TECHNICAL REPORT

Wandoan Coal Project Greenhouse Gas Assessment

Prepared for

Wandoan Joint Venture

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2 December 2008

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Date:	2 December 2008
Reference:	Wandoan Greenhouse Gas Assessment
Status:	Final: Revision 2

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Section 1 Introduction

1.1 Project Description

The Wandoan Coal Project (the Project) comprises the development of thermal coal resources and is located approximately 350 km northwest of Brisbane and 382 km southwest of the Port of Gladstone. The Project exists within the area of three Mine Lease Application Areas (MLAs) owned by The Wandoan Joint Venture.

The coal resources will be developed by an open-cut mine and related local infrastructure. The mine will produce thermal coal for export markets. The Project plans to operate the mine for a 30 year period beginning in 2012. The mine will produce up to 30 million tonnes of run of mine coal per annum.

The inventory and assessment presented in this report is based on the following understanding:

- The Project is defined as the open cut coal mining operations owned by the Wandoan Joint Venture.
- There will be a two-year construction period and a 30 year operational period.
- The Glebe Weir pipeline option is included in the project inventory. For full details, refer to the SunWater Glebe weir raising and pipeline impact assessment report.
- The coal will be crushed, sized and washed to a product coal yield of around 70% before being transported by rail to a port in Gladstone.
- The coal has an energy content of 5,800 GAR (kcal/kg) at 16% moisture.
- The coal will then be exported overseas through a port in Gladstone.

The inventory includes the following within the organisational boundary:

- construction and operation of the mine (scope 1 and 2 emissions);
- power supply options;
- electricity consumption (including operations and accommodation facilities); and

The inventory excludes the following items:

- Diesel used for earthworks in the two year construction period (due to lack of data at the time this report was completed).
- Construction and operation of the proposed airstrip (data not available at the time that the report was completed).
- Development of a possible landfill (data not available at the time the GHG report was prepared).
- Consumption of unleaded fuel (ULP) or liquid petroleum gas (LPG) in site vehicles. Most site vehicles run on diesel fuel, which is included in the inventory. Only small vehicles such

as cars belonging to site personnel will consume unleaded fuel and are typically immaterial in terms of the quantity of greenhouse gas emissions.

- Emissions arising from land use, land use change and forestry such as rehabilitation and clearing of the mine area are excluded on materiality grounds (see definition of materiality in section 3.4.3 below).
- Total GHG emissions relating to employee travel during the construction and operational phases of the mine are excluded on materiality grounds (see definition of materiality in section 3.4.3 below).

1.2 Report Objectives

This report presents an estimated inventory of projected future annual emissions for each GHG and the total emissions expressed as carbon equivalents for both the construction and the operational phase of the project over the life of the mine.

To provide context, the project's GHG emissions are presented as a percentage of Queensland, Australian and global annual greenhouse gas emissions.

This chapter also proposes greenhouse gas reduction measures against the background of the Carbon Pollution Reduction Scheme and lists commitments to the reduction of greenhouse gas emissions as required in section 3.5.2.1 of the Project's Terms of Reference.

Section 2 Greenhouse Gas Policy Background

2.1 International Policy

The Kyoto Protocol to the United Nations Framework Convention on Climate Change was signed in 1997 and entered into force in 2005. While the UNFCCC is predominantly a consensus body the Protocol sets binding targets for reduction of greenhouse gas emissions against 1990 levels for industrialised countries and the European Community over a five year period from 2008 to 2012. Australia has committed to meeting its Kyoto Protocol target of 108% of 1990 emissions by 2008-2012. The UNFCCC will meet in Copenhagen in 2009 and attempt to develop a post-Kyoto (2012) international framework agreement on climate change.

The Kyoto Protocol sets out three “flexibility mechanisms” to allow greenhouse gas targets to be met:

- The Clean Development Mechanism.
- Joint Implementation.
- International Emissions Trading.

The definitions of the three mechanisms above are complex but effectively they allow greenhouse gas reductions to be made at the point where the marginal cost of that reduction is lowest. Essentially, an industrialised country sponsoring a greenhouse gas reduction project in a developing country can claim that reduction towards its Kyoto Protocol target and those greenhouse gas reductions can be traded.

2.2 Australia’s Climate Change Policy

The Commonwealth Government policy on climate change was released in July 2007[1] and sets out the Commonwealth Government’s focus on reducing emissions, encouraging the development of low emissions and emission reduction technology, climate change adaptation, and setting Australia’s policies and response to climate change within a global context. In December 2007, the Australian Government ratified the Kyoto Protocol which essentially states that greenhouse gas emissions not be more than 108% of 1990 levels by the 2008-2012 period. Australia’s climate change policy is managed by the Department of Climate Change. In developing a broader climate change strategy the Government has also drawn on the findings of the Garnaut Review, which considered the potential impacts that climate change will have on Australia’s environment and economy. The review also makes recommendations on a preferred emission reduction trajectory for Australia.

[1] *Australia’s Climate Change Policy*, Department of the Prime Minister and Cabinet, Australian Government, July 2007.

2.2.1 Carbon Pollution Reduction Scheme (CPRS)

A 2007 report of the Prime Ministerial Task Group on Emissions Trading[2] foreshadowed a national emissions trading scheme to help Australia address the global issues of climate change.

In July 2008 the Federal Government released its Green Paper on the Carbon Pollution Reduction Scheme following the draft Garnaut review, which considered the potential impacts that climate change will have on Australia's environment and economy. The following summary of the proposed Carbon Pollution Reduction Scheme is based on the content of the Green Paper.

The scheme will be a "cap-and-trade" scheme, in which total GHG emissions are capped, permits allocated up to the cap, and trading in emissions permits allowed. Liable entities will be required to obtain carbon pollution permits to acquit their GHG emission obligations under the scheme. The CPRS is proposed to commence in July 2010.

The Green Paper proposes that key features of the CPRS will include the following features:

- The CPRS will cover stationary energy, transport, fugitive emissions, industrial processes, waste and forestry sectors, and all six greenhouse gases counted under the Kyoto Protocol from the time the scheme begins.
- A long-term emissions abatement goal of 60% by 2050 (against 2000 levels) will be set.
- Significant emitters (more than 25,000 tonnes CO2 equivalent (or CO2-e)/pa) of greenhouse gases need to acquire a 'carbon pollution permit' for every tonne of greenhouse gas they emit.
- At the end of each year, each liable firm would need to surrender a 'carbon pollution permit' for every tonne of CO2-e emissions produced in that year.
- As the cap of total allowable GHG emissions is decreased, liable entities will compete to purchase the number of 'carbon pollution permits' that they require.
- Assistance may be provided to emissions intensive trade exposed facilities / companies and some power generators.

It should be noted that the details of the CPRS have not been finalised, and are subject to the outcome of the current public submission process. The final scheme design will be released in the White Paper in December 2008.

The relationship between the CPRS and the Project is described in section 8.1 of this report.

2 Department of the Prime Minister and Cabinet, 2007, Report of the Task Group on Emissions Trading, http://www.pmc.gov.au/climate_change/emissionstrading/.

2.2.2 National Greenhouse and Energy Reporting Act 2007 (NGER)

The NGER Act establishes a national framework for Australian corporations to report Scope 1 and Scope 2 (see section 3.3) greenhouse gas emissions, reductions, removals and offsets and energy consumption and production, from July 2008. It is designed to provide robust data as a foundation to the CPRS.

From 1 July 2008, corporations will be required to register and report if:

- They control facilities that emit 25 kilotonnes or more of greenhouse gases (CO2 equivalent), or produce/consume 100 terajoules or more of energy; or
- Their corporate group emits 125 kilotonnes or more greenhouse gases (CO2 equivalent), or produces/consumes 500 terajoules or more of energy.

Lower thresholds for corporate groups will be phased in by 2010-2011. Companies must register by 31st August, and report by 31st October, following the financial year in which they meet a threshold. It is anticipated that Xstrata Coal will report to the NGER program on behalf of the Wandoan Joint Venture.

2.2.3 Energy Efficiency Opportunities (EEO)

The Energy Efficiency Opportunities legislation came into effect in July 2006, and requires large energy users (over 0.5PJ of energy consumption per year) to participate in the program. The objective of this program is to drive ongoing improvements in energy consumption amongst large users, and businesses are required to identify, evaluate and report publicly on cost effective energy savings opportunities.

Energy Efficiency Opportunities legislation is designed to lead to:

- Improved identification and uptake of cost-effective energy efficiency opportunities;
- Improved productivity and reduced greenhouse gas emissions; and
- Greater scrutiny of energy use by large energy consumers.

As a large energy user, Xstrata Coal, majority owner and manager of the Wandoan Joint Venture, is a mandatory participant in EEO. Consequently, the minimum requirements of the scheme need to be met at the Project by considering factors that influence energy use; the accuracy and quality of data and analysis; the skills and perspectives of a wide range of people; decision making and communicating outcomes.

The EEO will be incorporated into the National Framework for Energy Efficiency. Xstrata Coal will report to the EEO program on behalf of the Wandoan Joint Venture.

2.2.4 Greenhouse Challenge Plus

Xstrata Coal is a member of the voluntary Greenhouse Challenge Plus program, which is a commonwealth initiative encouraging participants to annually report their greenhouse gas emissions and make progress towards quantified greenhouse abatement measures.

2.2.5 Wilkins Review

In February 2008, the Rudd Government announced a strategic review of climate change programs in view of the proposed introduction of an Australian emissions trading scheme. One of the aims of the review is to develop principles of complementarity and assess whether programs are efficient, effective, appropriate and complementary to an emissions trading scheme. This is an important review in the context of reducing / streamlining the existing state and federal reporting and regulatory requirements on business especially in relation to greenhouse and energy reporting. The review submitted its report to government in July 2008. To date the report has not been made public and there has been no public government response to the review findings

2.3 State Policy and Initiatives

The Queensland Government created the Office of Climate Change in October 2007 in order to lead an effective climate change response.

2.3.1 ClimateSmart 2050

Climate Smart 2050 is the Queensland Climate Change Strategy. It aims to reduce greenhouse emissions by 60% from 2000 levels by 2050 in line with the national target by building initiatives into the Queensland Government's 2000 Energy Policy.[3] Its initiatives include:

- The introduction of a Smart Energy Savings Program, which targets large energy users and requires them to undertake energy efficiency audits and implement energy savings measures that have a three year or less payback period;
- The Queensland Future Growth Fund for development of clean coal technologies; and
- Changes to the Queensland Gas Scheme which will oblige major industries to source 18% of all power from Queensland based gas-fired generation.

3 Queensland Government, ClimateSmart 2050, Queensland climate change strategy 2007: a low carbon future, June 2007

Section 3 Inventory Methodology

3.1 Accounting and Reporting Principles

The greenhouse gas inventory for the Wandoan Joint Venture project is based on the accounting and reporting principles detailed within the Greenhouse Gas Protocol.[4] The Protocol was first established in 1998 to develop internationally accepted accounting and reporting standards for greenhouse gas emissions from companies. The main principles are as follows:

- Relevance: The inventory must contain the information that both internal and external users need for their decision making.
- Completeness: All relevant emissions sources within the inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is complied.
- Consistency: The consistent application of accounting approaches, inventory boundary and calculation methodologies is essential to producing comparable GHG emissions over time.
- Transparency: Information needs to be archived in a way that enables reviewers and verifiers to attest to its credibility. All parameter, values and methodologies used are accessible and presented within the inventory.
- Accuracy: Data should be sufficiently precise to enable intended users to make decisions with reasonable assurance that the reported information is credible.

3.2 Inventory Organisational Boundaries

The proponent of the Project will be the Wandoan Joint Venture, which includes Xstrata Coal Queensland Pty Ltd (75 percent), ICRA Wandoan Pty Ltd (12.5 percent) and Sumisho Coal Australia Pty Ltd (12.5 percent).

The organisational boundary of the Project inventory includes the construction and operation of the mine, power supply options and related infrastructure detailed in the introduction of section 4 of this report.

The inventory excludes the following activities on the basis that accurate data on fuel usage was not available at the time the Greenhouse Gas Assessment was prepared:

- Diesel used for earthworks during the two year construction period;
- Construction and operation of the proposed airstrip; and
- Development of a possible landfill.

The inventory also excludes a number of emissions on the basis of materiality. See the definition of materiality and outline of these emissions in section 3.4.3 below.

4 World Business Council for Sustainable Development & World Resources Institute (2004), The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.

3.3 Inventory Operational Boundaries

The Coordinator-General's Terms of Reference specify that both direct and indirect emissions from the project should be assessed.

The Greenhouse Gas Protocol further defines direct and indirect emissions through the concept of emission "scopes".

- Scope 1: Direct greenhouse gas emissions. Direct greenhouse gas emissions occur from sources that are owned or controlled by a company. For example:
  - Emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; and
  - Emissions from on-site power generators.
- Scope 2: Electricity indirect greenhouse gas emissions. This accounts for greenhouse gas emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated but they are allocated to the organisation that owns or controls the plant or equipment where the electricity is consumed. Scope 2 emissions also capture the importing of energy (such as chilled water or steam) into a site.
- Scope 3: Other Indirect greenhouse gas emissions. This is an optional reporting class that accounts for all other indirect greenhouse gas emissions resulting from a company's activities, but occurring from sources not owned or controlled by the company. Examples include extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

3.4 Calculation Approach

The greenhouse gas emission inventory for the Project is based on the methodology detailed in the Greenhouse Gas Protocol (the Protocol)[5], and the relevant emission factors in the National Greenhouse Accounts (NGA) Factors[6], the *Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2005 – Energy (Fugitive Emissions)*[7] and the relevant IPCC Good Practice Guidance.[8]

A spreadsheet model has been specifically developed for the Project and uses the data sources and emission factors detailed below in order to calculate project emissions for every year of construction and operation, according to the Protocol using the methodology detailed in the NGA Factors.

There are several greenhouse gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) that are relevant to the Project. In order to simplify inventory accounting, a

5 World Business Council for Sustainable Development & World Resources Institute (2004), The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.

6 Department of Climate Change (2008) National Greenhouse Accounts (NGA) Factors

7 Australian Greenhouse Office (2006), Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2005: Energy (Fugitive Emissions).

8 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

unit called carbon dioxide equivalents (CO_2-e) is used. This accounts for the various greenhouse warming potentials of non-CO_2 gases. The greenhouse warming potential is a measure of the amount of infrared radiation captured by a gas in comparison to an equivalent mass of CO_2, over a fixed lifetime. GHG inventories in this report are expressed as mass of CO_2-e released, following this convention.

3.4.1 Activity Data Sources

Data from the following sources have been utilised in the formation of the inventory:

- Activity data used to assess most Scope 1 emissions was provided in the Wandoan Joint Venture spreadsheet WNDLP3_07 Wandoan Schedule 30Mtpa Base Case V2 and included a two year construction period and a 30 years operational life of the mine. This included:
  - Estimated Run of Mine (ROM) Coal by pit and for the Mine Area as a whole (tonnes) for each year of operation of the mine;
  - Estimated depth to floor of each pit (m) for year of operation of the mine;
  - Estimated fuel consumption for each equipment class ('000 L) for each year of operation of the mine;
  - Estimated product coal by pit and for the Mine Area as a whole (after washing and sizing) for each year of operation of the mine; and
  - Estimated mass of explosives (tonnes) by type.
- Activity data for the three site energy usage options was provided in the document "PB Site maximum demand table"[9].
- Additional activity data used as a base for calculating Scope 3 emissions originates from a number of sources:
  - Transportation of materials associated with the construction of the Coal Handling & Preparation Plant was provided by Sedgman Ltd. The proportion of goods originating from each location and the type of trucks used has been estimated;
  - Estimated journeys by employees and methods of transport used during the construction and operational phases were provided in the Project's Transportation Assessment;
  - The fuel density of distillate fuel oil was sourced from ISO8217:2005 Standard for Marine Fuels;
  - According to the pre-feasibility report, the energy content of the product coal is 5,800 GAR (kcal/kg) at 16% moisture;

9 Parsons Brinkerhoff, 2008. PB maximum demand R8 JS, document prepared by PB describing the Project electricity demand, emailed to URS.

- The rail distance from Wandoan to Gladstone was sourced from the project pre-feasibility report;
- The fuel consumption of soil bulk carriers was sourced from the IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy;
- Required vegetation clearance for the Pipeline options was provided in Volumes 2 and 3 of the Terrestrial Ecology Technical Report; and
- The following were estimated from internet sources: tonnes of coal per train load; distance from Gladstone to a Japanese (Yokohama) and Chilean (Valparaiso) port; the carrying capacity and average speed of Panamax and Capesize category vessels; and the fuel consumption of a Queensland coal train, a semi-trailer and cars.

3.4.2 Emissions Factors

Direct measurement of GHG at the emission source can give the most accurate and precise assessment of GHG emissions. This is typically not feasible at a mine because of the cost involved, the disruption to production involved and the typically large number of trucks and plant equipment involved. Emission factors remove the need for site specific testing of emissions. They are a factor expressed as the amount of GHG emissions per unit of activity, which can be used to determine inventories for a site. This is much more feasible than testing each source individually, and it is one of the few ways that inventories for proposed sites can be calculated.

Emission factors can be identified from various sources, for example, the Department of Climate Change, from site-specific information or from operational details obtained from similar emission sources. The majority of the emission factors used in this report have been sourced from the Department of Climate Change NGA Factors Workbook, January 2008[10] as indicated in Table 3-1 below.

Table 3-1 Emission Factors used in the formation of the Project GHG Inventory

Emission Source	Units	Emission Factor	Source
Scope 1 Emissions			
Fugitive open cut coal mine emissions	kg CO_2-e/t ROM	17.1	NGA Factors, January 2008. Table 6 (Emission factors for the production of coal (fugitive)- Open cut)
Fugitive open cut coal mine emissions (between 0m and 45m below ground level)	kg CO_2-e/t ROM	1.4	GeoGAS report, May 2008

10 It is noted that the NGA Factors were updated in October 2008. However, the Wandoan Project GHG inventory was prepared prior to the release of the update.

Emission Source	Units	Emission Factor	Source
Fugitive open cut coal mine emissions (deeper than 45m below ground level)	kg CO_2-e/t ROM	Increases with depth – see Section 4.1	GeoGAS report, May 2008
Combustion emission factor diesel	t CO_2-e/kL	2.7	NGA Factors, January 2008. Table 3, (fuel combustion for transport) column C
Explosives - ANFO	t CO_2 / t product	0.17	NGA Factors, January 2008. Table 4 (explosive use)
Explosives - Emulsion	t CO_2 / t product	0.17	NGA Factors, January 2008. Table 4 (explosive use)
Consumption of Natural (or CSG) Gas - Queensland	t CO_2-e/GJ	51.3	NGA Factors, January 2008. Table 2 (Consumption of natural gas)
Scope 2 Emissions			
Electricity Consumption (QLD)	kg CO_2-e/kWh	0.91[a]	NGA Factors, January 2008. Table 5, Column A. (Indirect (scope 2) emission factors for consumption of purchased electricity from the grid – for users)
Scope 3 Emissions			
Black coal used for electricity - QLD	kg CO_2-e/GJ	91.1	NGA Factors, January 2008. Table 1 (fuel combustion factors, stationary energy) column B
Transport – diesel	t CO_2-e/kL	0.2	NGA Factors, January 2008. Table 3, (fuel combustion for transport) column E
Fuel Consumption, Bulk Carriers, Solid Bulk	t/day	33.8	Table 3.5.6, solid bulk carriers, Volume 2: Energy IPCC Guidelines for National Greenhouse Gas Inventories
Diesel Energy Content	GJ/kL	38.6	NGA Factors, January 2008. Table 3, (fuel combustion for transport) column A

a) It is assumed that the emission factor for Queensland is comparable to burning coal for electricity at the point of end use.

3.4.3 Materiality

Materiality is a concept used in accounting and auditing to minimise time spent verifying amounts and figures that do not impact a company's accounts or inventory in a material way. The exact materiality threshold that is used in GHG emissions accounting and auditing is subjective and dependant on the context of the site and the features of the inventory. Depending on the context, the materiality threshold can be expressed as a percentage of a company's total inventory, a specific amount of GHG emissions, or a combination of both.

All emissions that are found within the organisational boundary are included in the inventory unless they are excluded on materiality grounds or data was otherwise unavailable at the time of preparing the GHG assessment. Information is considered to be material if, by its inclusion or exclusion it can be seen to influence any decisions or actions taken by users. A material discrepancy is an error (for example, from an oversight, omission or miscalculation) that results in a reported quantity or statement being significantly different to the true value or meaning.

Emissions are generally immaterial for this Project if they are likely to account for less than 5 percent of the overall emissions profile (Scope 1 and 2). This materiality threshold has been chosen on the basis of URS' experience of open-cut coal mine GHG inventories. The exception to this are emissions relating to explosives, which although account for a maximum of only 3% of GHG emissions in any one year, were calculated from accurate explosive use data within the Wandoan Joint Venture spreadsheet WNDLP3_07 Wandoan Schedule 30Mtpa Base Case V2.

The following emissions are not included in the inventory on the basis of materiality:

- Consumption of unleaded fuel (ULP) or Liquid Petroleum Gas (LPG) in site vehicles. Most site vehicles run on diesel fuel, which is included in the inventory. Only small vehicles such as cars belonging to site personnel will consume unleaded fuel and are typically immaterial in terms of GHG emissions.

- Emissions arising from land use, land use change and forestry such as rehabilitation and clearing. According to the Parsons Brinckerhoff Terrestrial Ecology Impact Assessment in Volume 1 of the EIS, the development of the mine will involve clearing 673ha of remnant vegetation and 502ha of non-remnant vegetation, which comprises low density grazing and cropping. Based on this and using the most conservative scenario, which assumes the non-remnant vegetation is 50 years old regrowth, the total loss associated with clearing for the mine is calculated to be 182,693 tonnes CO2-e. This is equal to 1.6 percent of emissions for the calculated life of mine when comparing against the lowest emissions scenario using 100 percent site power production from a gas fired power station.

- Based on the traffic impact assessment provided in Volume 1, Chapter 12 of the EIS and assumptions provided in Volume 1, Chapter 2 of the EIS (Project Justification) in relation to employee transportation, total GHG emissions relating to employee travel during the operational phase of the mine (30 years) are estimated at 1,015 tonnes CO2-e based on employee transport to and from the mine being ground based, by bus. This would increase to 7,227 tonnes CO2-e if employees travelling to/from Brisbane use air transport to a proposed new air strip at Wandoan. This figure is based on a Dash 8 – 400 aircraft and does not include stops at the Gold Coast or Sunshine Coast, which would slightly increase fuel consumption and therefore GHG emissions caused by an increase in the number of landing and take-off cycles (LTOs).

- Total employee travel emissions during the construction period are estimated at 166 tonnes CO2-e assuming all journeys are made in private vehicles.

3.4.4 Aggregation

Aggregation refers to the combining of several inventories, typically of different sites or operations, into an overall inventory. This report is specific to the Wandoan Coal Project and does not contain an aggregated inventory of other projects.

Section 4 Scope 1 and Scope 2 Emissions

The greenhouse gas Scope 1 and Scope 2 emission sources from the Project included in this inventory are:

- Fugitive emissions of Coal Seam Gas (CSG) from the open cut mining of coal (Scope 1);
- Fuel consumption in vehicles (Scope 1);
- Use of explosives (Scope 1);
- Power requirements from onsite diesel generators during the construction phase (Scope 1);
- On-site power generation via coal seam gas power station (Energy Supply Option 1, Scope1);
- Partial on-site generation, balance grid purchased electricity (Energy Supply Option 2, Scope 1 and Scope 2); and
- 100 percent grid purchased electricity (Energy Supply Option 3, Scope 2).

The GHG emissions have been estimated for construction and operation of the Project, which is for 32 years (2 year construction phase plus 30 years operational phase).

Construction and operation of the Glebe Weir raising and pipeline water supply option is reportedly separately in the EIS and is summarised in section 4.5 of this GHG assessment report. Other water supply pipeline options are expected to be significantly less in GHG impacts than the Glebe Option and therefore have not been separately assessed.

4.1 Fugitive Emissions

Fugitive emissions from coal mines relate to Coal Seam Gas (CSG), the majority of which is methane with the remainder being CO_2. The most uncertain component of an open cut mine's GHG inventory is the emissions arising from CSG released during mining operations. Default fugitive CSG factors quote a single emission rate for all Queensland open cut coal mines. Since CSG can contribute up to approximately 50 percent of total greenhouse gas emissions from a mine, it is important that the emission factor be robust and based on in-situ testing of coal seam methane content.

The Project drilled a number of boreholes in the mining lease area and employed GeoGas Pty Ltd to carry out analysis on 86 gas content tests on the coal intervals intersected in six surface drilled and cored boreholes. The sampling covered depth ranges between 15m to 90m below ground level (bgl) and took place between 22nd October 2007 and 17th November 2007.

The concentration of CH_4 in the coal seams at Wandoan was provided in a GeoGas report dated May 2008.[11] GeoGas found that the gas content is relatively static with depth to approximately 50m below ground level and then appears to increase. According to GeoGAS:

[11] GeoGas Pty Ltd, Report on Gas content Testing Boreholes G8000, G80001, G8002, G8003, G8004, G8005 and G8006 MDL221 and MDL222. Xstrata Coal – Wandoan Project. May 2008. GeoGas Report No: 2008-512

- the total gas content between 15m to 45m below ground level is 0.1m3/tonne with a standard deviation of 0.072m3/tonne, and
- the total gas content (m3/tonne) deeper than 45m is equal to
  - (depth × 0.00488) - 0.12577, with a standard deviation of 0.08 m^3/tonne.

The GeoGAS report suggests that:

- between the surface and 40m depth, 20 percent of the gas in coal is CH4, 15% is nitrogen (N2) and 65 percent is CO2; and
- between 40m and 90m depth, 90 percent of the gas is CH4 and 10 percent CO2.

URS has assumed that 100 percent of the gas content released from the coal is methane. This is a conservative approach particularly for coal mined at less than 45m depth, but accounts for uncertainties in the sampling and analysis.

The ideal gas law was used to convert m^3 of CH_4 to kg of CH_4 for inventory calculations. Assuming an ambient pressure of 1atm and temperature of 293K, 0.1m^3 CH_4/tonne ROM is equivalent to 1.4kg (or 0.0014t)/tonne ROM.

The above concentrations are significantly lower than the standard concentrations assumed by published guidance, which are between 0.3m^3/ tonne ROM and 2m^3/tonne ROM.[12] The methodology for the calculation of fugitive emissions assumes that no methane will migrate from un-worked coal seams.

CSG emissions have been estimated for the Project by compiling the annual run of mine coal production and the depth to the floor (depth to the seam) in each pit. The ideal gas law was then used to convert the volume of gas into mass. The global warming potential of 21 for methane[13] has been included in the calculations of CO_2e.

As indicated in the GeoGAS report, the composition of the gas seams are dominant in CO_2 and N_2 in the shallowest samples, but rapidly increase to almost pure CH_4 at 60m bgl. Fugitive CO_2 and N_2 emissions from the seam gas are not included in the inventory and all gas is assumed to be methane.

Using site and seam specific gas concentration data as defined in the GeoGas report, the greenhouse gas emissions from fugitive emissions for each year of the life of the mine vary from 13,975 tCO_2-e to 44,705 tCO_2-e per year, with a mean average of 40,290 tCO_2-e per year. This variability is related to the amount of coal produced and the depth at which it is extracted. Fugitive emissions from coal mining are estimated to contribute between 8 percent and 14 percent of the total GHG emissions from the Project for any one year. This variability is due to increases in CSG emissions as a proportion of the Project's total emissions as deeper coal is extracted.

12 IPCC Guidelines for National Greenhouse Gas Inventories 2006. Volume 2: Energy. Chapter 4: Fugitive Emissions.

13 Table 24: Global Warming Potentials, National Greenhouse Accounts (NGA) Factors, January 2008, Department of Climate Change.

Using the published emissions factors based solely on the annual volume of run of mine coal fugitive Scope 1 emissions would be estimated at an average of 482,000 tCO_2-e per year. This indicates the value of conducting site-specific testing of coal seam content for open cut coal mines.

URS has relied upon the GeoGAS report for this inventory. URS is not in a position to comment on the representativeness of the sampling and measurement program. A specialist company (MBA Petroleum Consultants) has been commissioned to provide an opinion on the original GeoGAS work and their report is attached as an appendix in this EIS. It notes the measurements of in-situ gas content collected to date show consistent trends on both total gas content and methane content.

4.1.1 Spontaneous Combustion of Coal

Some articles[14,15] have suggested that oxidation of coal and carbonaceous wastes, such as uneconomic thin seams disposed of in overburden stockpiles, may be a source of GHG emissions. This is a result of spontaneous combustion of stockpiles, which is a known GHG source. This source has not been considered in the Project inventory because:

- There is no viable accepted methodology, at either an international or Australian level, for estimating GHG emissions from spontaneous combustion;
- There is a very large degree of variability between mines that experience spontaneous combustion and those that do not;
- The Project will implement management techniques according to ACARP guidelines to further minimise the occurrence of spontaneous combustion; and
- Based on coal stockpile assessments conducted to date, the Wandoan coal is unlikely to be prone to spontaneous combustion if appropriate management procedures are adopted.

4.2 Diesel Combustion by vehicles

Diesel is consumed by vehicles and stationary energy sources (for example, generators) at mine sites. The projected consumption of diesel for each major equipment and ancillary equipment, including excavators, loaders, dozers, dump trucks, drills, graders and water trucks for each year of the life of the mine up to year 27 (2038) was provided by in (Wandoan Joint Venture spreadsheet WNDLP3_07 Wandoan Schedule 30Mtpa Base Case V2). Diesel consumption in years 28 to 30 inclusive have been assumed to be equivalent to those of year 27.

The GHG emissions associated with diesel consumption during the period of operation increase from 65,410 tCO2-e to 136,070 tCO_2-e per year, with an average of 111,195 tCO_2-e annually.

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[14] Williams, D; Greenhouse Gas Emissions from Australian Coal Mining, *The Australian Coal Review;* October 1998.

[15] Day, S; Spontaneous Combustion in Open Cut Coal Mines; *Australian Coal Research Program Report C17006*; 10 May 2008

Combustion of unleaded petrol is not included as part of the GHG inventory as the only vehicles that consume unleaded petrol relate to cars owned by site personnel, and based on experience, this is likely to be an immaterial component of the inventory. GHG emissions arising from combustion of unleaded petrol are therefore considered immaterial in relation to the Project.

4.3 Explosives

Explosives are used by coal mines to loosen overburden material and to break apart the coal seam for ease of loading. Greenhouse gas emissions are generated from the use of explosives at the site due to release of nitrous oxide and fuel oil combustion. The two types of explosives to be used on site are ammonium nitrate-fuel oil (ANFO) mixture and emulsion based explosives.

The projected use of explosives for each year of the life of the mine up to year 30 was provided in Wandoan Joint Venture spreadsheet WNDLP3_07 Wandoan Schedule 30Mtpa Base Case V2.

The greenhouse gas emissions from explosives for each year of the life of the mine vary from 2,340 tCO_2-e to 10,000 tCO_2-e per year, with a mean average of 7,440 tCO_2 per year. The contribution of explosive use to Scope 1 and Scope 2 GHG emissions is small and accounts for a maximum of 3% of the GHG emissions for any one year. Although the GHG emission contribution from explosives is small and under the 5 percent materiality threshold, they have been included within the inventory as explosive use has been calculated and included in the Wandoan Joint Venture spreadsheet WNDLP307 Wandoan Schedule 30Mtpa Base Case V2.

4.4 Power Generation or Consumption

Open cut mines consume significant amounts of electricity to power draglines, conveyors, pumps, compressors, motors, haul-road lights and offices. There are three options relevant to GHG assessment for power consumption for the Project.

- Option 1 is 100 percent on-site generation via twelve dual-fuel diesel and gas engine units, each having 8MW of electrical output. Ten engine units will operate at any one time with two units remaining on stand-by. This option would result in greater Scope 1 emissions.
- Option 2 is partial on-site generation via six dual-fuel diesel and gas engine units, each having 8MW of electrical output. Four engine units will operate at any one time with two units remaining on stand-by. The balance of the power demand will be supplied via a grid connection. This combination results in both Scope 1 and Scope 2 emissions. This option can supply surplus energy to the Queensland grid as in Year 1 of operation and demonstrated in Table 4.1.
- Option 3 is 100 percent grid-purchased electricity. This option would result in greater Scope 2 emissions.

Energy consumption for the Project has been provided by Parsons Brinckerhoff and is expressed as an aggregate for the entire site operations by year of operation.

Table 4-1 below provides a comparison of GHG emissions for the three power options for the Project based on operational power consumption by year and throughout the life of the mine.

Table 4-1 Comparison of the three power consumption options

Power Option	Emission Scope	Annual Minimum GHG Emissions (tCO_2-e/yr)	Annual Maximum GHG Emissions (tCO_2-e/yr)	Annual Average GHG Emissions (tCO_2-e/yr)	Life of Mine GHG Emissions (tCO_2-e)
Option 1 (100% on-site generation).	Scope 1	91,736	250,346	225,674	6,770,213
Option 2 (Partial on-site generation, balance grid purchased).	Scope 1	36,694	100,138	90,270	2,708,085
	Scope 2	export to grid(1)	309,021	270,685	8,186,474
Option 3 (100% grid-purchased electricity).	Scope 2	175,165	478,022	430,913	12,927,377

1. In Year 1 of operation in this power consumption option, approximately 36.7 MWh is exported to the Queensland electricity grid due to a surplus of electricity generated on-site.

The table above shows that 100 percent on site generation is the least GHG intensive power option, given the high reliance on gas. Increasing the proportion of grid electricity increases the GHG intensity of the power option, demonstrating the high reliance on coal-fired generation of the Queensland electricity grid.

4.5 Glebe Weir Raising and Pipeline and other Pipeline Options

Volume 4 of the EIS calculates emissions from the construction and operation of the Glebe Weir raising and pipeline. This section summarises the key findings of that chapter and provides a conservative assessment for vegetation clearing for the other pipeline options, which have not been included within the inventory.

4.5.1 Construction

Emissions from construction of the raised weir and pipeline consist of diesel for construction vehicles and from land use change. As raising the weir will lead to permanent inundation of vegetation, which decomposes to release methane. Other chapters in this EIS estimate that approximately 129,778 t CO_2-e may be released over the lifetime of the weir through inundation of vegetation, clearing and release of carbon from soil.

It is not possible to accurately estimate the number of years over which this emission occurs. If it is assumed that this is released linearly over the operational period of the mine, it equates to approximately 4,300 tonnes of CO_2-e per year.

During the four-year construction period:

- Scope 1 emissions are estimated at 12,012 tonnes CO2-e;
- Scope 2 emissions are estimated at 81 tonnes CO2-e; and

- Scope 3 emissions are estimated at 16,295 tonnes CO2-e.

A preliminary and conservative assessment for vegetation clearing for the southern and western CSM pipeline options indicates total GHG emissions of:

- Southern pipeline – 9,544.36 t CO2-e (remnant - 150 years); 4,045.80 t CO2-e (non-remnant - 50 years); and
- Western pipeline – 1,674.49 t CO2-e (remnant – 150 years).

4.5.2 Operation of the Glebe Weir

Operational emissions result from the use of electricity for pumps. Annual operational emissions are expected to be 569 tonnes CO_2-e per year, based on calculations shown in Chapter 10, Volume 4 of the EIS.

4.6 Summary of Scope 1 and Scope 2 Emissions for the Mine

4.6.1 Annual Greenhouse Gas Emissions

Table 4-2 summarises the Project's annual average Scope 1 and Scope 2 GHG emissions and their percentage contribution to the sum of Scope 1 and Scope 2 emissions. This is shown for each power production / consumption scenario.

With 100 percent on-site power generation, gas consumption is the largest individual GHG source, accounting for approximately 58 percent, on average, of the total emissions inventory. This decreases to approximately 17 percent of total emissions for partial on-site generation. Purchased electricity accounts for 52 percent of total GHG emissions for partial on-site generation, and approximately 73 percent of GHG emissions when all power is purchased from the grid.

Table 4-2 Annual Scope 1 and 2 Greenhouse Gas Emissions

Scope	Mine Activity	Annual Average Greenhouse Emissions for mine activities ($t\ CO_2$-e/yr)		
		100% on-site generation	Partial on-site generation	100% grid-purchased electricity
1	Fugitive Emissions	40,291 (10%)	40,291 (8%)	40,291 (7%)
1	Diesel Consumption - trucks	111,195 (29%)	111,195 (29%)	111,195 (19%)

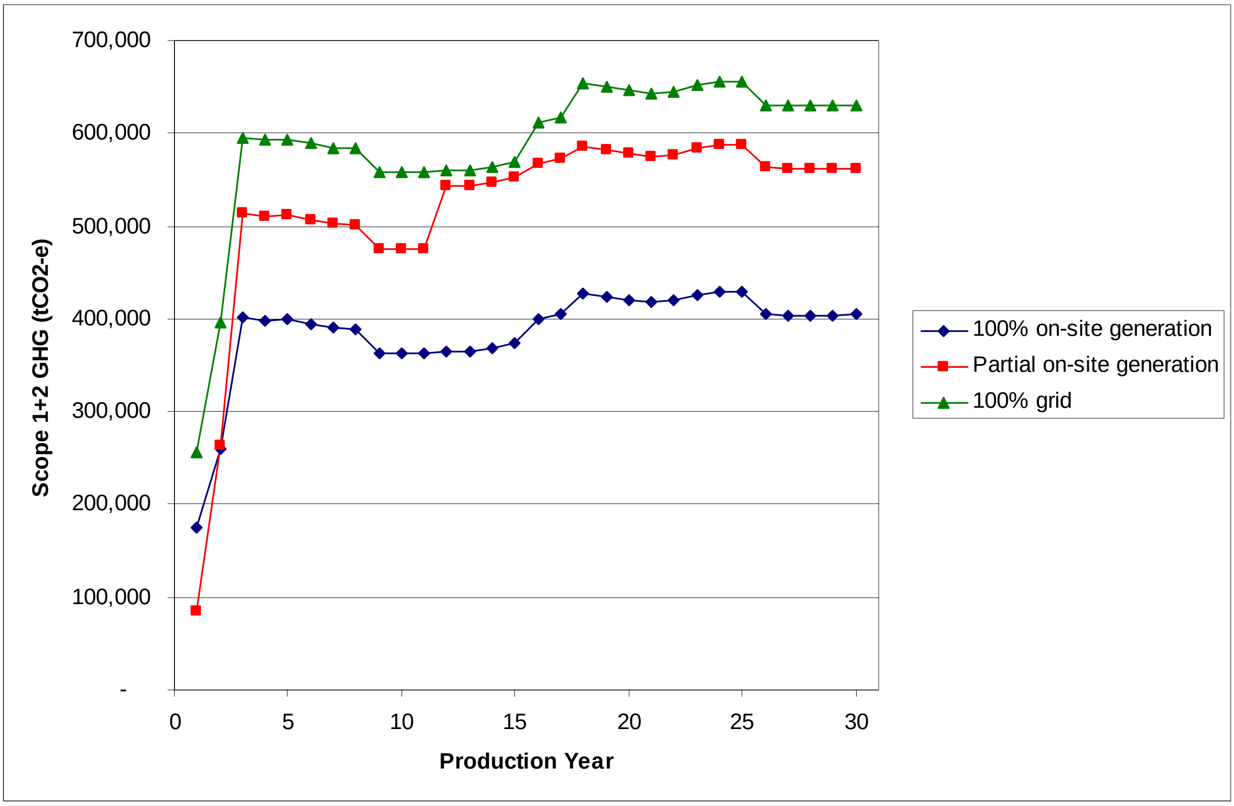
Scope	Mine Activity	Annual Average Greenhouse Emissions for mine activities ($t\ CO_2$-e/yr)		
1	Total Explosives	7,440 (2%)	7,440 (1.4%)	7,440 (1.3%)
1	Diesel Consumption - Power	1,711 (0.4%)	684 (0.1%)	0
1	Gas Consumption - Power	225,674 (58%)	90,270 (17%)	0
2	Purchased electricity	0 (0%)	270,685 (52%)	430,913 (73%)
	Total average annual GHG Emissions	386,310	520,565	589,838

The total average annual Scope 1 and 2 emissions can be compared to the emissions associated with a modern and comparatively efficient 750MW coal fired power station in Queensland emitting 6.0Mt CO2-e per year.[16] The tonnes CO2-e associated with mine activities would be between 6.32 percent and 9.72 percent of that emitted by the power station depending on the power supply option.

Figure 4-1 shows the estimated Scope 1 and 2 GHG emissions for the three different electricity consumption options throughout the life of the mine.

[16] Comparison using published figures for Kogan Creek Power Station. Climate Action Network Australia; National Statement on Coal Power Station Proposals. 2005

Figure 4-1 Sum of Scope 1 and Scope 2 GHG emissions (t CO2-e) for each power option



Analysis of the annual GHG inventory for all Scope 1 and Scope 2 emissions shows the GHG emissions are forecast to sharply increase in Years 1 & 2 in line with production. From Year 3 onwards GHG emissions are forecast to remain approximately steady with small fluctuations and the largest quantities of GHG emissions in Years 23, 24 and 25. These peaks do not correspond with the years of higher run of mine coal production, but are related to higher emissions from diesel consumption which will increase due to the increasing amount of overburden needed to be moved each year as the coal seam progresses downwards. From Year 28 the total GHG emissions will steadily reduce due to the decreasing production of coal.

The mine will be obliged to report under the NGER Act given that emissions for the Project's Scope 1 and 2 emissions will exceed the 25 kilotonne threshold from the first year of operation.

4.6.2 Life of Mine Greenhouse Gas Emissions

The summary of Life of Mine Emissions is based on the assumption that the duration of the mine's life will be 30 years based on existing technology and includes a two year construction period. The life of the mine is a projected duration of the mining project based on the economically feasible extraction of coal. Therefore it is a fundamentally economic variable and subject to change with the coal market, introduction of the CPRS, changes in technology and policy changes such as a global increase in renewable sources of electricity. The following estimates should be considered in this context.

Section 4 Scope 1 and Scope 2 Emissions

Table 4-3 shows the total Scope 1 and Scope 2 emissions over the life of the mine. Over the life of the mine total GHG emissions are estimated to be 11.4 Mt CO_2-e if power is generated by an on-site power station. This would rise by 6.1 Mt CO_2-e to 17.5 Mt CO_2-e if the mine were powered entirely by electricity purchased from the Queensland grid.

Table 4-3 Life of Mine Scope 1 and Scope 2 Greenhouse Gas Emissions

Scope	Mine Activity	Life of Mine Greenhouse Emissions for mine activities (t CO_2-e)		
		100% on-site generation	Partial on-site generation	100% grid-purchased electricity
1	Fugitive Emissions	1,208,728	1,208,728	1,208,728
1	Diesel Consumption - trucks	3,335,844	3,335,844	3,335,844
1	Total Explosives	223,192	223,192	223,192
1	Diesel Consumption - Power	102,290	71,497	50,969
1	Gas Consumption - Power	6,770,213	2,708,085	0
2	Purchased electricity	0	8,186,474	12,927,377
	Total GHG Emissions	11,640,266	15,733,820	17,746,110

The GHG emissions presented are based on current knowledge about the mine operations and GHG emissions from diesel and electricity generation, and may change over the life of the mine due to technology improvements.

Should Energy Usage Option 3 be determined to be the preferred option for the Project, emissions from the Project's purchased electricity will change as the generation mix in the National Electricity Market changes with the introduction of new generation capacity utilising various fuels, the available supply of renewable electricity in the National Energy Market and the amount of inter-state electricity trading. In addition, the CPRS may influence the overall Australian GHG inventory by capping emissions and making carbon emissions a tradable commodity, which will influence the overall composition of the generation grid and therefore, the Project's Scope 2 emissions.

Section 5 Inventory Uncertainty Analysis

5.1 Uncertainty Analysis Background

A measure of the uncertainty within the inventory is a standard part of a GHG inventory as indicated by the GHG Protocol.[17] Uncertainties associated with the GHG inventory are either related to scientific uncertainty or estimation uncertainty. Analysing and quantifying scientific uncertainty is extremely problematic and is beyond the capacity of this inventory. Estimation uncertainty can be classified further into two types: model uncertainty and parameter uncertainty. Model uncertainty refers to the uncertainty associated with mathematical equations. This is also beyond the scope of the Project Inventory.

Parameter uncertainties within this inventory can be divided into two parts: uncertainty relating to activity data and uncertainty relating to emission factors. Activity uncertainties relate to measured quantities, such as production, consumption, monitored data etc. Emission factor uncertainty considers the conversion from measured activities to GHG emissions.

The method used to calculate uncertainty is based on the IPCC guidelines[18], namely the Error Propagation Function analysis. The activity and emission factor uncertainties are defined using qualitative techniques, and then values are assigned to each source on the following basis:

- Low uncertainty: 0 – 5 percent.
- Medium uncertainty: 6 – 20 percent.
- High uncertainty: >21 percent.

The Error Propagation Function analysis is then used to determine the level of uncertainty that each source contributes to the overall uncertainty of the inventory, weighted by the percent of contribution of each source towards the total inventory.

5.2 Inventory Uncertainty Analysis

Table 5-1 shows the results of the uncertainty analysis used to define the uncertainty within annual GHG emissions. Production year 24 for the partial on-site generation option was selected as the base year, as this includes a combination of on-site and grid-purchased electricity, and is the year with the highest Scope 1 and 2 GHG emissions for this power scenario.

[17] World Business Council for Sustainable Development & World Resources Institute (2004), The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.

[18] IPCC, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories Intergovernmental Panel on climate change (IPCC), 2000.

Section 5 Inventory Uncertainty Analysis

Table 5-1 Scope 1 and 2 Emissions Uncertainty for the Project Year 24, partial on-site generation

Scope	Source of Emissions	Contribution to Emissions (%)	Activity Uncertainty (±%)	Emission Factor Uncertainty (±%)	Contribution to Overall Uncertainty (±%)	Absolute Uncertainty tCO_2-e
1	Fugitive Emissions	7%	15%	40%	3%	18,239
1	Diesel Consumption - trucks	21%	15%	10%	4%	22,628
1	Total Explosives	2%	10%	20%	0%	2,063
1	Diesel Consumption - Power	0%	15%	10%	0%	137
1	Gas Consumption - Power	17%	10%	10%	2%	14,162
2	Purchased Electricity	53%	10%	10%	7%	43,702
	Total				**17%**	**100,930**

Given that operations at the mine have not commenced, uncertainties for all activity levels have been estimated by URS on the basis of past experience and are considered to have a low or medium activity uncertainty.

With the exception of fugitive emissions, all emissions factors have been sourced from the National Greenhouse Accounts factors workbook, which are nationally derived emission factors. Therefore, the uncertainty associated with emissions factors is considered to be low. The emission factor for fugitive emissions is considered to be high due to the high standard deviation for the gas content stated in the GeoGAS report. Despite this, there is strong evidence that the overall amount of coal seam gas in the Juandah Coal Measures (Kogan, Macalister Upper & Lower, and Wambo coal seams) is low and significantly lower than default emission factors would suggest.

The analysis based on Year 24 of the mine's operation indicates that the overall uncertainty within the inventory is ±17%, with the majority of the uncertainty contribution due to purchased electricity. The absolute uncertainty expressed as tCO_2-e for this Year 24 of the mine's operation is estimated to be ± 100,930 tCO_2-e.

Section 6 Scope 3 Emissions

6.1 Calculation Approach

Scope 3 emissions are defined in the Greenhouse Gas Protocol as an optional reporting class that accounts for GHG emissions resulting from a company's activities, but occurring from sources not owned or controlled by the company. Examples include extraction and production of purchased materials, transportation of purchased fuels, and employee business travel and commuting.

Scope 3 emissions are not routinely reported by companies because:

- Emissions are difficult to estimate accurately;
- The company does not have effective control of the emissions sources; and
- A company's Scope 3 emissions will be reported elsewhere by a second company as their Scope 1 emissions. As an example, emissions from coal sold to a power station for electricity generation will be reported by the power station as one of their Scope 1 emissions.

The overwhelming majority of Scope 3 emissions from the Project are due to the end use of the coal in electricity generation. Other scope 3 emissions from the Project are:

- Emissions from transport of materials for the construction of the Coal Handling & Preparation Plant;
- Emissions from extraction and processing of diesel consumed by the Project;
- Emissions from the transportation of coal by rail from the mine to a port in Gladstone;
- Emissions from handling at a port in Gladstone;
- Emissions from the transportation of coal by ship from Gladstone to end ports in Asia and South America;
- Emissions from handling at an overseas port;
- Emissions from the transportation of coal from end ports to clients' facilities; and
- Emissions associated with waste to landfill.

Published emission factors have been used in calculating the Scope 3 emissions.

Due to limitations in data availability, Scope 3 emissions for the following sources have not been included in the inventory:

- Coal handling at a port in Gladstone;
- Handling at overseas ports,
- Transportation of coal from end ports to clients' facilities; and

- Waste to landfill.

These emission sources are not expected to be material.

6.2 Scope 3 Emissions

Scope 3 emissions associated with the project are summarised in Table 6-1 below.

Table 6-1 Annual Scope 3 Greenhouse Gas Emissions during the operational phase of the mine.

Activity	Annual GHG Emissions Scope 3 (tCO_2-e/yr)			
	Minimum GHG Emissions	Maximum GHG Emissions	Average GHG Emissions	Average Contribution (%)
Transport to port by rail	18,886	71,208	63,607	0.1
Shipping	77,661	292,822	261,565	0.6
End-Use for electricity production	12,976,921	48,929,828	43,706,866	99.3

6.2.1 End-Use

The emissions associated with the end-use of the coal in electricity production were calculated on the basis of the energy content of the coal of 5,800 GAR (kcal/kg) at 16% moisture.

The impact of the eventual end-use of the coal in electricity production is much greater than the greenhouse gas emissions due to mining and transportation and contributes to over 99% Scope 3 emissions. Not all known Scope 3 emissions are included in this inventory, however, end use emissions are expected to be the overwhelming majority of all Scope 3 emissions.

6.2.2 Transportation

Product coal will be loaded onto trains at the site and sent by rail to a port in Gladstone. Diesel locomotives will be used to transport the coal to Gladstone. Fuel consumption figures for laden and unladen trains were taken from the Surat Basin Rail EIS, which covers the derivation of these figures in detail.

In calculating the GHG emissions associated with shipping, the inventory assumes 80% will be exported to an Asian port (Yokohama, Japan) and 20% will be exported to a South American port (Valparaiso, Chile). Approximately 50% of the coal will be shipped via Panamax sized vessels and 50% will be shipped by Capesize vessels. The consumption of fuel oil of solid bulk carriers is assumed to be 33.8 tonnes per day for both Panamax sized vessels and Capesize vessels. This figure is taken from the 2006 IPCC guidance on calculating emissions associated with water-borne navigation. The average carrying capacity of Panamax and Capesize vessels was assumed to be 75,000 and 165,000 tonnes of product coal, respectively.

A small proportion of the Project emissions, expected to be 223 tonnes CO2-e are associated with transport of materials for the construction of the Coal Handling & Preparation Plant. This is not considered to be material to the Project inventory and has not been included in the summary table.

A small proportion of project emissions will be associated with ULP and diesel consumption from workforce vehicles travelling to and from the site and air travel for employees. The emissions associated with workforce travel have not been assessed, but will be minor in context of Scope 3 emissions.

6.3 Life of Mine Full Fuel Cycle Emissions

Table 6-2 summarises the Project's annual full fuel cycle GHG emissions and provides the average and range of annual GHG emissions from each source. The full fuel cycle GHG emissions have been calculated by addition of the Scope 1, 2 and 3 emissions.

Table 6-2 Annual Full Fuel Cycle Greenhouse Gas Emissions

	Minimum GHG Emissions (tCO_2-e)	Maximum GHG Emissions (tCO_2-e)	Average GHG Emissions (tCO_2-e)	Life of Mine GHG Emissions (tCO_2-e)
100% on-site generation	20,616*	49,687,920	41,643,794	1,332,550,452
Partial on site generation	50,104*	49,800,636	41,771,718	1,336,578,092
100% grid-purchased	20,616*	49,882,434	41,834,602	1,338,656,297

* Annual minimum GHG emissions relate to the construction period.

The overwhelming majority of full fuel cycle emissions from the Project are associated with emissions from end-use for electricity production. The average proportion of emissions associated with end-use is approximately 99% and remains approximately constant throughout the life of the mine. Scope 1 and 2 emissions contribute between 0.9% and 1.3% over the operational life of the mine, depending on the power option.

Section 7 Emissions Comparison

7.1 Australian Emissions

The National Greenhouse Gas Inventory (Department of Climate Change, 2008) is the latest available national account of Australia's GHG emissions. The National Greenhouse Gas Inventory has been prepared in accordance with the Revised 1996 and 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The IPCC guidance defines six sectors for reporting greenhouse gas emissions:

1) Energy (including coal mining);
2) Industrial Processes;
3) Solvent and Other Product Use;
4) Agriculture;
5) Land Use, Land Use Change and Forestry; and
6) Waste.

Australia's net greenhouse gas emissions across all sectors totalled 576 MtCO_2-e in 2006, with the energy sector being the largest emitter at 400.9 Mt CO_2-e. Emissions from coal-mining sources are captured under the energy category of the IPCC methodology. Approximately 34.5 Mt of energy sector emissions were attributable to fugitive emissions, representing 6.0% of national emissions.

Table 7-1 shows total annual Scope 1 and 2 emissions at different stages of the life of the mine as a percentage of Australian total and energy sector emissions taken from the National Greenhouse Gas Inventory 2006. This assumes worst case GHG performance from the Project, which occurs when 100 percent of its electricity is purchased from the grid.

Table 7-1 Comparison of Australian and Project GHG emissions, assuming 100% grid-purchased electricity

Year of Operation	Proportion of Australian Energy Sector Total (%)	Proportion of Australian Total (%)
1 (minimum GHG emissions)	0.06	0.04
24 (peak GHG emissions)	0.16	0.11
7 (approximate average GHG emissions)	0.15	0.1

7.2 Queensland Emissions

Table 7-2 shows total annual Scope 1 and 2 emissions at different stages of the life of the mine as a percentage of Queensland total and Queensland energy sector emissions taken from the National Greenhouse Gas Inventory 2006. This also assumes worst case GHG performance from the project, which occurs when 100 percent of power consumption is electricity purchased from the grid.

Queensland total emissions were 170.9 Mt CO_2-e according to the National Greenhouse Inventory 2006.

Table 7-2 Comparison of Queensland and Project GHG emissions

Year of Operation	Percent of Queensland Energy Sector	Percent of Queensland Total
1 (minimum GHG emissions)	0.27	0.15
24 (peak GHG emissions)	0.68	0.38
7 (average GHG emissions)	0.61	0.34

When viewed in an Australian or Queensland context the Scope 1 and 2 emissions from the Project are not considered materially relevant given the project emissions are 0.68% of the Queensland energy sector at peak annual emissions (Year 24).

7.2.1 Impact of the Project on Queensland Emissions Targets

The Queensland government has proposed to reduce greenhouse gas emissions by 60% by 2050 based on 2000 levels in line with the national target.[19] This equates to a reduction of approximately 98 MtCO_2-e.

In the years of peak greenhouse gas emissions, Scope 1 and 2 emissions from the mine will be 0.66 MtCO_2-e if 100% of the mine's power is purchased from the grid. The Scope 1 and 2 emissions in peak years will be equal to 0.38% of the State inventory. Project emissions are therefore unlikely to have a significant impact on Queensland government emissions targets.

7.3 Comparison with World Emissions

According to the United Nations Framework Convention on Climate Change (UNFCCC), aggregate emissions from Annex I countries in 2005, including the contribution from land use, land use change and forestry (LULUCF) was 16,738 Mt CO_2-e.[20] Emissions from non-Annex I countries including LULUCF was 11,931 Mt CO_2-e in 1994[21], the most recent year for which data from non-Annex I countries is available.

Using these two figures, annual global GHG emissions from reporting countries can be estimated as 28,670 Mt CO_2-e. The Project's maximum annual full fuel cycle emissions (including scope 1,2 & 3) are approximately 49.9 Mt CO_2-e and they occur in Year 6 of operation (based on the production schedule as provided in the Wandoan Joint Venture spreadsheet WNDLP3 07 Wandoan Schedule 30Mtpa Base case V2). On a full-fuel cycle basis (that is, the sum of scopes 1, 2 and 3), this represents 0.17% of annual global emissions compared with data from reporting countries only.

[19] Queensland Government. ClimateSmart 2050. Queensland climate change strategy 2007: a low carbon future. June 2007

[20] UNFCCC, National Inventory Greenhouse Data for the period 2000-2005, United Nations, 2007

[21] UNFCCC, Sixth compilation and synthesis of initial national communications from Parties not included in Annex I to the Convention, United Nations, 2005

Section 8 Greenhouse Gas Reduction Measures

8.1 Carbon Pollution Reduction Scheme

The details of the proposed Carbon Pollution Reduction Scheme (CPRS) are explained in Section 2.2.1 above. The scheme requires significant emitters, defined as those emitting more than 25,000 tCO_2-e per year as scope 1 emissions, to acquire permits for every tonne of greenhouse gas emitted. Those emitting more than 25,000 tCO_2-e per year of Scope 1 emissions need to acquire a 'carbon pollution permit' for every tonne of greenhouse gas they emit.

At the end of each year, each liable firm would need to surrender a 'carbon pollution permit' for every tonne of emissions produced in that year. Firms will compete to purchase the number of 'carbon pollution permits' that they require to meet their annual liability. There is therefore a financial incentive to reduce GHG emissions as this will reduce the size of the financial liability the Project will be potentially exposed to.

The Project will be affected as its total Scope 1 emissions are well above the 25,000 tCO_2-e threshold, and therefore will need to participate in the scheme.

The Commonwealth Government has indicated in its Green Paper into the CPRS that approximately 30 per cent of carbon pollution permits may be allocated to emissions-intensive trade-exposed industries. The initial assistance level will depend on the emissions intensity per million dollars of revenue:

- An emissions intensity above 2,000 t CO_2-e/$ million revenue would have the initial assistance level set at around 90 per cent of industry average emissions per unit of output; and
- Emissions intensities between about 1,500 tCO_2-e/$ and 2,000 tCO_2-e/$ million revenue would have the initial assistance level set at around 60 per cent.

According to data published in the Green Paper, the black coal industry emits 1,722 t CO_2-e/$ million revenue and would appear to be a candidate for assistance if the coal from the project is exported – and the greenhouse gas assessment presented in this EIS assumes that 100% of the coal from the Project is exported. However, the Green Paper makes clear that the exact definition of emissions-intensive trade-exposed industries will be developed during the consultation phase of the Carbon Pollution Reduction Scheme. Further advice from the Wandoan Joint Venture suggests that the project is highly unlikely to be classed as an emissions-intensive trade-exposed industry.

Regardless of whether the project is granted assistance or not, it will be affected by the CPRS. It will need to purchase and surrender permits for its Scope 1 emissions. The exact effects of the CPRS on the Project are not yet quantified.

8.2 Electrical Efficiency

The project will be a significant consumer of electricity, primarily through dragline usage, coal handling and preparation plant. It is normal operating procedure to maximise electrical efficiency at an open cut coal mine due to the business requirements to minimise costs. The following activities are normally undertaken by mining companies to maximise electrical efficiency and the Project will similarly undertake these measures, which are typical of best practice management at open cut coal mines. The Project will implement the following practices:

- Conduct regular monitoring of electrical load on the draglines and investigate whenever the load falls outside optimal parameters.
- Implement a regular program of bucket inspection and repair. Poorly maintained dragline buckets reduce the efficiency of each dragline load, increasing electricity required to move a tonne of overburden.
- Minimise the distance the dragline needs to “swing” the bucket load from its source to the dumping location.
- Undertaking regular electrical calibration checks on the draglines as per the manufacturers instructions.
- Use high efficiency electrical motors throughout the mine site.
- Use variable speed drive pumps with high-efficiency linings at the coal handling and preparation plant.
- Conduct regular monitoring of the compressed air circuit so that leaks are repaired in a timely manner, as this maximises the operating efficiency of the compressor.
- Install light-sensitive switches on haul road lights so that they do not operate during the day.

Chapter 6.10 describes sustainability measures to be adopted by the project in terms of electrical and diesel efficiency.

8.3 Diesel Efficiency

Diesel consumption by on-site vehicles is a major business cost and source of greenhouse gas emissions and it is normal business practice at open cut coal mines to minimise its use. The following activities are normally undertaken by mining companies to minimise diesel consumption and the Project will similarly undertake these measures, which are typical of best practice management at open cut coal mines. The Project will implement the following practices:

- Haul truck scheduling, routing and idling times will be optimised through the use of sophisticated satellite tracking software designed to minimise the amount of diesel consumed.
- Pit access ramps will be designed to limit the amount of effort required for fully-laden trucks to climb.
- Haul roads will be compacted to reduce rolling resistance.
- The location of ROM and overburden dumps will be optimised to limit the amount of distance haul trucks need to cover while fully laden.

8.4 Fugitive emissions

There is little that can be done to minimise fugitive emissions from open-cut coal mines for the following reasons:

- The open-cut coal is usually at insufficient depth to generate the required pressure for efficient CSG extraction;
- The large geographical area covered by open cut pits makes extraction of CSG and collection to a single point not possible; and
- Open-cut pits have lower amounts of methane per tonne of coal due to the natural escape of methane from shallow coal seams.

The National Greenhouse Account gives emission factors for fugitive coal seam gas emissions from Queensland mines, which can be used to estimate emissions in the absence of any on-site measurements of coal seam gas. The default emission factor is 17.1 kg CO_2-e per tonne of ROM coal mined.

The Project has conducted a drilling program to directly measure on-site coal seam gas contents across proposed seams and pits. This program identified the coal seam gas content to be significantly lower than the default factor. As described in Section 4.1 above:

- The total gas content between 15m to 45m below ground level is 0.1m^3/tonne with a standard deviation of 0.072m^3/tonne, and
- The total gas content (m^3/tonne) deeper than 45m is equal to
  - (depth × 0.00488) - 0.12577, with a standard deviation of 0.08 m^3/tonne.

The above equations state total gas content. The GeoGAS report suggests that:

- Between the surface and 40m depth, 20 percent of the gas in coal is CH_4, 15 percent is nitrogen (N_2) and 65 percent is CO_2.
- Between 40 and 90m depth, 90 percent of the gas is CH_4 and 10 percent CO_2.

8.5 Land Clearance

It is understood that the Wandoan Joint Venture proposes to develop and implement a Biodiversity Offset Strategy, which is proposed to include protection for an equal or greater area of similar vegetation as will be lost through the Project, It is understood that the draft strategy proposes a target ratio of up to 3:1 in terms of the vegetation protected in offsets compared with that disturbed by the Project's mining operations.

The draft Biodiversity Offset Strategy does not specifically cover offsets for greenhouse gas emissions as these emissions will be covered by the CPRS. However, the draft strategy does assist in minimising GHG emissions associated with land clearance, as it proposes to actively increase the habitat value of the offset areas through planting, which will increase biomass and in turn the carbon sequestration potential of the forest sink. It is also understood that the Wandoan Joint Venture will rehabilitate some mining areas for nature conservation which will provide further carbon sequestration. Full details on the draft Biodiversity Strategy are provided in Chapter 17A of the EIS.

8.6 Industry and Wandoan Joint Venture (Xstrata Coal) Policy

The coal industry and Xstrata Coal have the following research programs and initiatives that are relevant to the greenhouse gas policy mix and has committed around $250 million in financial support to low emissions technology projects...

- The Australian Coal Association Research Program (ACARP), funded via an industry levy supports projects in the following areas:
  - Greenhouse Gas Mitigation;
  - Safety & Occupational Health;
  - Environment & Rehabilitation of Mined Land;
  - Community Concerns & Land Access;
  - Cost of Production;
  - Technical Support for Marketing Australian Coals; and
  - Sustainable Use of Coal.
- Wandoan Joint Venture through Xstrata Coal is a significant contributor into the $1 billion COAL21 Fund, which financially supports the research, development and deployment of low emission power generation technologies in Australia.
- Wandoan Joint Venture through Xstrata Coal is a partner in the Oxyfuel Project lead by CS Energy, together with other industry participants. The aim of the Oxyfuel Project is to test the feasibility of a clean coal technology to capture carbon dioxide from CS Energy's Callide A power station in central Queensland and store it underground. This project was awarded funding from the Federal Government's Low Emissions Technology Development Fund (LETDF). If this project demonstrates viability, Australia's first near-zero emission coal-fired power station could be operating within five years. Further, significant opportunities may exist from the retrofitting of this technology to existing coal-fired power stations with the potential for significant cut in GHG emissions from the power generation sector.
- Australian Coal Mine Methane Reduction Programme - The Australian Coal Mine Methane Reduction Programme aims to reduce greenhouse gas emissions from coal mining activities. This is a grant programme designed to reduce fugitive emission from coal mines in the Kyoto commitment period of 2008 – 2012, through activities that would not be undertaken by the industry in the normal course of business and is relevant to black coal mines in Queensland.
- Xstrata Coal is working with the CO2CRC on the CO2 storage demonstration project in Otway, Victoria.
- Xstrata Coal has committed $US25 million to the Future Gen Project in the USA.
- As announced on 26 November 2008, Xstrata Coal has become a foundation member of the Global Carbon Capture and Storage Institute (GCCSI). The GCCSI, announced in

September by Prime Minister Kevin Rudd, aims to accelerate the commercial deployment of carbon capture and storage technologies.

Section 9 Climate Change Impact Assessment

Recent reports suggest that the mine area is likely to be subject to climate change during the life span of the mine. Climate change therefore has the potential to affect operations at the mine. This section provides an assessment of the Project's vulnerabilities to climate change and describes the adaption strategies to be undertaken by the Project as per section 3.5.2.2 of the Wandoan Project Terms of Reference (Climate Change Adaption).

9.1 Summary of Predicted Impacts

The following tables summarise the likely effects of climate change in the vicinity of the mine area, in terms of temperature change, rainfall change, relative humidity, sea surface temperature, wind speed and potential evapotranspiration. The data is sourced from Climate Change in Australia technical report[22] and Climate Change in Queensland technical report.[23] Projections are relative to the period 1980 – 1999 (referred to as the 1990 baseline for convenience). To provide the most accurate result possible, the best estimate results (50th percentile) and the medium emissions scenario from the IPCC Special Report on Emissions Scenarios were used.

Table 9-1 The impacts of Climate Change in Queensland in 2030 and 2050

	Temperature Change (ºC)		Rainfall Change (%)		Change in Relative Humidity (%)	
	2030	2050	2030	2050	2030	2050
Annual	+1 to +1.5	+1.5 to +2	-2 to -5	-5 to -10	0.5 to -0.5	-0.5 to -1
Summer	+1 to +1.5	+1.5 to +2	2 to -2	-2 to -5	0.5 to -0.5	0.5 to -0.5
Autumn	+1 to +1.5	+1.5 to +2	-2 to -5	-5 to -10	0.5 to -0.5	0.5 to -0.5
Winter	+0.6 to +1	+1.5 to +2	-5 to -10	-5 to -10	0.5 to -0.5	-0.5 to -1
Spring	+1 to +1.5	+1.5 to +2	-5 to -10	-10 to -20	-0.5 to -1	-0.5 to -1

	Wind Speed Change (%)		Change in Potential Evapotranspiration (%)		Sea Surface Temperature Change (ºC)	
Annual	+2 to +5	+2 to +5	+2 to +4	+4 to +8	+0.6 to +1	+1 to +1.5
Summer	+2 to +5	+2 to +5	+2 to +4	+4 to +8		
Autumn	2 to -2	2 to -2	+2 to +4	+4 to +8		
Winter	2 to -2	2 to -2	+4 to +8	+4 to +8		
Spring	+5 to +10	+5 to +10	+2 to +4	+4 to +8		

[22] Climate Change in Australia, Technical Report 2007. CSIRO, 2007
[23] Office of Climate Change. Climate Change in Queensland: What the science is telling us. June 2008

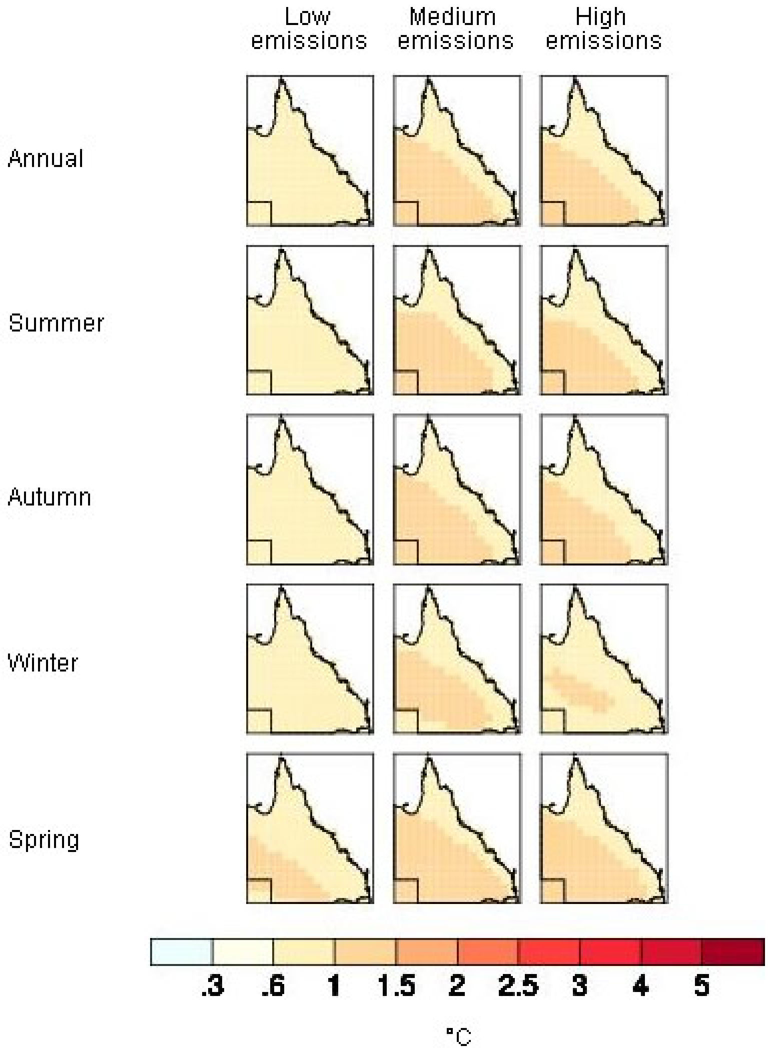


Figure 9-1 Projection in temperature change for Queensland under the low, medium and high GHG emissions scenario

It can be seen that by 2030 the average annual temperature is expected to increase by between 1ºC and 1.5 ºC. There is likely to be a corresponding decrease in rainfall of between 2 percent and 5 percent and wind speed is expected to increase by between 2 percent and 5 percent.

The changes in temperature are expected to be less pronounced in winter. Changes in rainfall are expected to be more pronounced in winter and spring with a reduction expected in the range of 5 percent to 10 percent. It is noted that a reduction in rainfall can sometimes lead to a much greater reduction in water availability.

By 2050 average annual temperature is expected to increase by between 1.5ºC and 2 ºC. There is likely to be a corresponding decrease in rainfall of between 5 percent and 10 percent, relative humidity is expected to decrease by up to 1% and wind speed is expected to increase by between 2 percent and 5 percent.

The changes in temperature are expected to be experienced equally throughout the year. Changes in rainfall are expected to be more pronounced in spring with a reduction of to 20 percent. Wind speed increases are expected to be more pronounced in spring and summer with summer wind speeds expected to increase by up to 10 percent.

In summary, during the operating life of the mine it is expected that the local conditions will become hotter, drier and windier. Changes in rainfall and wind speed are expected to be more pronounced in the spring.

The Climate Change in Queensland report notes that a significant proportion of Queensland's agricultural, industrial and mining activity is located in central Queensland and these industries are highly dependant on water resources.

9.2 Risk Assessment

9.2.1 Methodology

The following semi-quantitative risk assessment procedure was used to evaluate the risks as a result of the various potential climate change impacts on mining operations. This approach is consistent with the Australian Standard for Risk Management AS/NZS4360:2004. The key steps in undertaking the risk assessment involved:

- Identification of the potential climatic impacts on mining operation;
- Analysis of the risks in terms of consequence and likelihood; and
- Evaluate risks, including risk ranking to identify priorities for their management.

To assist in the process of assigning levels of consequence and likelihood, the following measures were used.

Measures of Likelihood		
Level	Descriptor	Description
E	Rare	Occurs only in exceptional circumstances
D	Unlikely	Could occur but not expected
C	Possible	Could occur
B	Likely	Will probably occur in most circumstances
A	Almost Certain	Is expected to occur in most circumstances

Measures of Consequence				
Level	Descriptor	Environmental Impact	Mine Site Functionality	Financial (per event/per year)
1	Insignificant	Env consequence weeks	No loss of use	<$50,000
2	Minor	Env consequence <12 months	Short terms loss of use (all/part) <1 week	$50,000 to $500,000
3	Moderate	Env consequence 1-2 years	Loss of use (all/part) 1 wk to 1 month	$500,000 to $1 million
4	Major	Env consequence 2-5 years	Loss of use (all/part) 1 month to 1 year	$1 million to $10 million
5	Catastrophic	Env consequence >5 years	Loss of use (all/part) > 1 year	<$10 million

The following risk assessment matrix was used to determine the level of risk based on likelihood and consequence scores. Scenarios with a combined score of 10 or greater are considered to pose a high level of risk. Scenarios with a combined score of between five and eight are considered to pose a medium level of risk. Scenarios with a combined score of less than five are considered to pose a low level of risk.

Risk Matrix					
Likelihood	Consequence				
	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
A (Almost Certain)	5	10	15	20	25
B (Likely)	4	8	12	16	20
C (Possible)	3	6	9	12	15
D(Unlikely)	2	4	6	8	10
E (Rare)	1	2	3	4	5

9.2.2 Results

The risks scenarios were identified on the basis of the URS' experience of mining operations, together with consultation with URS mining specialists. The results of the risk assessment are presented in Table 9-2 below.

Table 9-2 Risk Assessment of the potential impacts of climate change on mine operations

Risk Scenario	Likelihood	Severity	Risk Score
Reduced process water availability due to decreased rainfall and increased evapotranspiration.	Likely B	Moderate 3	High 12
Decrease in soil moisture, increased winds and reduced availability of water which increases generation of dust and reduces ability to manage dust.	Likely B	Moderate 3	High 12
Increased flood risk due to increased rainfall intensity (including pit area).	Possible C	Major 4	High 12
Health impacts on mine site staff from increased temperatures (e.g., heat stress).	Possible C	Moderate 3	Medium 9
Increased soil erosion due to decrease in soil moisture and increased rainfall intensity (including access tracks).	Possible C	Moderate 3	Medium 9
Unsuccessful rehabilitation planting due to reduced rainfall and more severe storm events.	Possible C	Moderate 3	Medium 9
Increased slope failure due to decreased soil moisture and increased rainfall intensity.	Unlikely D	Major 4	Medium 8
Increased maintenance costs for infrastructure due to more severe storm events.	Possible C	Minor 2	Medium 6
Increased bushfire events due to increased temperatures and evapotranspiration potential.	Unlikely D	Moderate 3	Medium 6
Restrictions on blasting events due to increased number of windy days	Possible C	Minor 2	Medium 6
Failure/overtopping of tailings dams.	Rare E	Catastrophic 5	Medium 5
Community/workforce isolation due to higher risks of flooding events.	Rare E	Minor 2	Low 2

9.3 Risk Management Measures

Relevant risk management measures as described elsewhere in the EIS are summarised here. Where practicable, the Wandoan Joint Venture should undertake these measures in a cooperative approach with government, other industry and other sectors as part of the measures described in section 8.5.

9.3.1 High Risk Impacts

It is understood that the following measures will be implemented to increase water use efficiency:

- Xstrata's Sustainable Development Policy sets its commitment to continually improve and review the efficiency with which it uses raw materials, energy and natural resources including water.
- It is understood the project proposes to implement a water management plans and include an assessment of:
  - the operation with regard to actual and future potential water scarcity
  - water availability and potential impacts on water.

It is understood that the following measures will be implemented to manage dust emissions on site, as detailed in Chapter 13 of the EIS (Volume 1):

- Development of an air quality management plan will be prepared prior to the commencement of construction;
- Development of a coupled real time weather forecasting and dust monitoring system that will initiate the application of management and mitigation strategies prior to the onset of an air quality exceedance as a result of adverse weather conditions;
- Effective design and management of roads and exposed areas (eg. minimising speed of on-site traffic, regular watering, grading and if necessary use of surface treatments) to reduce wheel-generated dust;
- Where practicable, limit dust-generating activities such as earthworks that could potentially affect residents during high wind conditions;
- Stockpiles and other mine infrastructure will attempt to be located away from affecting sensitive receptors;
- Limiting vegetation and soil clearing to approved areas, so as to minimise exposed ground; and
- Rehabilitate disturbed land as soon as practicable.

It is understood the following measures are proposed to be implemented to reduce the likelihood of floods and/or manage the impacts of floods, as detailed in Chapter 11 (Volume 1):

- The proposed conceptual creek diversion channels can be feasibly constructed to the criteria specified NRW watercourse diversion guidelines; and
- A preliminary extent of inundation and design flood levels has been identified, which may be used for the planning of mine infrastructure. The locations and major dimensions of the creek diversions and levees has been conceptualised and the flood immunities of various infrastructure and creek crossings may be identified. However, during more detailed design

phases and the waterworks licence approval process, more detailed modelling will be conducted in the immediate vicinity of the proposed structures. The hydraulic and hydrology models will be developed further for this purpose.

9.3.2 Medium Risk Impacts

The effects of heat will be managed by providing suitable working environments, equipment and protective clothing, making workers aware of the signs and symptoms of heat effects including dehydration, and ensuring that adequate hydration levels are maintained (refer to Chapter 24 for more detail).

It is understood the following measures are proposed to be implemented to reduce the likelihood of soil erosion, as detailed where appropriate in Chapter 9 (Volumes 1-3) and Chapter 7 (Volume 4):

- Specific sediment and erosion control plans should be prepared following detailed design and implemented prior to the commencement of construction for mine infrastructure areas;
- Design of all drainage around proposed structures and permanent landforms consider the presence of dispersive soils and apply suitable erosion reduction methods. All disturbed areas should be revegetated, or covered with material that has low erosion potential, to minimise the potential for erosion;
- Erosion should be remediated as soon as practicable. This may include levelling the eroded area, capping with non-dispersive topsoil, application of seed and applying erosion control measures to prevent water impacting the site;
- Clear the minimum amount of vegetation (including grass cover) required for Project works;
- Minimise disturbance of the ground layer of vegetation by controlled operation of machinery and equipment selection;
- Site drainage, erosion and sediment controls should be implemented and in place prior to, or as soon as possible, following the removal of vegetation;
- Revegetate exposed soils as soon as practical after works have been completed. This includes the rehabilitation of spoil dumps;
- Install erosion and sediment control measures on disturbed natural or constructed slopes to minimise erosion and sediment released into waterways. This is especially important for soils with dispersive subsoils (e.g. Cheshire, Woleebee, Rolleston and Teviot);
- Minimise slope grade within infrastructure areas where possible based on results of geotechnical data obtained during detailed design phase;
- Locate infrastructure, parking and laydown areas at sites with minimal slope grade;
- Construct hardstands from erosion resistant material;
- Erosion monitoring should continue until the vegetation cover has become fully established;

- Monitoring for the development of tunnel erosion should be undertaken every three months for the 12 months following the completion of construction; and
- If monitoring indicates the formation of tunnel erosion, remediation works should be undertaken immediately, with further monitoring of the area until vegetation cover has become fully established.

It is understood the following measures are proposed to be implemented increase the success rate of rehabilitation planting, as detailed where appropriate in Chapter 17 (Volumes 1 - 3) and Chapter 12 (Volume 4):

- A revegetation/rehabilitation plan will include, where appropriate:
  - Planting of a range of locally occurring native shrubs, trees and groundcover plants, in keeping with the existing vegetation types present;
  - Incorporating existing natural vegetation where possible;
  - Linking vegetation remnants, where practicable;
  - Focusing on riparian vegetation to protect waterways; and
  - Excluding stock from areas rehabilitated for nature conservation objectives.
- A flora and fauna monitoring program for the Project will be developed and implemented aimed at achieving a better understanding of impacts and rehabilitation actions to flora and fauna throughout the study area. Monitoring will also include exotic weeds and feral animals.

It is understood the following measures are proposed to be implemented in regard to the stability of overburden and to prevent slope failure, as detailed in Chapter 9 (Volume 1):

- The setback distance of overburden piles from the crest of the wall should consider the wedge failure potential of the low wall;
- Design overburden dumps to limit dump heights or use benching on dumps to improve overall stability;
- Toe of stockpiles should be buttressed with interburden waste as soon as possible after coal is removed;
- The area of disturbed land at any one time will be minimised through planning, staged developments and designation of specific site areas;
- A comprehensive strength testing program for both fresh and slaked materials should be undertaken; and
- A 5 m wide bench should be left between the toe of a weathered overburden cut and the crest of a weathered overburden cut to reduce the rock fall hazard.

- Preliminary high wall and low wall and overburden dump design would be conducted to the cut angles contained elsewhere in the EIS.

Section 10 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Wandoan Joint Venture and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated June 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between March 2008 and November 2008 and is based on the information available at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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