal is mined and stockpiled. One tonne of CH_4 has a global warming potential of 21. The NGA workbook provides a factor to calculate the CO_2 equivalent related to CH_4 emissions.
- Typically the long-term average carbon sink capacity for Eucalypt biomass in central Queensland is 0.53 t Carbon (C) Ha-1y-1. It is understood that approximately 500 ha will be cleared initially and for the purpose of this assessment it is conservatively assumed that 500 ha will remain cleared. Thus there is a loss of carbon sink of 265 t C per annum for the duration of the Project. This is multiplied by 3.67 (NGA, 2011) to obtain an annual loss of sink capacity of 970 t CO_2 –e.
- Cleared vegetation will be mulched and not burnt.

The principal sources of Scope 2 GHG emissions will be purchased electricity for draglines, Coal Handling and Preparation Plant (CHPP) and lighting.

Based on these assumptions, the projected annual emissions over the life of the SGCP are contained in **Table 11-2** for Scope 1 emissions and **Table 11-3** for Scope 2 emissions (the numbers in the tables have been rounded to the nearest whole number). The projected emissions for each GHG are provided in

Table 11-4.

Table 11-2 Life of Mine Greenhouse Emissions – Scope 1

Year	Source Data				Greenhouse Gas Emissions (t *10³ CO_{2}-e)			
	Coal ROM	Total Waste (Prime)	ANFO	Diesel	Scope 1			
	Mt	Mt	kt	kL	Coal Seam Gas	Diesel	ANFO	Total
2013	0.0	4.3	0.9	3,515	0	9	0	10
2014	0.0	4.4	0.9	3,715	0	10	0	10
2015	5.6	54.1	10.8	25,949	95	70	2	167
2016	5.7	67.3	13.5	27,441	98	74	2	173
2017	10.4	81.8	16.4	27,782	177	75	3	254
2017	11.9	77.1	15.4	26,862	202	72	3	277
2017	14.2	84.5	16.9	27,084	241	73	3	317
2020	14.0	80.8	16.2	27,713	238	75	3	315
2021	15.4	68.1	13.6	18,817	262	51	2	315
2022	18.0	68.6	13.7	18,893	306	51	2	359
2023	17.2	57.1	11.4	13,666	292	37	2	331
2024	18.6	56.4	11.3	13,310	317	36	2	354
2025	17.6	54.5	10.9	12,121	299	33	2	333
2026	17.6	56.0	11.2	12,820	300	34	2	336
2027	17.9	44.7	8.9	14,278	305	38	1	345
2028	17.5	41.5	8.3	12,527	297	34	1	332
2029	17.5	46.0	9.2	13,224	298	36	2	335
2030	17.8	51.0	10.2	13,891	303	37	2	342
2031	18.6	53.8	10.8	13,712	317	37	2	355
2032	17.7	67.0	13.4	13,182	300	35	2	338
2033	17.8	60.0	12.0	12,477	303	34	2	338
2034	17.2	66.9	13.4	13,534	292	36	2	330

Table 11-2 Life of Mine Greenhouse Emissions – Scope 1 (cont)

Year	Source Data				Greenhouse Gas Emissions (tonnes *10^3 CO_2-e)			
	Coal ROM	Total Waste (Prime)	ANFO	Diesel	Scope 1			
	M tonnes	M tonnes	k tonnes	kL	Coal Seam Gas	Diesel	ANFO	Total
2035	16.6	66.4	13.3	13,043	282	35	2	320
2036	17.0	67.8	13.6	13,753	289	37	2	328
2037	17.4	74.4	14.9	14,171	296	38	2	336
2038	16.6	74.3	14.9	14,151	283	38	2	323
2039	18.0	86.1	17.2	15,679	306	42	3	351
2040	16.8	86.8	17.4	15,677	286	42	3	331
2041	16.9	73.4	14.7	14,286	288	38	2	328
2042	17.4	60.9	12.2	15,407	296	41	2	339
2043	11.2	60.6	12.1	15,036	191	40	2	233
2044	10.5	70.5	14.1	15,514	178	42	2	222
2045	10.4	62.7	12.5	15,250	177	41	2	220
2046	10.9	82.6	16.5	16,436	185	44	3	232
2047	10.9	82.6	16.5	16,436	185	44	3	232
Total Scope 1	**499**	**2,195**	**439**	**561,352**	**8,484**	**1,509**	**72**	**10,061**

Table 11-3 Life of Mine Greenhouse Emissions – Scope 2

Year	Source Data	Greenhouse Gas Emissions (t x 10^3 CO_2-e)	
	Electricity	Scope 2	
	MWh	Queensland Grid	Total
2013	0	0	0
2014	0	0	0
2015	10,815	10	10
2016	38,925	34	34
2017	67,470	59	59
2017	65,436	58	58
2017	67,470	59	59
2020	67,689	60	60
2021	79,741	70	70
2022	79,741	70	70
2023	79,741	70	70
2024	79,961	70	70

Table 11-3 Life of Mine Greenhouse Emissions – Scope 2 (cont)

Year	Source Data	Greenhouse Gas Emissions (t x 10^3 CO_2-e)	
	Electricity	Scope 2	
	MWh	Queensland Grid	Total
2025	79,741	70	70
2026	79,741	70	70
2027	51,116	45	45
2028	51,257	45	45
2029	57,250	50	50
2030	65,429	568	58
2031	71,563	63	63
2032	100,464	88	88
2033	89,965	79	79
2034	100,188	88	88
2035	100,188	88	88
2036	100,464	88	88
2037	112,456	99	99
2038	112,456	99	99
2039	130,858	115	115
2040	131,218	115	115
2041	110,411	97	97
2042	81,786	72	72
2043	81,786	72	72
2044	100,464	88	88
2045	85,875	76	76
2046	122,533	108	108
2047	122,533	108	108
Total Scope 2	**2,776,731**	**2,444**	**2,444**

Table 11-4 Projected Emissions for Each Relevant Greenhouse Gas with GHG Equivalent Components

Year	Emissions (tonnes *1,000)					
	CO_2 Actual	CO_2-e	CH_4[1] Actual	CO_2-e	N_2O[2] Actual	CO_2-e
2013	9.4	9.4	0.0	0.0	0.001	0.2
2014	9.9	9.9	0.0	0.0	0.001	0.2
2015	69.3	69.3	4.5	95.4	0.006	2.0
2016	73.3	73.3	4.6	97.6	0.008	2.5
2017	74.2	74.2	8.4	176.7	0.010	2.9

Table 11-4 Projected Emissions for Each Relevant Greenhouse Gas with GHG Equivalent Components (cont)

Year	Emissions (tonnes *1,000)					
	CO_2 Actual	CO_2-e	CH_4[1] Actual	CO_2-e	N_2O[2] Actual	CO_2-e
2018	71.8	71.8	9.6	202.0	0.009	2.8
2019	72.3	72.3	11.5	241.1	0.010	3.0
2020	74.0	74.0	11.3	238.2	0.009	2.9
2021	50.3	50.3	12.5	262.1	0.008	2.4
2022	50.5	50.5	14.6	305.7	0.008	2.4
2023	36.5	36.5	13.9	292.3	0.006	2.0
2024	35.6	35.6	15.1	316.7	0.006	2.0
2025	32.4	32.4	14.2	299.1	0.006	1.9
2026	34.2	34.2	14.3	299.9	0.006	2.0
2027	38.1	38.1	14.5	304.9	0.005	1.6
2028	33.5	33.5	14.2	297.3	0.005	1.5
2029	35.3	35.3	14.2	297.6	0.005	1.6
2030	37.1	37.1	14.4	303.1	0.006	1.8
2031	36.6	36.6	15.1	316.6	0.006	1.9
2032	35.2	35.2	14.3	300.2	0.008	2.3
2033	33.3	33.3	14.4	302.9	0.007	2.1
2034	36.2	36.2	13.9	291.8	0.008	2.3
2035	34.8	34.8	13.4	282.4	0.007	2.3
2036	36.7	36.7	13.8	288.9	0.008	2.4
2037	37.9	37.9	14.1	295.7	0.008	2.6
2038	37.8	37.8	13.5	282.9	0.008	2.6
2039	41.9	41.9	14.6	306.4	0.010	3.0
2040	41.9	41.9	13.6	286.0	0.010	3.0
2041	38.2	38.2	13.7	287.6	0.008	2.6
2042	41.2	41.2	14.1	295.8	0.007	2.2
2043	40.2	40.2	9.1	190.9	0.007	2.1
2044	41.4	41.4	8.5	177.7	0.008	2.5
2045	40.7	40.7	8.4	177.4	0.007	2.2
2046	43.9	43.9	8.8	185.5	0.009	2.9
2047	43.9	43.9	8.8	185.5	0.009	2.9
Total	**1499.4**	**1499.4**	**404.0**	**8484.3**	**0.250**	**77.7**

1 Methane Global warming potential (SAR 100 year) = 21

2 Nitrous Oxide Global warming potential (SAR 100 year) = 310

Source: IPCC (2005) Table 2.14 page 212

11.5. EMISSION DISCUSSION

Over the life of the mine the SGCP will emit 12,505,000 t of CO_2-e of which 68 % is sourced from CH_4 fugitive emissions.

Coal production peaks in 2024 and 2031 at 8.6 million ROM t and the Scope1 emissions reflect this trend as diesel and fugitive emissions are tied to production. Scope 2 emissions peak in 2039 as the pit deepens and electricity use is at its highest, the emissions then fall as production declines.

Over 35 years operation the average GHG emission is 357,000 t CO_2-e per annum which is 0.065 % of the 2008/09 Australian emission total of 546 Million tonnes (Mt) and 0.23 % of the 2008/09 Queensland emission total of 155 Mt CO_2-e (including land use, land-use change and forestry).

11.6. ABATEMENT MEASURES

The SGCP will initially develop an opencut pit followed by an underground mine. At times the two operations will run concurrently. Thus, over the life of the mine the major energy users will be a dragline and two longwall units together with diesel truck use, conveyors and the CHPP.

The following management measures are proposed to minimise GHG emissions:

11.6.1. Electrical Efficiency

- a dragline is more energy efficient than a truck and shovel operation in removing overburden
- a number of measures to maintain efficiency of the dragline will be implemented including load monitoring, regular bucket maintenance and electrical calibration checks
- longwall efficiency will be monitored
- the compressed air circuit will be regularly monitored as leaks degrade the efficiency of the compressor
- the energy efficiency of electrical equipment will be a consideration during purchase.

11.6.2. Diesel Efficiency

- the fuel efficiency of haul trucks will be a consideration during purchase
- access ramps will be designed to optimise truck diesel use efficiency

- a conveyor will transport coal to the CHPP from the underground operation. Since this infrastructure passes the open pit, there are dump stations to the conveyor to significantly shorten the coal haul route.

11.6.3. Fugitive Emissions

It is difficult to reduce CSG fugitive emissions from the open-pit as it is too shallow to generate sufficient CH_4 to extract and too difficult to collect over the wide area of the pit. CSG will be emitted from underground via the ventilation shafts and will be monitored.

No significant indications of gas have been reported during SGCP exploration activities. Work undertaken on the tenements located immediately north of the SGCP has not identified economically recoverable gas reserves, nor was CH_4 considered to be a likely significant operational management issue. Pre-drainage and flaring CH_4 to reduce emissions is thus not considered viable.

Other direct means of reducing GHG emissions could include such measures as:

- minimising clearing at the site
- utilising the existing Central Line Railway where practicable to transport construction material/equipment
- utilising the Galilee Basin common user rail line to transport supplies/equipment during the operations phase, where practicable
- maximising the use of renewable energy sources
- improved accuracy in GHG measurement by advancing from default factors to direct measurement methodologies.

Other indirect means of reducing GHG emissions could include such measures as:

- carbon sequestration at nearby or remote locations
- progressive rehabilitation of disturbed areas
- planting trees or other vegetation to achieve greater biomass than that cleared for the SGCP
- carbon trading through recognised markets.

The Environmental Management Plan (EM Plan) will address greenhouse abatement including:

- commitments to the abatement of GHG emissions from the development
- commitments to energy management, including undertaking periodic energy audits with a view to progressively improving energy efficiency

- opportunities for offsetting greenhouse emissions, including, if appropriate, carbon sequestration and renewable energy uses
- commitments to monitor, audit and report on greenhouse emissions from all relevant sources and the success of offset measures.

The Proponent is fully committed to sustainable development and complies with its obligations under *NGER* and specifically annual reporting of GHG emissions. The Proponent is committed to reducing the GHG emissions of its operations, accelerating the uptake of energy efficiency, integrating greenhouse issues into business decision making and providing consistent reporting of GHG emission levels.

11.7. CLIMATE CHANGE ADAPTATION

11.7.1. Methodology

The potential climate change risks to the SGCP were assessed in a desktop study. Scenarios developed by the UN IPCC, the Garnaut Review (2008) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) were used to assess the risks.

During the assessment, mitigation methods associated with the potential risks were identified and documented. The risk assessment is consistent with the requirements of the ToR and *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines*.

Identified strategies to adapt to changes in climate will be incorporated into the SGCP **Section 21—Environmental Management Plan** (refer to **Section 21.3.3**). Strategies include cooperating with government, other coal mining companies and other sectors where practicable to adapt to potential changes in climate.

11.7.2. Background

11.7.2.1. United Nations Intergovernmental Panel on Climate Change (IPCC)

A range of GHG emission scenarios were developed in the IPCC Special Report on Emissions Scenarios. These 40 scenarios combine assumptions about demographic, economic and technological factors likely to influence future emissions.

11.7.2.2. The Garnaut Review Predictions

The Garnaut Climate Change Review (2008) predicted the impacts that global GHG emissions will have on Australian climate patterns and the Australian economy. The review identified three global emission scenarios (see **Table 11-5**):

1. No mitigation – emissions increase throughout the 21st century with GHG concentrations reaching 1,565 parts per million (ppm) by 2100.

2. 450 ppm with over shoot – concentrations would overshoot to 530 ppm CO_2-e by mid- century stabilising to 450 ppm CO_2-e by 2100 (Australian emissions would need to be reduced by 25 % by 2020 falling to 90 % by 2050).

3. 550 ppm stabilisation – Emissions would stop rising in 2060 and stabilise around 550 ppm CO_2-e. Australia's share of the burden would be a 10 % reduction by 2020 and an 80 % reduction by 2050 over 2000 levels.

Table 11-5 Global Emission Scenarios

Global Agreement	Australian Target		
	2020	South Galilee t CO_2-e (%) of 2020 Target	2050
No global agreement	405.8 Mt CO_2-e	398,000 (0.098 %)	59.7 Mt CO_2-e
450 ppm stabilisation with overshoot	495.3 Mt CO_2-e	398,000 (0.080 %)	107.4 Mt CO_2-e
550 ppm stabilisation	519.2 Mt CO_2-e	398,000 (0.077 %)	220.8 Mt CO_2-e

Reflecting on the three scenarios above, Garnaut forecast impacts globally and in Australia for various years through to 2100. The discussion below will not consider beyond 2050, three years post the estimated life of mine of the SGCP.

With respect to aspects that may impact a mine in central Queensland:

- temperature – Garnaut predicts an increase in global average temperature of 1.20 °C–1.30 °C over 1990 for the three scenarios at 2030
- precipitation – at 2030 with no mitigation, rainfall will decrease 2.4 % in Queensland from the 1990 level
- cyclones and storms – there is uncertainty in an Australian context
- bushfires – Garnaut estimate that with no mitigation between 2013 and 2034 there will be a 5–65 % increase in number of days with extreme fire weather
- heatwaves – Garnaut predicts that by 2030 there will be an increase (over 1990) of 1.7 days of over 35 °C temperature.

11.7.3. Predicted Impacts

In 2007, CSIRO in association with the Australia Bureau of Meteorology (BOM), assessed and reported on future changes to Australia's climate for the years 2030, 2050 and 2070.

Table 11-6 summarises the potential effects of climate change in Queensland in terms of a number of parameters including temperature and rainfall change. The data is sourced from the CSIRO report and Queensland Government climate change reports. To average the numbers the best estimate results (50th percentile) and the medium emissions scenario from the IPCC Special Report on Emissions Scenarios were used.

Table 11-6 The Projected Impacts (Annual) of Climate Change in Queensland in 2030 and 2050

	2030	2050
Temperature Change (°C)	+1 to +1.5	+1.5 to +2
Rainfall Change (%)	-2 to -5	-5 to -10
Relative Humidity Change (%)	0.5 to -0.5	-0.5 to -1
Wind Speed Change (%)	+2 to +5	+2 to +5
Potential Evapotranspiration Change (%)	+2 to +4	+4 to +8

By 2030 it is projected that temperatures would have increased by 1–1.5 °C with rainfall likely dropping by 2–5 %. The wind speed will have increased by 2–5 %.

By 2050 it is projected that temperatures would have increased by 1.5–2 °C with rainfall likelihood declining by 5–10 %. The wind speed will have increased by 2–5 %, no increase from 2030, similarly in 2050.

It is projected that the number of days/year where the temperature exceeds 35 °C at the coast (Brisbane and Cairns) in 2030 would approximately double while further inland at St George the number of days would increase 35 % to 63 days.

11.7.4. Queensland Government Predictions

In *ClimateQ: Towards a Greener Queensland 2009 and Climate Change in Queensland what the science is telling us* the Queensland Government projects that:

- Queensland regions can expect increased temperatures of between 1.0 °C and 2.2 °C by 2050
- days over 35 °C are projected to range from 2 to 4 times the current rate
- rainfall is expected to change, with a potential decrease by up to 7 % in central Queensland by 2050
- projections indicate that annual potential evaporation could increase 7–15 % by 2070.

In summary, during the operating life of the mine, climate change models predict that it will become hotter, drier and windier in Central Queensland.

11.8. CLIMATE CHANGE RISK ASSESSMENT

The potential risk to the SGCP of the various climate change variables discussed above was assessed using the Likelihood Rating (refer to **Table 11-7**) and the Consequence Rating (refer to **Table 11-9**).

11.8.1. Evaluation

Once the analysis was carried out using the consequence and likelihood ranking the risk assessment matrix (refer to **Table 11-7**) was used to identify the residual risk potential for a number of scenarios. The risk potential will decline once potential controls are introduced leaving a residual risk and a lower potential impact. The risk ranking descriptors are provided in **Table 11-8**.

For further information on SGCP risk identification and management refer to **Section 19—Hazard and Risk**.

These potential incident scenarios, including the potential consequence risk and the likelihood of occurrence were scored in accordance with the Risk Assessment Matrix provided in **Table 11-7** and consequences in **Table 11-9**. **Table 11-10** shows the results of the risk assessment including the overall risk score, control measures and the residual risk.

Table 11-7 SGCP Risk Assessment Matrix

Consequences (see **Table 11-9**) (5 = Catastrophic, 1 = Minor)	**5**	C	B	B	A	A
	4	C	C	B	B	A
	3	D	C	B	B	B
	2	D	D	C	C	B
	1	D	D	C	C	B
		Rare (R)	**Unlikely (U)**	**Possible (P)**	**Likely (L)**	**Almost certain (Ac)**
		Rare - may only occur in exceptional circumstances (once in 100 years)	Unlikely - not likely to occur (once in 10 years or less)	Possible - might occur at some time (once in 5 years or less)	Likely – could probably occur and has occurred (less than once a year)	Almost certain - common/frequent occurrence (once a year or more)
		Likelihood				

From the Risk Assessment Matrix, risks are assigned a risk ranking that is used to determine their priority for management. The risk rankings are provided below (refer to **Table 11-8**).

Table 11-8 Risk Ranking Descriptors

A	Extreme Risks
B	High Risk
C	Moderate Risk
D	Low Risk

Table 11-9 SGCP Consequence Criteria

Consequence Criteria					
Loss Type	**1. Minor**	**2. Significant**	**3. Serious**	**4. Major**	**5. Catastrophic**
Safety	First aid injury, exposure to minor health risk.	Medical treatment injury, Restricted work case, exposure to major health case.	Lost time injury, reversible health impact.	Single fatality, permanent injury/disability, irreversible/ultimately fatal health impact.	Multiple fatalities, ultimately fatal health impact.
Material/Property	Minor damage to plant or system.	Impact on budget and program.	Significant damage to plant or system.	Extensive damage to plant or system.	Virtual complete loss of plant or system.
$ AUS	<$10 K	$10 K-100 K	$100 K-1 M	$1-10 M	>$10 M
Environment	Minor impact- contained on-site and easily reversible- No DEHP notification.	Transient release: Reversible Impact- the DEHP to be notified.	Moderate impact- full off-site release. Difficult to reverse- DEHP action.	Major environmental event. Medium to long-term widespread impact.	Catastrophic event, long-term or permanent widespread impact.
Community/ Reputation	Slight impact/ local public awareness.	Limited impact/ local public concern.	Considerable impact/ regional public concern.	Major or national impact/ national public concern.	International impact/ international public concern.

A number of climate change induced scenarios were assessed and the results of the risk assessment are presented in **Table 11-10**.

Table 11-10 Risk Assessment of Climate Change Induced Scenarios

SGCP Element	Project Risk Elements		Overall Risk	Controls	Residual Risk
	Likelihood	Consequence			
Reduced raw water available due to rainfall declining and evaporation increasing	L	3	High	• a water management strategy, including recycling, will be developed and maintained. The strategy will cater for anticipated changes in rainfall trends • ensure a guaranteed water supply	Moderate
Unsuccessful rehabilitation due to increased temperature decreased rainfall	P	4	High	• suitable species to achieve nominated end-use will be planted • optimal slopes angles will be constructed to minimise erosion landform profile maximising water use • ensure water quality of final voids has no potential for environmental harm • monitor rehabilitation and where deficient reviewed and new strategies implemented	Moderate
Failure/overtopping of Tailings Storage Facility (TSF) due to severe storm events	P	3	High	• decant water management procedure will be developed • TSF built to specifications • TSF inspected annually by a certified engineer	Moderate
Increased closure costs due uncertain climate during life of operation	L	3	High	• carry out annual closure cost reviews • ensure closure costs adequately costed and funded and updated annually	Moderate
Increased dust generation due to increased winds and decreased soil and tailings cap moisture	L	2	Moderate	• water haul roads • manage tailings • cover conveyors • install stockpile sprays • monitor sensitive receptors for dust concentration and fall out. • measures will be reviewed and amended as appropriate if wind speeds increase	Low

Table 11-10 Risk Assessment of Climate Change Induced Scenarios (cont)

SGCP Element	Project Risk Elements		Overall Risk	Controls	Residual Risk
	Likelihood	Consequence			
Health impacts of increased temperature and more days > 35^0 C	L	1	Moderate	• a Health and Safety System will be developed • the infrastructure will be designed for a tropical climate • any increased hot days will be addressed through the management system	Low
Increased soil erosion due to a decrease in soil moisture and increased rain intensity	L	1	Moderate	• available disturbed areas will be progressively rehabilitated • landforms will be designed to minimise erosion	Low
Increased slope failure due to increased erosion, drop in soil moisture and increased flood events	P	2	Moderate	• landforms will be designed to minimise slope failure, increase infiltration and minimise runoff	Low
Increased bushfires affecting infrastructure	U	2	Low	• a Bushfire Management plan will be developed • design infrastructure to protect against fires	Low

11.8.2. Climate Change Adaption

The risk assessment (refer to **Table 11-10**) indicates that pre-implementation of controls that there are no extreme risks and five scenarios that carry high risk. Once the controls are in place it is expected that the residual risks will be lower leaving no high risks. Controls will be included in the sites operating procedures and the SGCP Environmental Management Program (EMP) in this EIS (refer to **Section 21—Environmental Management Plan**).

11.8.3. Conclusion

The Garnaut Review (2008) states "*Effects of future warming on rainfall patterns are difficult to predict because of interactions with complex regional climate systems. Best-estimate projections show considerable drying in southern Australia, with risk of much greater drying. The mainstream Australian science estimates that there may be a 10 % chance of a small increase in average rainfall, accompanied by much higher temperatures and greater variability in weather patterns.*"

The life of the mine is approximately 35 years and the likely changes over this time will be gradual and relatively minor. A reduction in rainfall and an increase in temperatures will result in higher dust emissions. However, the changes are only likely to be small and within the capacity of management to respond within the bounds of current dust control technology. It is expected the risk of a significant increase in emissions is very small.

Management commits to undertake, where practicable, a cooperative approach with government, other industry and sectors to address adaptation to climate change. The Proponent is committed to reducing its GHG emissions.

A GHG assessment was carried out utilising the 2011 NGA workbook and the best available projections for the SGCP. The SGCP will result in GHG emissions as the result of the use of diesel fuel, explosives, clearing and indirectly in the use of electrical power.

CH_4 will be released from the coal seam. The quantities of greenhouse emissions are small and unlikely to have a measureable effect on climate. Nevertheless the Proponent intends to seek new and improved ways to reduce GHG emissions.