

Q | Coal Mine
– Greenhouse Gas

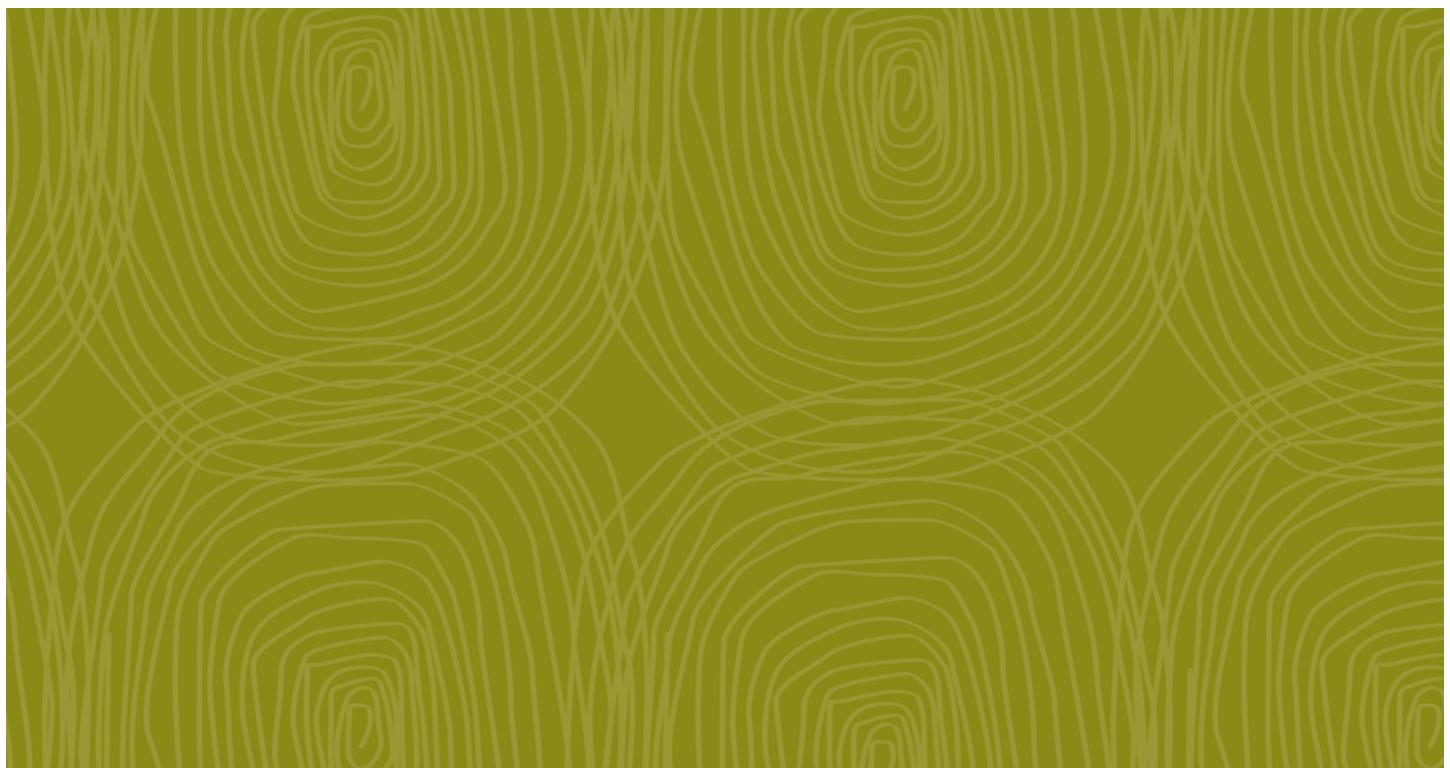
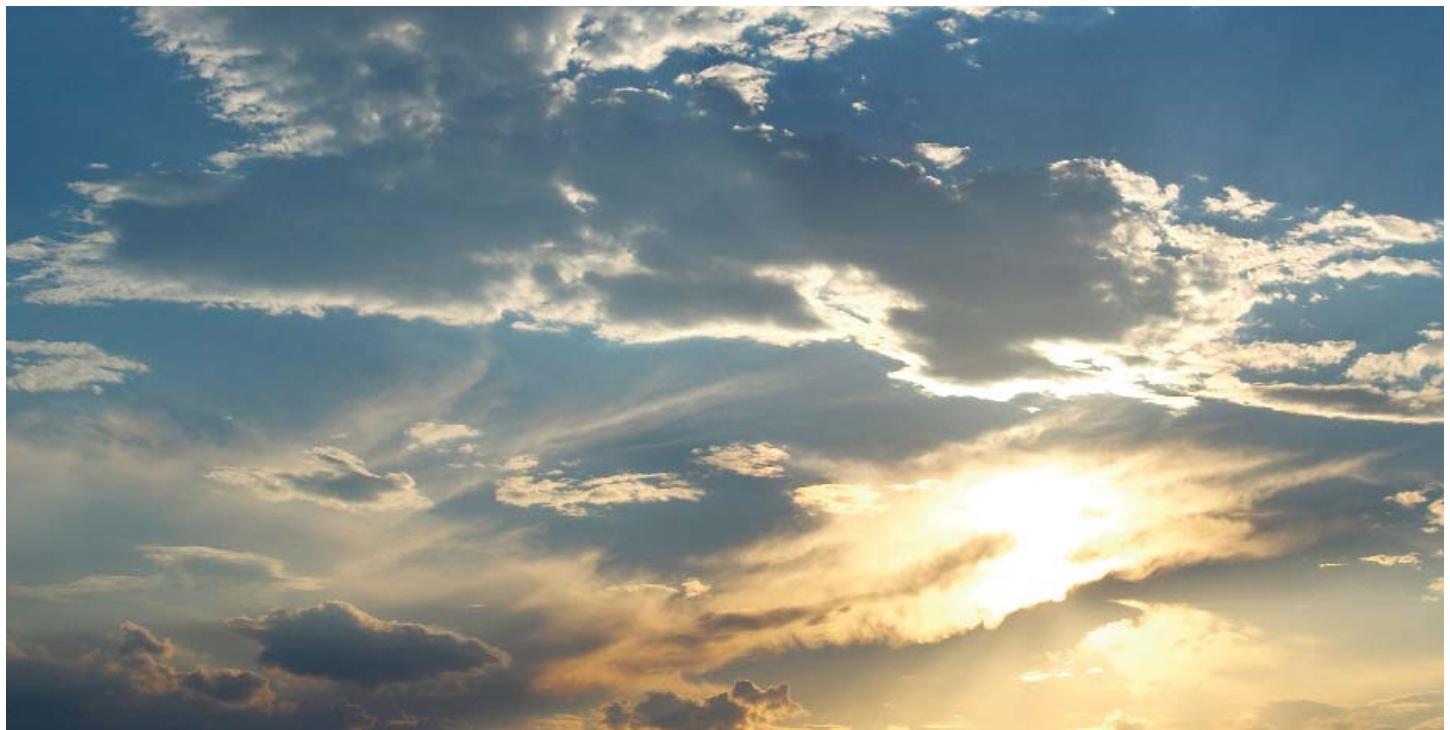


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Appendix Q Greenhouse Gas

Q.1 Introduction

Q.1.1 Legislative Framework

On 24 February 2011, the Prime Minister Julia Gillard announced the climate change framework outlining the broad architecture for a carbon price mechanism that has been considered by the Multi-Party Climate Change Committee (Department of Climate Change and Energy Efficiency [DCCEE], 2011). The proposed mechanism has been agreed to by the Labour Government and Australian Greens members of the Committee.

The proposal focuses on the high level architecture, sectoral coverage, international linking arrangements and potential progression to emissions trading. It outlines a two-stage plan for a carbon price mechanism commencing in July 2012 with a fixed price period for three to five years before transition to an emissions trading scheme.

Further detailed discussions are required in relation to a starting carbon price for the mechanism; assistance arrangements for households, communities and industry; and support for low emissions technology and innovation. The architecture also allows for consideration of other design options such as phased coverage and an intensity-based allocation scheme for the electricity sector.

Definitive details of the proposal are yet to be determined, and the legislation is subject to a majority agreement in both houses of Parliament, which will be sought later this year. Therefore, it is not yet clear how this proposal might impact the Alpha Coal Project.

Q.1.2 Project Description Changes

Since the release of the EIS, updates have been made to the geological model providing a more detailed understanding of the stratigraphy of the proposed mine area. This has allowed for updates to both the mine plan and mining methods in order to optimise mining output. Accordingly, there have been changes in the activity data used in the initial greenhouse gas (GHG) inventory.

Updates have been provided to the following information:

- Activity data used to assess Scope 1 fugitive emissions (extraction of coal) based on information provided by the Proponent, broken down into annual production from 2013 to 2042. This includes:
 - Estimated Run of Mine (ROM) coal (tonnes) for the mine area as a whole for each year of operation of the mine; and
 - Estimated product coal (tonnes) for each year of operation of the mine.
- Activity data used to assess Scope 1 emissions from diesel usage based on information provided by the Proponent, broken down into annual consumption in litres from 2011 to 2042. For the purposes of this assessment, the assumption has been made that all diesel will be used for transport, providing a more conservative (i.e. higher emission) assessment than dividing into stationary and transport usage;
- Activity data used to assess Scope 2 emissions from electricity usage based on information provided by the Proponent, broken down into annual consumption from 2014 to 2042.

Q.1.3 Inventory Methodology

In the Technical Guidelines for estimation of GHG emissions by facilities in Australia (DCCEE, 2010a), there are three methods provided to estimate emissions from open-cut mines, of which Methods 1 and 2 pertain to the Alpha Coal Project:

- Method 1 derives the estimate from the National Greenhouse Account methodology as published in the National Inventory report (DCCEE, 2010a). Emissions are estimated for a particular location of the mine by multiplying a physical quantity of ROM coal extracted by an emission factor:

$$\text{Emission (t CO}_2\text{-e)} = \text{Quantity of ROM (t)} \times \text{Emission Factor (t CO}_2\text{-e per t of raw coal)}$$

Where the emission factor for Queensland is 0.017

- Method 2 involves the estimation of a total stock of gas available for release as emissions from the mine extraction area. This is determined by sampling the gas content of coal and non-coal strata layers in the area, adjusted for past quantities of gas captured for combustion, flared or transferred off-site.

For the EIS, Method 1 was used to determine the fugitive emissions associated with the extraction of coal. Since release of the EIS, a report by GeoGAS Pty Ltd (GeoGAS, 2010) has become available detailing the direct measurement of GHG at the mine site, giving more accurate and precise calculations of the CO₂-e emitted from this source. The report is included as Attachment 1.

Therefore, for this update to the GHG inventory, the Method 2 estimates have been adopted as they represent real site data, as opposed to the conservative, generic factors applied in the absence of site-specific data across Queensland. The estimates were based on measured gas content data and provided for the determination and reporting of the actual gas-in-place. The calculations included formulae for the degree of emission, covering the stratigraphic interval above and below the working seam. Gas content was assigned to the gas-bearing strata based on a number of relationships that were established in the area. Gas contents were measured using the Australian Standard (AS) 3980 (1999) fast desorption method.

Q.2 Calculated Emissions

The GHG Scope 1 and Scope 2 emission sources from the project included in this inventory are:

- Fugitive emissions of coal seam gas from the mining of coal (Scope 1);
- Diesel combustion for transport and stationary purposes (Scope 1);
- Diesel combustion for explosives (Scope 1); and
- Electricity consumption (Scope 2).

The Scope 1 and Scope 2 emissions for the project are summarised in Table Q-1. These include the average annual emissions for the project and the total GHG emissions over the 30-year project life.

Table Q-1 Greenhouse gas emissions for the Alpha Coal Project

Scope	Source	Minimum Emissions (t CO ₂ -e / yr)	Maximum Emissions (t CO ₂ -e / yr)	Average Emissions (t CO ₂ -e / yr)	Life of Mine Emissions (t CO ₂ -e)
1	Fugitive Emissions	1,400	20,071	10,547	337,494
1	Diesel Combustion	40,986	368,381	201,533	6,449,066
1	Diesel- Explosives	24	7,504	4,384	140,296
	Annual Scope 1 ¹	42,410	377,731	216,464	6,926,856
2	Purchased Electricity	128,880	751,824	549,448	17,582,321
	Annual Scope 1 and 2 ²	42,410	1,066,742	765,912	24,509,177

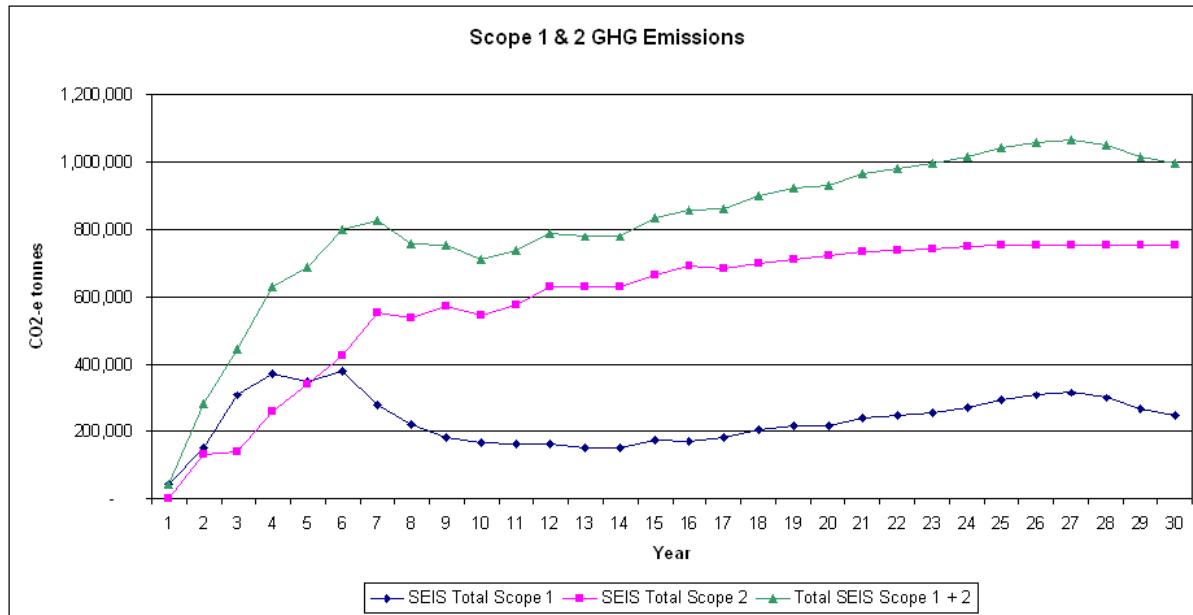
¹This row indicates the minimum, maximum, average and life of mine emissions of all the totalled Scope 1 emissions and hence will not equal the total of the Scope 1 emissions included in this table.

²This row indicates the minimum, maximum, average and life of mine emissions of all the totalled Scope 1 and Scope 2 emissions and hence will not equal the total of the Scope 1 and 2 emissions included in this table.

The GHG emissions presented are based on current knowledge about the mine operations, coal seam gas content, predicted diesel use, and electricity consumption. However, GHG emissions may in fact reduce over the life of the mine due to technology improvements.

Figure Q-1 shows the estimated GHG emissions for Scope 1 and Scope 2 emissions throughout the life of the project. The figure shows that for all Scope 1 and Scope 2 emissions, GHG is forecast to sharply increase in Operational Years 1 to 7 in line with commencement of coal production. From Year 8 onwards GHG emissions are forecast to remain relatively constant, with the largest GHG emissions (1,066,742 tonnes CO₂-e) in Year 27.

The Proponent will be obliged to report under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) (Commonwealth Government, 2007) given that emissions for the project's Scope 1 and Scope 2 emissions will exceed the 25,000 tonne CO₂-e threshold from the first year of construction.

Figure Q-1 Total of Scope 1 and Scope 2 greenhouse gas emissions (tonnes CO₂-e)

The GHG emissions efficiency of the mine can be measured as *emissions intensity*, as defined by the National Greenhouse and Energy Reporting Guidelines (DCC, 2008). Emissions intensity is defined as the tonnes CO₂-e produced per tonne of product coal. The emissions intensity of the Project based on Scope 1 and Scope 2 emissions ranges from 0.02 to 0.04 tonnes CO₂-e per tonne of project coal and averages 0.03 tonnes CO₂-e per tonne of product coal. This is broadly consistent with other open-cut coal mines.

Q.3 Emissions Comparison

Q.3.1 Australian Emissions

The National Greenhouse Gas Inventory (DCCEE, 2010b) is the latest available national account of Australia's GHG emissions. The National Greenhouse Gas Inventory (DCCEE, 2010b) has been prepared in accordance with the Revised 1996 and 2006 Intergovernmental Panel on Climate Change (IPCC) Objectives for National Greenhouse Gas inventories (IPCC, 2007). The IPCC guidance defines six sectors for reporting greenhouse gas emissions; these include:

- Energy Sector (including coal mining);
- Industrial Processes;
- Agriculture;
- Waste;
- Other; and
- Land Use, Land Use Change and Forestry.

Australia's net greenhouse gas emissions across all sectors totalled 576 million tonnes (Mt) CO₂-e in 2008, with the mining sector emitting 71.3 Mt CO₂-e.

Table Q-2 shows total annual Scope 1 and Scope 2 emissions at different stages of the life of the mine as a percentage of Australian total and mining sector emissions taken from the National Greenhouse Gas Inventory 2008 (DCCEE, 2008).

Table Q-2 Comparison of Australia and Project greenhouse gas emissions

Year of Operation	Percentage of Australian Mining Sector	Percentage of Australian Total
Minimum GHG emissions (Year 1)	0.06	0.01
Peak GHG Emissions (Year 27)	1.50	0.19
Average GHG Emissions	1.07	0.13

Q.3.2 Queensland Emissions

Table Q-3 shows total annual Scope 1 and Scope 2 emissions at different stages of the life of the mine as a percentage of Queensland total (160.3 Mt) and Queensland mining sector (15.9 Mt) emissions taken from the National Greenhouse Gas Inventory 2008 (DCCEE, 2008).

Table Q-3 Comparison of Queensland and Project greenhouse gas emissions

Year of Operation	Percentage of Queensland Mining Sector Total	Percentage of Queensland Total
Minimum GHG emissions (Year 1)	0.27	0.03
Peak GHG Emissions (Year 27)	6.71	0.67
Average GHG Emissions	4.82	0.48

When viewed in an Australian or Queensland context the Scope 1 and Scope 2 emissions from the Project are considered materially relevant given the Project emissions are 6.71% of the Queensland mining sector at the peak emission rate.

The Queensland Government has proposed to reduce GHG emissions by 60% by 2050 based on 2000 levels, in line with the national target. This equates to a reduction of approximately 98 Mt CO₂-e.

Average Scope 1 and Scope 2 greenhouse gas emissions from the Project will be 2 Mt CO₂-e or 0.5% of the state inventory.

Q.4 Abatement

As discussed in Volume 1, Section 2 (Amendments to the Project Description), updates have been made to the geological model since the release of the EIS, providing a more detailed understanding of the geological stratigraphy of the proposed mine area. This has allowed for updates to both the mine plan and mining methods in order to optimise mining output, and reduce GHG emissions. Specifically, the changes to the Project description that impact the amount of GHG emissions, and the advantages provided in terms of GHG emissions reduction, are provided in Table Q-4.

Table Q-4 Project description changes impacting on greenhouse gas emissions

Project Description Change	Result of Change	Advantage
Introduction of In-Pit Crushing and Conveying (IPCC)	Reduced volumes requiring trucking	Reduced diesel requirements
Coal mine layout changed due to updates to geological model, methods to mine modified	Reduced draglines, excavators and shovels	Reduced electricity requirements Reduced diesel requirements
Coal mine layout changed due to updates to geological model, increase in land bridges (access from the front of the pit to the back of the pit) used to transport overburden	Reduced truck hours Less dragline rehandle	Reduced diesel requirements Reduced electricity requirements

In addition to the reductions to GHG emissions achieved through changes to the Project description, the following process management principles will be implemented:

- Plant and equipment:
 - Energy efficiency ratings will be investigated, with higher ratings the preferred option;
 - Plant and equipment will be regularly serviced and maintained according to manufacturers recommendations; and
 - Plant and equipment will be operated in an appropriate manner.
- Blasting activities will be optimised to minimise double handling;
- A GHG inventory will be maintained from the beginning of the construction phase, and the reporting requirement to the Greenhouse and Energy Data Officer will be filed annually (per the NGER legislation).

Q.5 Limitations

The fugitive emissions estimates have been prepared by GeoGAS Pty Ltd for Salva Resources in accordance with Method 2 of the Emissions Estimation Manual (DCCEE, 2010a).

ATTACHMENT 1
OPEN CUT FUGITIVE GREENHOUSE GAS EMISSIONS
ASSESSMENT

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OPEN CUT FUGITIVE GREENHOUSE GAS EMISSIONS ASSESSMENT

Salva Resources

Report No.: 2010-712 / September, 2010

Alpha Coal Project Open Cut Fugitive Greenhouse Gas Emissions

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1 . E X E C U T I V E S U M M A R Y

This report presents the results of an Open Cut Fugitive Greenhouse Gas (GHG) emissions assessment for the Alpha Coal Project, in the Galilee Basin, Queensland. It was undertaken through Mark Winsley, Salva Resources. The objective was to estimate the potential open cut fugitive greenhouse gas emissions at the Alpha Coal Project. Specific tasks were to:

- Provide an assessment of the measured gas data at Alpha Coal Project
- Develop an estimate of the Gas Reservoir Size (CH_4 , CO_2)
- Determine open cut fugitive greenhouse gas emissions (CO_2 equivalent) for the coal and other gas bearing strata.

Alpha Coal Project's deposit contains the A, B, C, D and E seams of which the A, B, C, and D are the mining seams. Emissions were calculated for the provided 38 year open pit mining schedule spanning from 2013 to 2050. Calculations of fugitive greenhouse gas emissions have been completed to meet with the National Greenhouse and Energy Reporting (Measurements) Determination 2008 (NGER) requirements, which are made under the National Greenhouse and Energy Reporting Act 2007 and were implemented in July 2008.

Two methods were utilised for calculating the GHG emissions. Method 1 applies a default emissions factor per tonne of coal mined. Method 2 is based on measured gas content data and provides for determination and reporting of the actual gas-in-place (GIP). It includes formulae for the degree of emission, covering the stratigraphic interval above and below the working seam. Method 2 assigns gas content to gas bearing strata based on a number of relationships that are established in the area.

Gas contents were measured using the Australian Standard fast desorption method. Modelled relationships were developed from the measured data to assist in the assignment of gas content and composition to carbonaceous stratigraphy within representative boreholes. Gas reservoir size was calculated for 12 boreholes across the Alpha Coal Project, and used to calculate the annual CO₂-e emissions in tonnes.

Calculations were completed using both the default Method 1 and Method 2. **Method 1** estimates the average annual GHG emissions to be 690,352 tonnes, for the years from 2013 to 2050. **Method 2** estimates the average annual GHG emissions to be 11,817 tonnes, during the same time span. The measured values from Method 2 are on average 58 times less, compared to Method 1 for the same production interval. The lower emission is commensurate with the very low measured gas contents.

The GHG emissions progressively rise with increasing mining seam depth to a maximum value of 20,071 tonnes in the year 2042 and afterwards decline with the reduction in mine production.

Year	CO2-e (t/m2)	
	Method 1	Method 2
2013	81,839	1,400
2014	282,493	2,952
2015	430,989	4,188
2016	595,965	5,723
2017	732,699	6,696
2018	744,734	6,312
2019	747,332	6,735
2020	773,431	7,144
2021	768,316	7,588
2022	761,984	8,250
2023	767,545	7,993
2024	775,603	8,713
2025	779,876	8,865
2026	775,322	9,398
2027	775,930	10,137
2028	771,927	11,185
2029	769,368	11,725
2030	771,951	12,136
2031	771,910	13,052

Year	CO2-e (t/m2)	
	Method 1	Method 2
2032	779,147	13,374
2033	785,388	14,132
2034	791,316	15,395
2035	794,236	16,428
2036	782,939	16,706
2037	781,977	16,971
2038	776,666	17,012
2039	784,236	18,024
2040	788,251	19,372
2041	794,423	19,817
2042	788,996	20,071
2043	787,981	18,977
2044	796,581	19,483
2045	793,275	18,289
2046	790,907	17,793
2047	795,228	18,199
2048	520,425	12,936
2049	208,076	5,660
2050	14,131	209

Salva Resources can update in-house GHG emission using “CO₂-e emissions-Mining Depth” the provided relationship for any changes in production scheduled areas.

The gas content data from boreholes and the lithological relationships established to determine the representative gas reservoir size are sufficiently robust to determine the mine's fugitive emissions in compliance with the NGERS guidelines.

Uncertainty analysis was not conducted on these estimations, but in all other respects the determination of fugitive emissions from the Alpha Coal Project complies with NGERS guidelines.

2 . I N T R O D U C T I O N

This report presents the results of an Open Cut Fugitive Greenhouse Gas (GHG) emissions assessment for the Alpha Coal Project, in the Galilee Basin, Queensland. It was undertaken through Mark Winsley, Salva Resources.

The objective of this study was to develop and apply a method to estimate potential open cut fugitive greenhouse gas emissions at the Alpha Coal Project. The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (NGER) commenced on July 1st 2008 and is made under the National Greenhouse and Energy Reporting Act 2007. It mandates the annual reporting of greenhouse gas emissions.

For open cut mining, three methods have been described. Method 1 applies a default emissions factor per tonne of coal mined, for cases where no measured data exist or the reporting body elects to use this option. Methods 2 and 3 are based on measured gas content data, and provide for determination and reporting of the actual gas-in-place (GIP) for methane (CH_4) and carbon dioxide (CO_2), and include a formula for the degree of emission of CO_2 equivalent ($\text{CO}_2\text{-e}$) gas. This report presents the results from both method one and method two.

The scope of work entails the following process to implement Method 2:

1. Gas content and composition assessment:

- Validate measured gas content¹ (Qm) and composition data
- Calculate Qm to a standard ash (nominally 20%, 60%, 85% and 95% ash)
- Determine measured Ash-RD² relationship for assignment to borehole wireline LAS³ density
- Determine "Zero Qm " Ash from data set for assignment of Qm to non-tested strata
- Develop Qm relationship with depth from data set for assignment of Qm to non-tested strata
- Determine the gas composition relationship with Qm .

2. Calculation of Gas Reservoir Size for stratigraphy:

- Assess and composite received lithology data for boreholes with gas content data
- Highlight major lithologies (i.e. carbonaceous/non carbonaceous)
- Assess and organise borehole wireline data (i.e. density and lithology proxy)

¹ Qm is the measured desorbable gas content derived from summing the estimate of "lost gas" Q1 , desorbed gas Q2 and desorbed gas on crushing Q3 . Unless otherwise indicated, all gas volumes are reported to 20°C and 1013 hPa.

² RD is relative density

³"Log ASCII Standard" file, by the Canadian Well Logging Society (CWLS). The LAS format provides an easy method to read and distribute well log data such as density, temperature etc.

- Develop a relationship between wireline density, contours and measured sample RD
- Assign gas content to stratigraphy using relationship(s) developed in Gas Content Assessment
- Calculate the Gas Reservoir Size (GRS) (CH_4 , CO_2) and $\text{CO}_2\text{-e}$ for each selected borehole.

3. Calculation of annual fugitive GHG emission:

- Create $\text{CO}_2\text{-e}$ emission contours and $\text{CO}_2\text{-e}$ emission-Depth relationship
- Assign areas and $\text{CO}_2\text{-e}$ emissions for annual production
- Calculate open cut fugitive emissions based on default emission factor and minable tons for area/block (Method 1)
- Calculate open cut fugitive emissions based on $\text{CO}_2\text{-e}$ emissions and minable area (Method 2).

Alpha Coal and Kevin's Corner Project deposits lay within the late Permian, Colinlea and Bandanna Formations. The coal seams dip gently to the west at approximately 1° to 3° . A depth of cover ranges from 50 m to 220 m and the seams vary in thickness from 5 m to 8 m over the Alpha Coal and Kevin's Corner Project areas. These favourable attributes enables high production open-cut mining (Figure 1 and Figure 2).

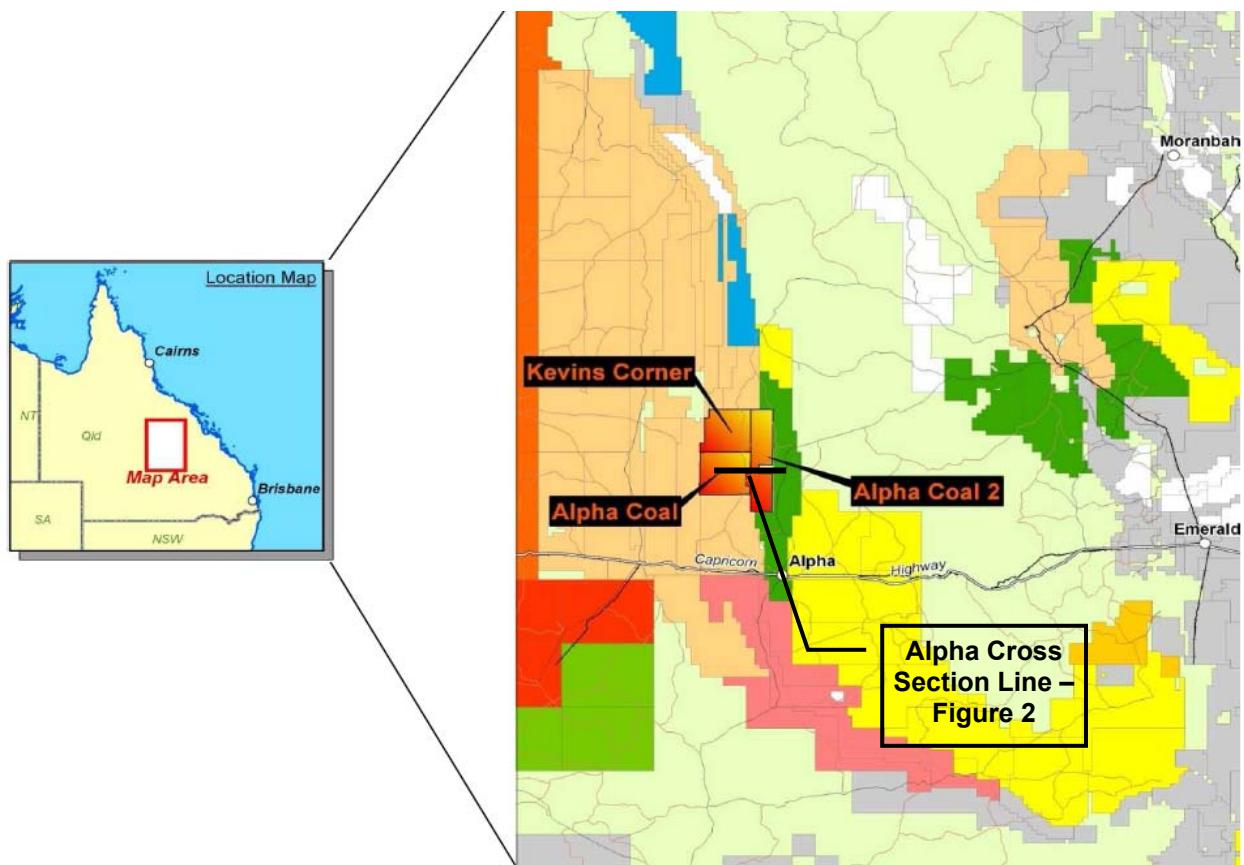


Figure 1 Alpha Coal and Kevin's Corner Project (Source: Hancock Coal Pty Ltd Website)

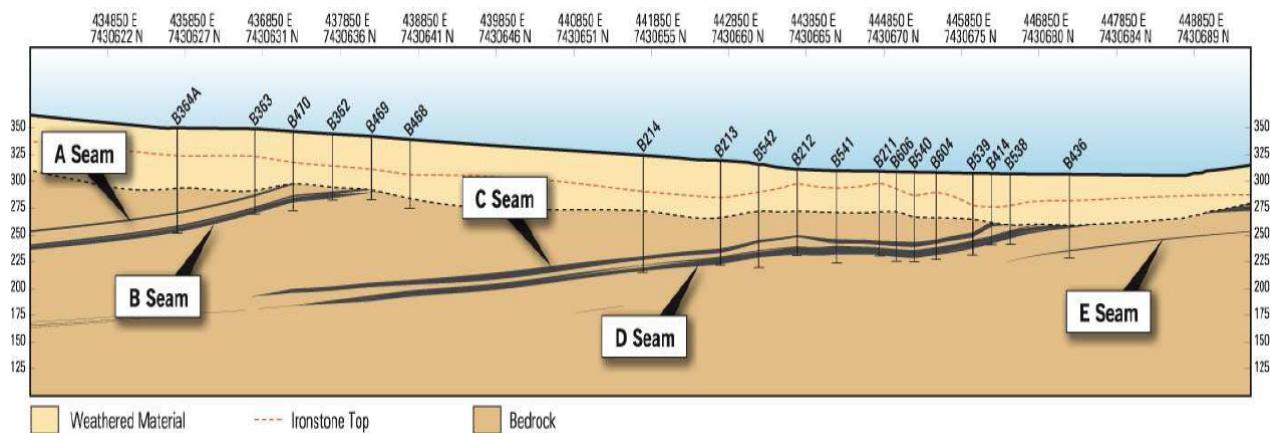


Figure 2 Cross Section of the Alpha Coal (MLA 70426) (Source: Hancock Coal Pty Ltd Website)

Alpha Coal will mine around 40 million tonnes of thermal coal annually (Figure 3).

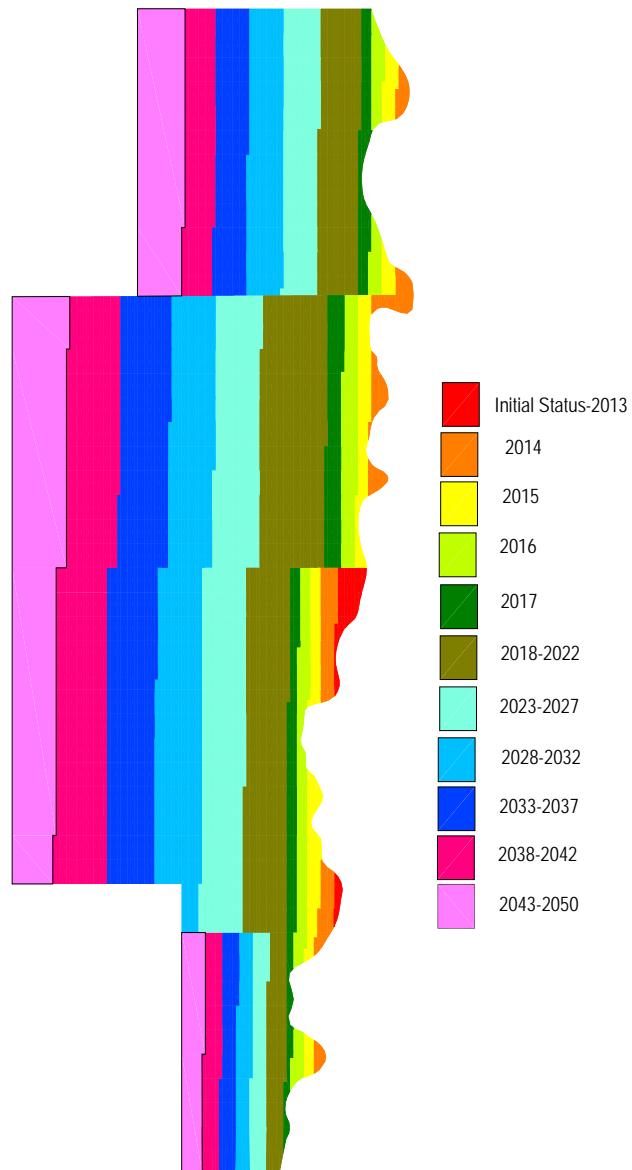


Figure 3 Alpha Coal Project Schedule (Source: Salva Resources)

3 . M E T H O D O L O G Y

3.1 Open Cut Fugitive Greenhouse Gas Emission Guidelines – Open Cut Mines

There are three advised methodologies for estimating fugitive emissions due to coal extraction in an open cut mine. All methods for open cut mining have been derived from *The Australian Government Department of Climate Change* as published in the *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2008 (NGER)*.

Method 1 estimates emissions for a particular state by multiplying a quantity of coal extracted from the mine by an emission factor. The factor is based on the location of the mine and varies for each state in Australia. New factors have been adopted by some states as a result of international review.

Method 1 is expressed as:

$$E_j = Q \times EF_j$$

Where:

E_j is the fugitive emissions of methane (**j**) that result from extraction of coal from the mine during the year. It is measured in CO₂-e tonnes

Q is the quantity of coal (run-of-mine) extracted during the year. It is measured in tonnes

EF_j is the emission factor for methane (**j**). It is measured in CO₂-e tonnes per tonne of coal extracted from the mine, values shown in Table 1.

Table 1 Open Cut Fugitive Emission Factors for Australian States

MINE LOCATION (STATE)	FACTOR
NEW SOUTH WALES	0.0450
VICTORIA	0.0007
QUEENSLAND	0.0170
WESTERN AUSTRALIA	0.0170
SOUTH AUSTRALIA	0.0007
TASMANIA	0.0140

Methods 2 and 3 involve the estimation of a total stock of gas available for release from the mining extraction area based on general sampling and appropriate sampling standards⁴, respectively. This gas stock is determined by sampling coal/carbonaceous strata and non-carbonaceous strata to analyse gas

⁴ AS 2617 -1996 Sampling from coal, or *equivalent standard*; AS 2519 – 1993 Guide to the technical evaluation of higher rank coal deposits, or equivalent standard.

content of the area. Emissions that have already been released into the atmosphere (past flaring, venting etc) are accounted for. Sampling of coal and measurement of gas content is governed by Australian industry standards, which can be obtained from <http://www.jorc.org>.

Methods 2 and 3 are expressed as:

$$E_j = y_j \Sigma_z (S_{j,z})$$

Where:

E_j is the fugitive emissions of methane (**j**) that result from extraction of coal from the mine during the year. It is measured in CO₂-e tonnes

y_j is a conversion factor, converting a quantity of gas type (**j**) from cubic metres to CO₂-e tonnes. The following parameters were used for conversions factors (for the specified gas):

- British Standard has methane density of 0.7174 kg/m³ and carbon dioxide density of 1.977 kg/m³ at 0°C⁵. NGER states 0.6784 kg/m³ and 1.861 kg/m³ density for methane and carbon dioxide respectively, at standard conditions (15°C). British Standard values are in accordance with Saghafi, A. (2008), CSIRO Report⁶. However NGER values are utilized for calculations
- CH₄ have to be converted to CO₂-e using the Global Warming Potential (GWP) value. Values in Table 2 are based on the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Environment Programme (UNEP). NGER states CH₄ GWP of 21 which based on the 1995 Intergovernmental Panel on Climate Change publication. UNEP CH₄ GWP of 23 for calculations of greenhouse emissions (reported as CO₂-e emissions in tonnes) is used in Saghafi, A. (2008), CSIRO Report⁴. However the current report uses GWP of 21 as per NGER guidelines
- CO₂ has a GWP of exactly 1 (it is the baseline unit to which all other greenhouse gases are compared)

⁵ British Standard 1042: part 1: 1964 Methods for the measurement of fluid flow in pipes

⁶ Saghafi, A. (2008), Evaluating a tier 3 method for estimating fugitive emissions from open cut mining, Joint Research Project ACARP (C15076) and CSIRO. CSIRO Investigation Report ET/IR 1011.

Table 2 GWP Values for Open Cut Emission Calculations

Emission Output	Lifetime (years)	GWP Value		
		20 years	100 years	500 years
Methane	12 (12)	72 (62)	25# (23)^	7.6 (7)
Nitrous oxide	114 (114)	289 (275)	298 (296)	153 (156)
HFC-23 (hydrofluorocarbon)	270 (260)	12,000 (9400)	14,800 (12000)	12,200 (10000)
HFC-134a (hydrofluorocarbon)	14 (13.8)	3830 (3300)	1430 (1300)	435 (400)
Sulfur hexafluoride	3200 (3200)	16,300 (15100)	22,800 (22200)	32,600 (32400)

2007 IPCC AR4 (Intergovernmental Panel on Climate Change)

^ 2001 IPCC TAR (GRID-Arendal is an official United Nations Environment Programme (UNEP) collaborating centre

$\Sigma_z (S_{j,z})$ is the total of gas type (**j**) in all gas bearing strata (**z**) under the extraction area of the mine during the year (Figure 4). It is measured in cubic metres (m^3).

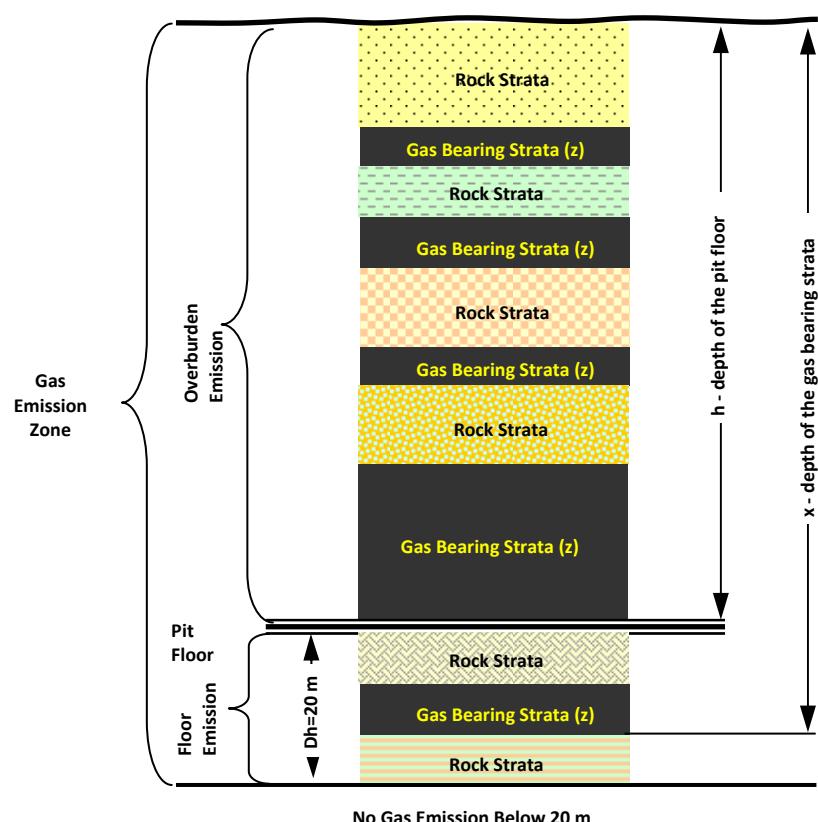


Figure 4 Schematic of Model of Emissions from Open Cut Mining (after Saghafi et al. 2008⁷)

⁷ Saghafi, A. (2008), Evaluating a tier 3 method for estimating fugitive emissions from open cut mining, Joint Research Project ACARP (C15076) and CSIRO. CSIRO Investigation Report ET/IR 1011.

To estimate the total gas contained by gas bearing strata the following equation is used:

$$S_{jz} = M_z \times \beta \times GC_{jz} - \sum_t Q_{ij,cap,z} - \sum_t Q_{ij,flared,z} - \sum_t Q_{ij,tr} - \sum_t E_{ij,vented,z}$$

Where:

M_z is the mass of the gas bearing strata (**z**) under the extraction area of the mine during the year. It is measured in tonnes

β is the proportion of the gas content of the gas bearing strata (**z**) that is released by extracting coal from the extraction area of the mine during the year, as follows:

- a) if the gas bearing strata is at or above the pit floor – “1”
- b) in any other case, estimated as a proportion of gas content released below the pit floor (see below)

GC_{jz} is the content of gas type (**j**) contained by the gas bearing strata (**z**) before gas capture, flaring or venting is undertaken. It is measured in cubic metres per tonne of gas bearing strata at standard conditions

Σ_t Q_{ij,[cap;flared;tr]z}, **Σ_t E_{ij,vented,z}** s the total quantity of gas type (**j**) in coal mine waste (**i**) captured for combustion (**cap**), flared (**flared**), transferred out of the mining activities (**tr**), or vented (**vented**) from the gas bearing strata (**z**) at any time before the coal is extracted from the extraction area of the mine during the year. It is measured in cubic metres. In this study there were no emissions attributed to captured, flared, transferred or vented gas.

To estimate the proportion of gas content released below the pit floor, the following equation is used:

$$\beta = 1 - (x-h)/\delta h$$

Where:

x is the depth (in m) of the floor of the gas bearing strata (**z**) measured from ground level

h is the depth (in m) of the pit floor of the mine measured from ground level

δh is 20 m, being representative of the depth in metres of the gas bearing strata below the pit floor that releases gas.

Method 2 was used, based on the gas content testing employed which was carried out accordingly to Australian Standards AS 3980 – 1999.⁸

⁸ AS 3980 – 1999 Guide to the determination of gas content of coal and direct desorption methods

3.2 Methodology

Method 1 involves multiplying the QLD methane open cut emissions factor of 0.017 by the quantity of coal to be extracted, per year. The production schedule for Alpha Coal project is provided in Table 3.

Table 3 Mine Production Schedule (in tonnes) (Source: Salva Resources)

Seam	ROM per Year (tonnes)																		
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48,632	115,540	79,672	83,465	
C	-	239,819	1,058,349	2,297,460	5,812,625	8,501,818	9,003,850	11,837,680	12,525,763	12,833,808	14,798,792	14,880,751	15,670,131	15,651,292	14,402,035	15,396,387	14,409,321	14,995,502	14,616,793
DU	190,815	827,386	1,559,162	2,489,283	3,234,061	2,977,100	4,268,722	4,171,710	3,239,765	3,221,518	2,596,160	3,072,598	3,173,428	2,864,822	2,836,348	2,572,687	2,538,032	2,252,064	2,349,454
DLM1	-	979,796	1,194,483	1,586,585	1,965,367	2,621,077	2,258,049	1,599,816	1,381,508	912,002	889,776	838,520	1,283,329	1,308,809	1,435,707	777,579	466,430	500,802	572,821
DLM2	2,149,173	3,681,946	8,495,496	10,475,508	9,899,464	8,608,588	7,863,914	7,062,184	7,608,608	7,851,802	6,807,068	7,135,139	5,869,055	6,240,380	5,786,364	6,715,092	5,850,948	4,727,800	5,069,659
DL1	-	-	59,409	-	66,504	65,958	-	-	-	-	-	-	-	-	-	-	-	-	
DL2	2,474,056	10,888,282	12,985,410	18,207,941	22,121,914	21,033,349	20,566,174	20,824,566	20,439,441	20,003,433	20,057,900	19,696,713	19,879,135	19,541,894	21,182,477	19,897,076	21,876,659	22,853,021	22,714,261
Total	4,814,044	16,617,228	25,352,308	35,056,777	43,099,935	43,807,889	43,960,709	45,495,956	45,195,086	44,822,563	45,149,697	45,623,721	45,875,078	45,607,197	45,642,931	45,407,453	45,256,931	45,408,861	45,406,454

Pit	ROM per Year (tonnes)																		
	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
A	-	-	-	-	-	-	-	-	-	-	46,660	88,884	118,186	151,092	188,805	371,766	165,013	-	-
B	247,883	689,405	1,246,698	1,410,222	2,725,167	1,814,993	2,306,228	2,483,580	2,226,508	2,353,871	1,888,624	2,754,487	2,565,692	3,002,303	4,287,338	4,360,679	4,072,765	2,137,328	-
C	15,496,869	15,502,945	15,717,486	16,023,005	15,383,075	15,471,992	15,877,763	15,427,049	15,562,926	15,748,946	15,928,771	16,769,201	16,289,163	16,499,904	16,088,696	16,802,267	9,355,545	2,145,120	80,152
DU	2,000,103	1,942,387	1,656,584	1,509,939	1,163,050	1,257,082	964,049	944,573	1,084,375	857,504	942,091	903,375	821,759	1,017,664	1,138,807	937,509	700,331	460,988	-
DLM1	749,215	874,686	749,915	839,154	983,573	1,546,483	1,676,924	1,656,404	1,401,662	1,961,778	1,950,335	1,633,060	2,095,691	1,461,152	1,596,690	1,128,351	958,265	357,965	-
DLM2	5,650,215	6,960,872	6,852,108	5,979,976	5,451,636	5,390,815	4,982,609	4,723,719	4,328,084	4,439,984	4,530,814	3,773,974	3,818,589	4,602,439	3,899,280	3,683,305	2,007,727	-	-
DL1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	321,992	
DL2	21,687,895	20,229,004	20,325,210	20,957,471	20,348,757	20,517,286	19,878,659	20,896,202	21,764,173	21,368,706	21,170,865	20,471,064	21,177,929	19,961,577	19,362,032	19,677,202	13,146,833	6,973,368	429,092
Total	45,832,180	46,199,298	46,548,001	46,719,768	46,055,257	45,998,651	45,686,232	46,131,527	46,367,727	46,730,789	46,411,503	46,351,821	46,857,708	46,663,226	46,523,936	46,778,118	30,613,233	12,239,782	831,236

Method 2 involves a number of assumptions and calculations if the complete stratigraphy within the emission zone has not been sampled and analysed for gas content and composition. Gas is adsorbed onto carbonaceous material and held by pressure; therefore gas content will vary with the amount of non carbonaceous material (measured by ash content and/or density) and depth (as a proxy for pressure).

The main task for Method 2 is to indirectly assign gas content and composition to non tested strata, based on measured gas content relationships with tested strata. The strata intervals are deemed to be gas-bearing based on the presence of coal or carbonaceous material onto which gas is adsorbed. Sandstones may hold some free gas based on their porosity. Non porous rock types, such as tuff, mudstone and siltstone, are assumed to be non gas-bearing. For Alpha Coal, only carbonaceous materials were used for emission calculations. It was assumed that sandstone intervals contained no gas available for emissions. The gas-bearing strata assignment was entirely based on lithology logs described from core in the field. Representative sampling and rock type analysis (in particular carbonaceous sandstone, carbonaceous siltstone and carbonaceous mudstone) will enable the reduction of uncertainty in the classification of gas and non-gas bearing lithologies, and in turn the indirect assignment of gas content.

Step 1 involves defining the measured gas content relationships. These relationships will be unique to each area, and work has to be undertaken to obtain the most accurate and representative relationship possible.

In general:

- Establish an ash and relative density (RD) relationship
- Determine the relationship between gas content and ash content
- Determine the ash content at 0 m³/t of gas
- Normalise gas content at a specified ash content (e.g. Qm at 20%, 60%, 85% and 95% ash) to develop a relationship with depth (which may not be linear and have more than one solution that changes with stratigraphic intervals)
- Establish a gas content and gas composition relationship.

Step 2 involves assigning gas content to the “gas bearing” stratigraphy within a borehole, utilising a relationship between gas content, ash content or density, and depth.

The process was:

- Preparation of borehole lithology and wireline data
- Identification of gas-bearing strata based on lithological descriptions for the borehole (i.e. any lithology containing carbonaceous material, regardless of grain size, was flagged as a potential emitter $\beta=0-1$; tuff, claystone, siltstone, siderite, sandstones and conglomerates were not $\beta=0$)
- Correlation of wireline density from LAS files with ash contours and measured RD available from gas content testing
- Assignment of gas content and composition to gas bearing strata through relationships defined in step one
- Adjustment of calculated gas content to actual strata ash defined from RD-ash relationship for each stratigraphic unit
 - Calculation of gas content to actual ash is made on the basis of a linear relationship, using two data points, 0.0 m³/t gas content corresponding to 100% ash and sample gas content at sample ash.

Step 3 is to calculate the Gas Reservoir Size within the borehole:

- Calculation of the Gas Reservoir Size (GRS) for both CH₄ and CO₂
 - Gas Content × Density × Thickness of gas bearing strata (m³/m²)
- Calculation of CO₂-e fugitive emission per square metre for the stratigraphic interval
 - Conversion of gas type to CO₂-e tons (t/m² or E_{sqm}).

Step 4 is to calculate the annual CO₂-e emissions for the selected mining area (CO₂-e per square metre multiplied by the annual production extent in square metres):

- Determine the annual production extent from production schedule

NGER guidelines require the calculation of the gas emission ***below the pit floor*** from the gas bearing strata (z) that is released by extracting coal from the extraction area of the mine during the year using coefficient β and 20 m distance below the pit floor (Page 10). **Note that NGER** guidelines do not state how to calculate and estimate mining extraction area for the whole borehole stratigraphy. It is not easy to apply a single mining extraction area for most of the mature mining operations, and in particular to estimate the proportion of gas content released below the pit floor because:

- Multiple mining benches occur that are commonly configured with offsets between the various intervals mined; and
- The full stratigraphic sequence of a reserves “strip” may not be mined in any one year.

Therefore:

- For the case when only one seam is mined, the mining extraction area is determined directly from the production schedule
- For a multi-seam open cut mining case, when the annual production extents for each of the seams offset each other, it is problematical to calculate an accurate annual mining extraction area, annual emissions above mining seams and emissions below the pit floor.

For example, in a particular year the pit floor seam is not mined and the upper seam is mined, then it means that emission should be calculated from the 20 m interval below the upper seam. Next year, when the pit floor seam is mined, the emission should be calculated from the 20 m interval below the upper seam assuming the reduction of the gas content from the previous year. Therefore, it is practically impossible to assess the emissions below the pit floor and reductions of the gas content for the subsequent years. **For the Alpha Coal Project, the annual mining extraction areas are based on the DL2 seam annual extents derived from XPAC data.**

A flowchart summarising both Methods 1 and 2 is presented in Figure 5.

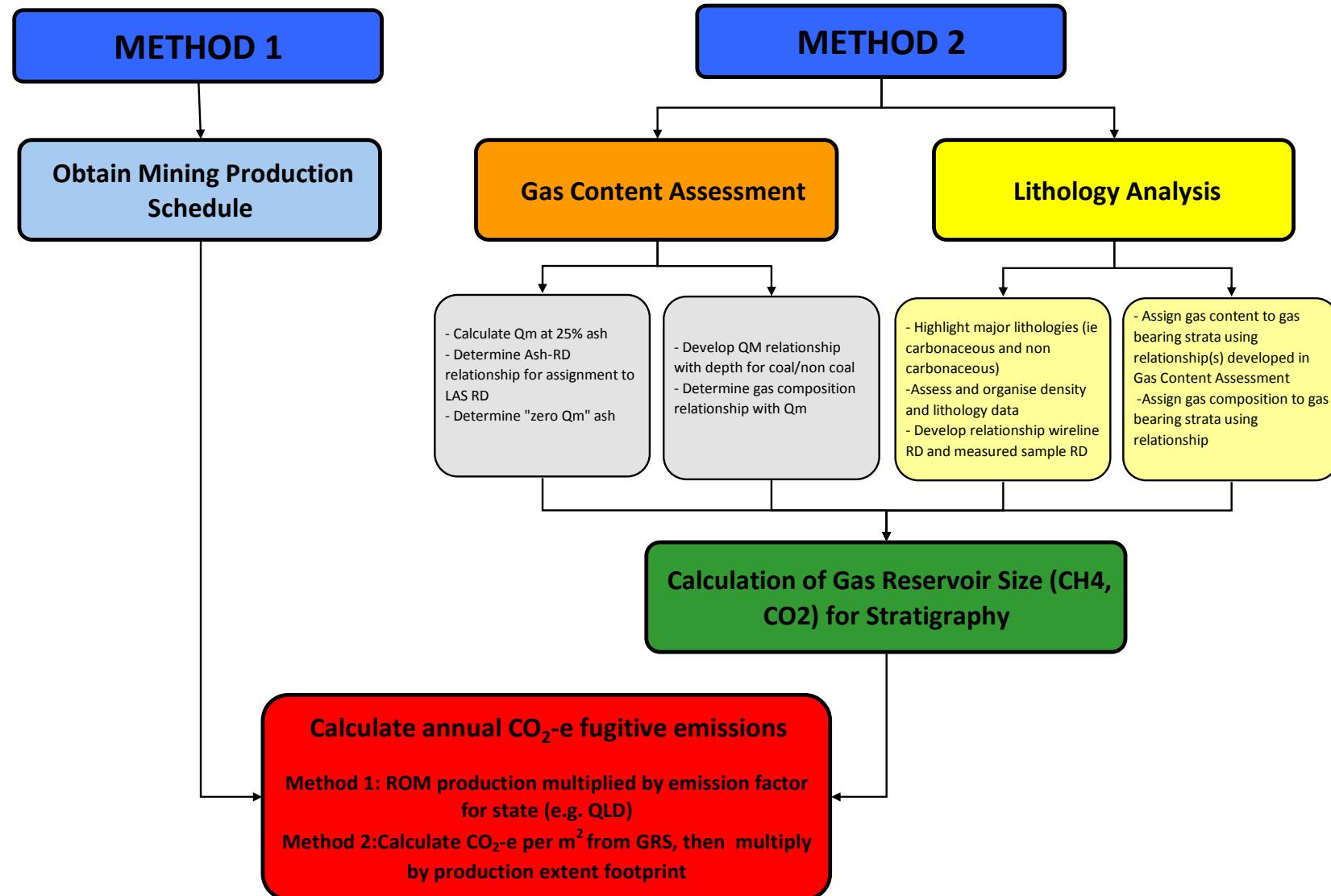


Figure 5 Flowchart of GHG Methodologies

4 . G A S R E S E R V O I R D E S C R I P T I O N

There is no gas reservoir description for Method 1 as the carbon emissions are calculated by multiplying a quantity of coal extracted from the mine by an emission factor. The carbon emission calculation for Method 2 involves establishing a number of relationships, and assigning gas contents to boreholes containing no gas content measurements. This is done by assigning gas contents based on determined relationships from measured data for a given area.

Individual relationships need to be established for each coal basin and/or coal area, based on existing gas content data. The closer the data is to the area where it is being assigned, the greater the accuracy of gas content estimations.

4.1 Gas Content

Gas content data from 14 boreholes have been used to characterise the gas content relationships. Of these 14 gas content boreholes only four are located within the Alpha Coal mining schedule area: 1336D, 1337DG, 1338DG and 1339DG (Figure 6). The remainder are located down dip within the mining lease. Several gas content samples were taken from each borehole.

4.1.1 Gas Content Test Method

Gas content testing involves the determination of Q1 (lost gas), Q2 (desorbed gas), and Q3 (gas released on crushing). The sum of these three components is the “Measured Gas Content,” also known as Qm as defined in AS3980-1999. Two methods are available in the AS3980-1999 standard - fast or slow desorption method. The fast desorption method reduces the time involved during the Q2 component of testing as well as preventing oxidation of the coal and the loss of CO₂ in solution. In very low gas content coals, the contribution of Q1 and Q2 is negligible and often difficult to measure in the field. CO₂ is commonly prevalent due to its lower desorption pressure relative to CH₄.

Both methods can deliver comparable results, however GeoGAS recommend fast desorption method for low gas content coals to avoid possible air contamination and/or oxidation. Gas content testing at Alpha Coal was conducted by GeoGAS using the AS3980-1999 standard fast desorption method on 0.8 m surface drilled borehole samples (HQ core)⁹.

⁹ GeoGAS Report 2010-704 Gas Content Testing Alpha

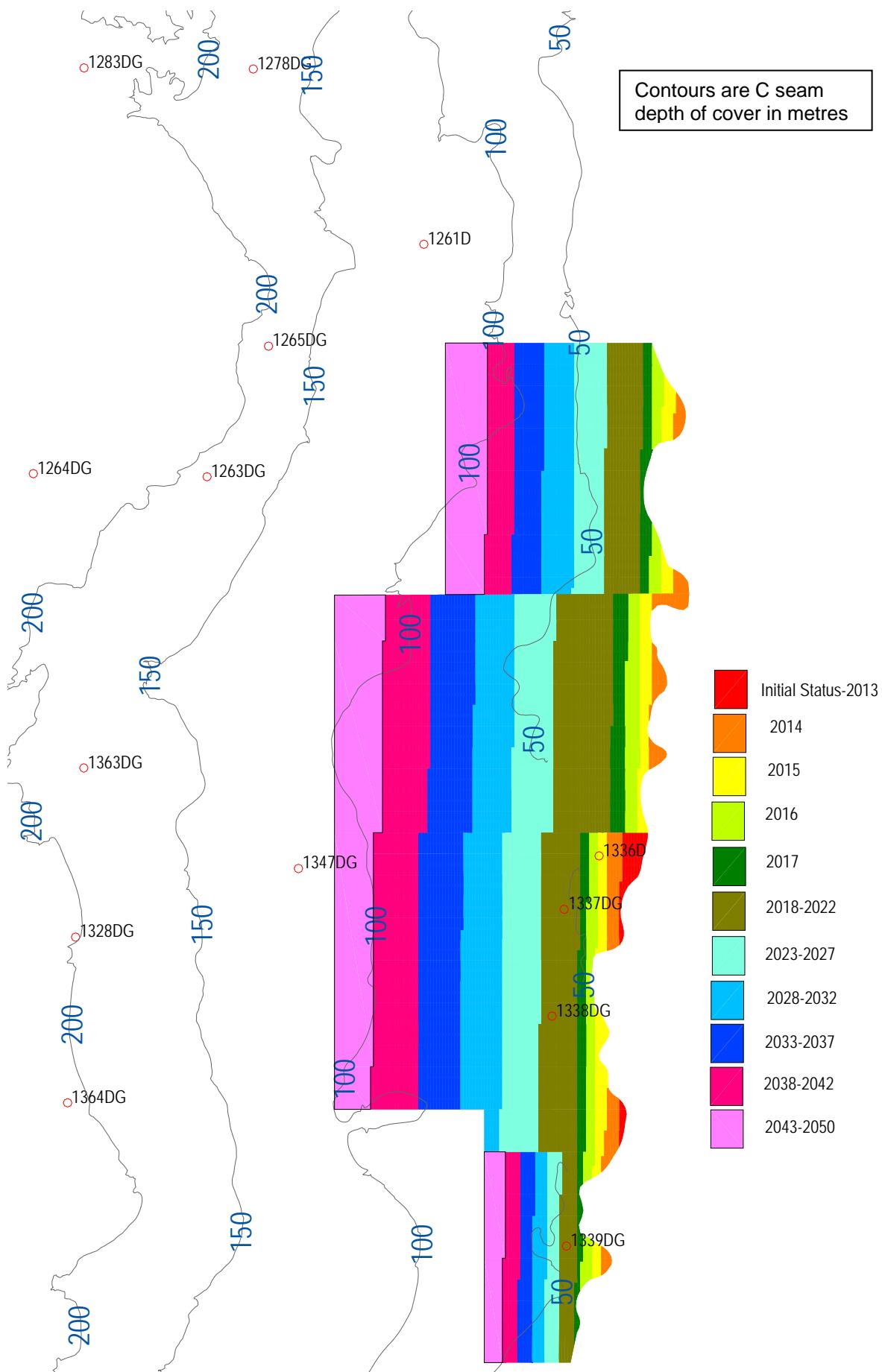


Figure 6 Alpha Coal Gas Content Boreholes in Mining and Down Dip Area

4.1.2 Gas Content Results

The gas content results are from 51 samples across a range of lithologies described as coal seams and interburden¹⁰. Gas contents at sample ash vary from a minimum value of 0.02 m³/t to a maximum value of 0.34 m³/t within all gas content tests. For the four gas tested boreholes located within the Alpha Coal mining schedule area, gas contents range from 0.02 m³/t to 0.22 m³/t (Table 4).

An overview of gas content (at sample ash or normalised to an average 50% ash) versus depth for all samples across all boreholes show poor to no relationship with depth, with an average gas content of about 0.05 - 0.1 m³/t (Figure 7).

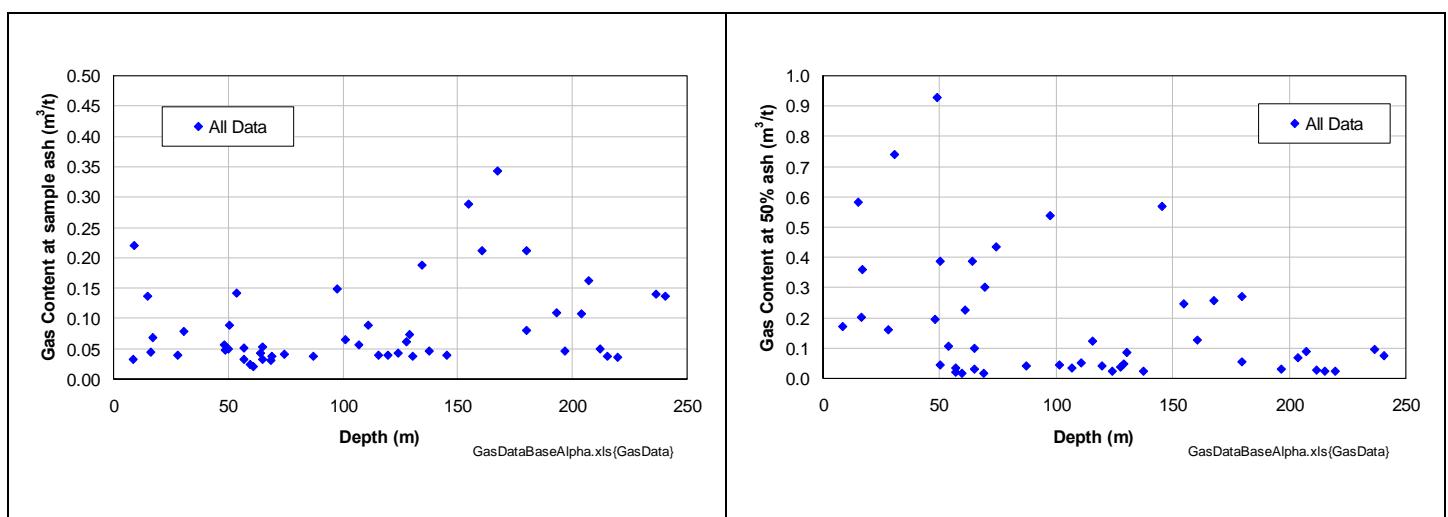


Figure 7 Gas Contents vs Depths

To define gas content trends and relationships with depth, the gas content for coal and carbonaceous strata has been normalised to an average ash according to four ash ranges: <45%, 45-80%, 80-90% and 90-97% ash (Figure 8).

¹⁰ GeoGAS Report 2010-704 Gas Content Testing Alpha

Table 4 Summary of Gas Content and Composition, for All Boreholes

Borehole	Easting	Northing	Sample	Seam	Average Depth (m)	Gas Content Qm		CH ₄ /(CH ₄ +CO ₂) Ratio	Sample Ash (%)
						Qm at Sample Ash (m ³ /t)	Qm		
1261D	442587	7446321	APH0001	DLL	161	0.21	0.82	15.8	
1263DG	437522	7440859	APH0002	C23	193	0.11	0.52	16.3	
1263DG	437522	7440859	APH0003	D Interburden	212	0.05	0.29	11.8	
1264DG	433464	7440931	APH0004	B3	168	0.34	0.95	32.9	
1264DG	433464	7440931	APH0005	C3	237	0.14	0.83	26.3	
1264DG	433464	7440931	APH0006	DLL	256	0.14	0.89	13.5	
1265DG	438959	7443927	APH0007	DLM	207	0.16	0.91	7.8	
1283DG	434649	7450463	APH0008	A3	135	0.19	0.86	10.1	
1283DG	434649	7450463	APH0009	B3	155	0.29	0.90	41.6	
1283DG	434649	7450463	APH0010	DLL	240	0.14	0.62	8.2	
1278DG	438601	7450438	APH0011	CU	180	0.21	0.64	60.9	
1278DG	438601	7450438	APH0012	DLM2	204	0.11	0.68	20.8	
1336D	446681	7431953	APH0013	N/A	9	0.03	0.35	90.6	
1336D	446681	7431953	APH0014	Tertiary	16	0.04	0.00	89.0	
1336D	446681	7431953	APH0015	Permian	28	0.04	0.00	87.8	
1337DG	445865	7430696	APH0016	CU	50	0.05	0.00	43.9	
1337DG	445865	7430696	APH0017	C12	60	0.02	0.08	23.3	
1337DG	445865	7430696	APH0018	C-D Interburden	64	0.04	0.00	94.6	
1337DG	445865	7430696	APH0019	DLM2	69	0.03	0.50	13.2	
1337DG	445865	7430696	APH0020	D floor	74	0.04	0.00	95.3	
1338DG	445582	7428189	APH0021	Tertiary	9	0.22	0.00	89.2	
1338DG	445582	7428189	APH0022	Weathered Permian	31	0.08	0.00	94.7	
1338DG	445582	7428189	APH0023	Fresh Permian	50	0.09	0.00	88.5	
1338DG	445582	7428189	APH0024	CU	54	0.14	0.00	34.2	
1338DG	445582	7428189	APH0025	C	57	0.05	0.81	23.5	
1338DG	445582	7428189	APH0026	Fresh Permian	61	0.02	0.00	95.6	
1338DG	445582	7428189	APH0027	DLM2	65	0.05	0.36	13.5	
1328DG	434450	7430045	APH0028	A3	107	0.06	0.00	14.8	
1328DG	434450	7430045	APH0029	B4	124	0.04	0.75	10.5	
1328DG	434450	7430045	APH0030	DLM2	220	0.04	0.00	23.5	
1339DG	445920	7422786	APH0031	Weathered Permian	17	0.07	0.00	90.5	
1339DG	445920	7422786	APH0032	Fresh Permian	49	0.05	0.00	97.4	
1339DG	445920	7422786	APH0033	DU	57	0.03	0.00	13.8	
1339DG	445920	7422786	APH0034	D-E Interburden	69	0.04	0.00	93.7	
1339DG	445920	7422786	APH0035	E	87	0.04	0.00	56.0	
1347DG	439658	7431655	APH0036	Tertiary	15	0.14	0.00	88.3	
1347DG	439658	7431655	APH0037	Permian	48	0.06	0.00	85.5	
1347DG	439658	7431655	APH0038	Fresh Permian	65	0.03	0.00	83.1	
1347DG	439658	7431655	APH0039	Fresh Permian	97	0.15	0.00	86.3	
1347DG	439658	7431655	APH0040	CU	115	0.04	0.07	84.0	
1347DG	439658	7431655	APH0041	CU	120	0.04	0.00	52.0	
1347DG	439658	7431655	APH0042	C23	128	0.06	0.43	16.3	
1347DG	439658	7431655	APH0043	C-D Interburden	130	0.04	0.25	78.3	
1347DG	439658	7431655	APH0044	DLL	138	0.05	0.53	7.8	
1347DG	439658	7431655	APH0045	D Floor	145	0.04	0.00	96.5	
1363DG	434643	7434018	APH0046	DLM2	101	0.07	0.29	29.6	
1363DG	434643	7434018	APH0047	C1	180	0.08	0.63	27.1	
1363DG	434643	7434018	APH0048	DL1	197	0.05	0.36	26.8	
1364DG	434264	7426152	APH0049	A2	111	0.09	0.77	13.6	
1364DG	434264	7426152	APH0050	B4	129	0.07	0.83	25.9	
1364DG	434264	7426152	APH0051	C3	215	0.04	0.44	22.6	

GasDataBaseAlpha.xls{ReportTable}

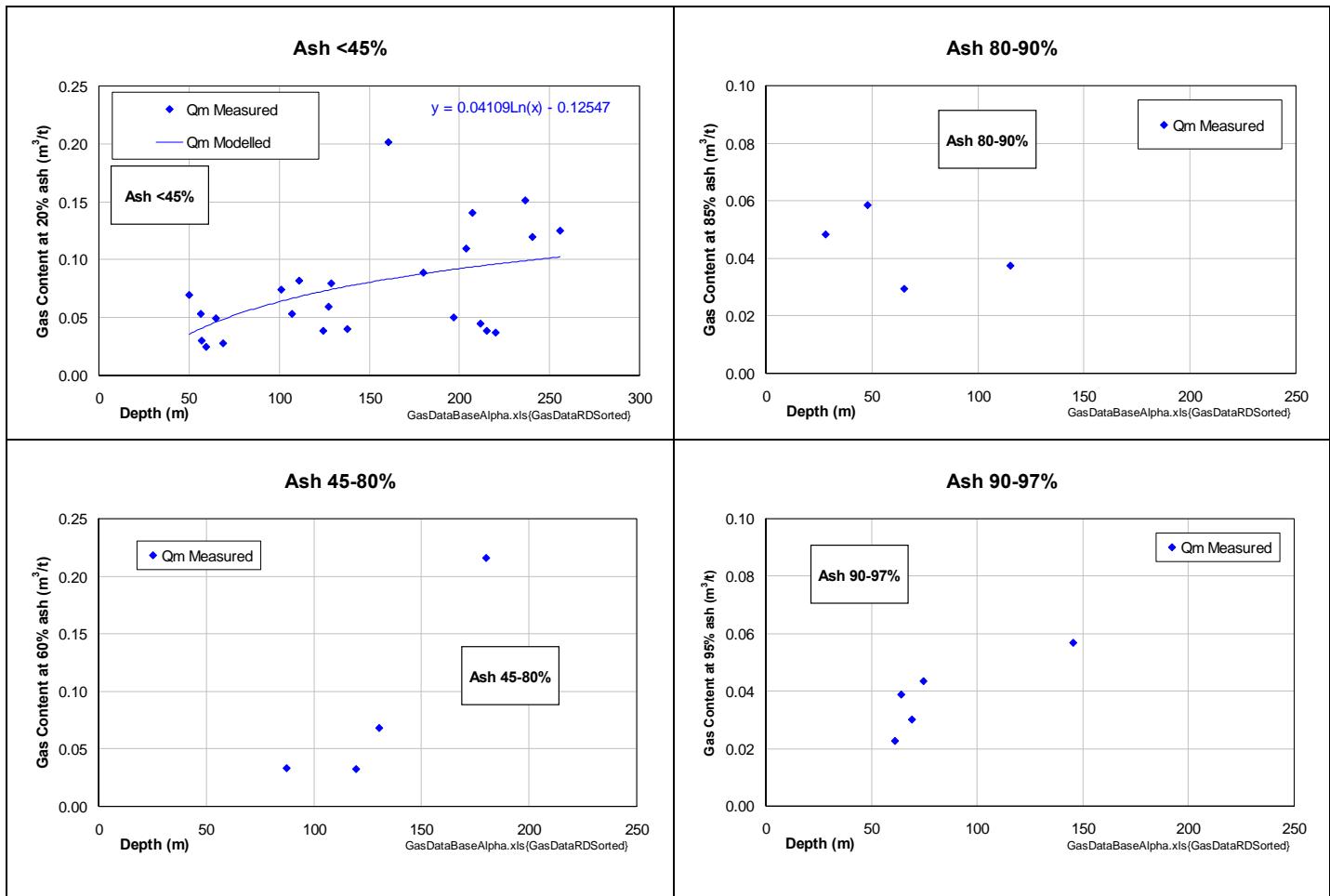


Figure 8 Gas Contents Depth Relationship

None of the relationships are strong, and the relationship for strata > 45% ash is nil. The modelled relationships can be expressed as:

- for ash <45%: $Qm = 0.04109 * \ln (\text{Depth}) - 0.12547$
- for ash >45%: $Qm = 0.04 \text{ m}^3/\text{t}$.

4.2 Gas Composition

There was no relationship between gas composition and depth but there was an increasing trend in CH₄ with gas content (Figure 9).

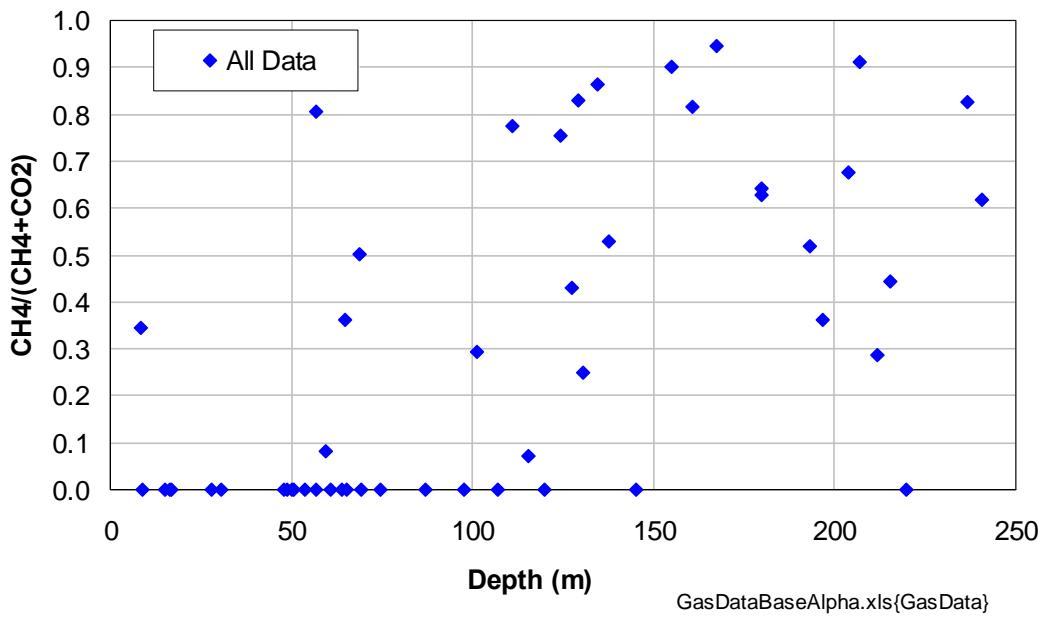


Figure 9 Gas Composition with Depth

The modelled gas content and composition relationship can be expressed as (Figure 10):

- for gas content at strata ash < 0.04 m³/t: **100% CO₂**
- for gas content at strata ash > 0.04 m³/t: **CH₄ Composition = a + b * Qm + c/Qm²**

where:

$$a = 0.98049289$$

$$b = -0.099679887$$

$$c = -0.0014655676.$$

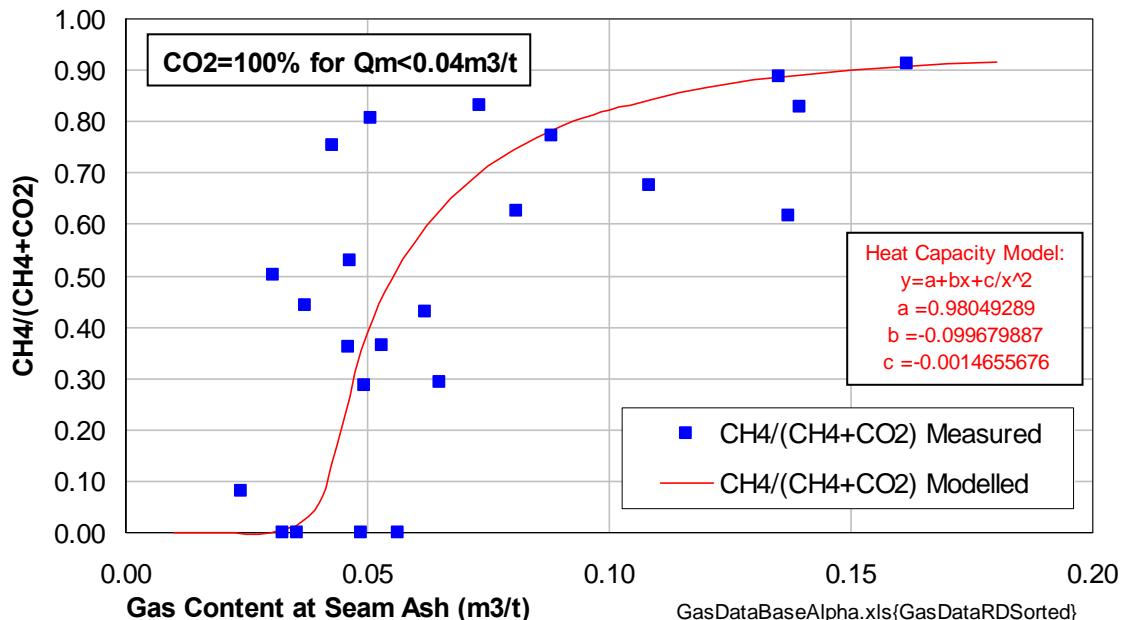


Figure 10 Gas Composition with Gas Content

4.3 Ash

In order to calculate ash from the LAS (density log) file, the following relationship between relative density and ash has been established from data supplied by Salva Resources¹¹ (Figure 11):

$$\text{Ash} = -3.1735 * (\text{RD})^3 - 2.4559 * (\text{RD})^2 + 113.4165 * (\text{RD}) - 133.48914$$

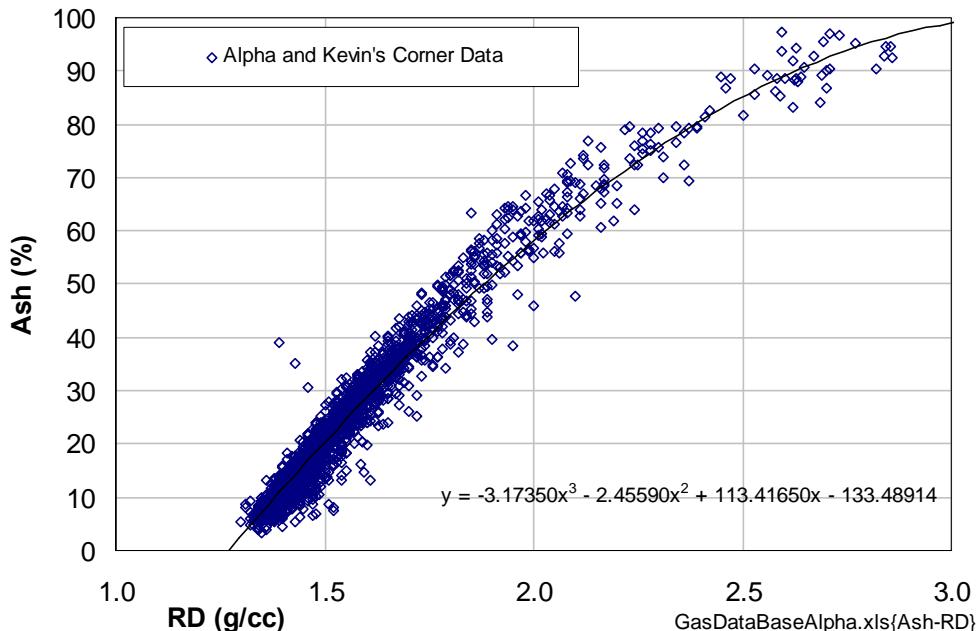


Figure 11 Ash vs Relative Density (RD) Relationship

¹¹ Salva Resupces database, file “alpha_kc_db_26072010.xlsx”

5. CARBON EMISSIONS

5.1 Gas Emission Calculation for Each Borehole

Gas bearing strata is defined from the lithology, and gas content and composition are assigned from relationships established between gas content, depth, composition, ash and density. For the open cut pits 11 boreholes were selected around production areas, and one deep borehole 1363DG for comparison in order to produce CO₂-e emission contours and relationship with mining seam depth (Figure 12).

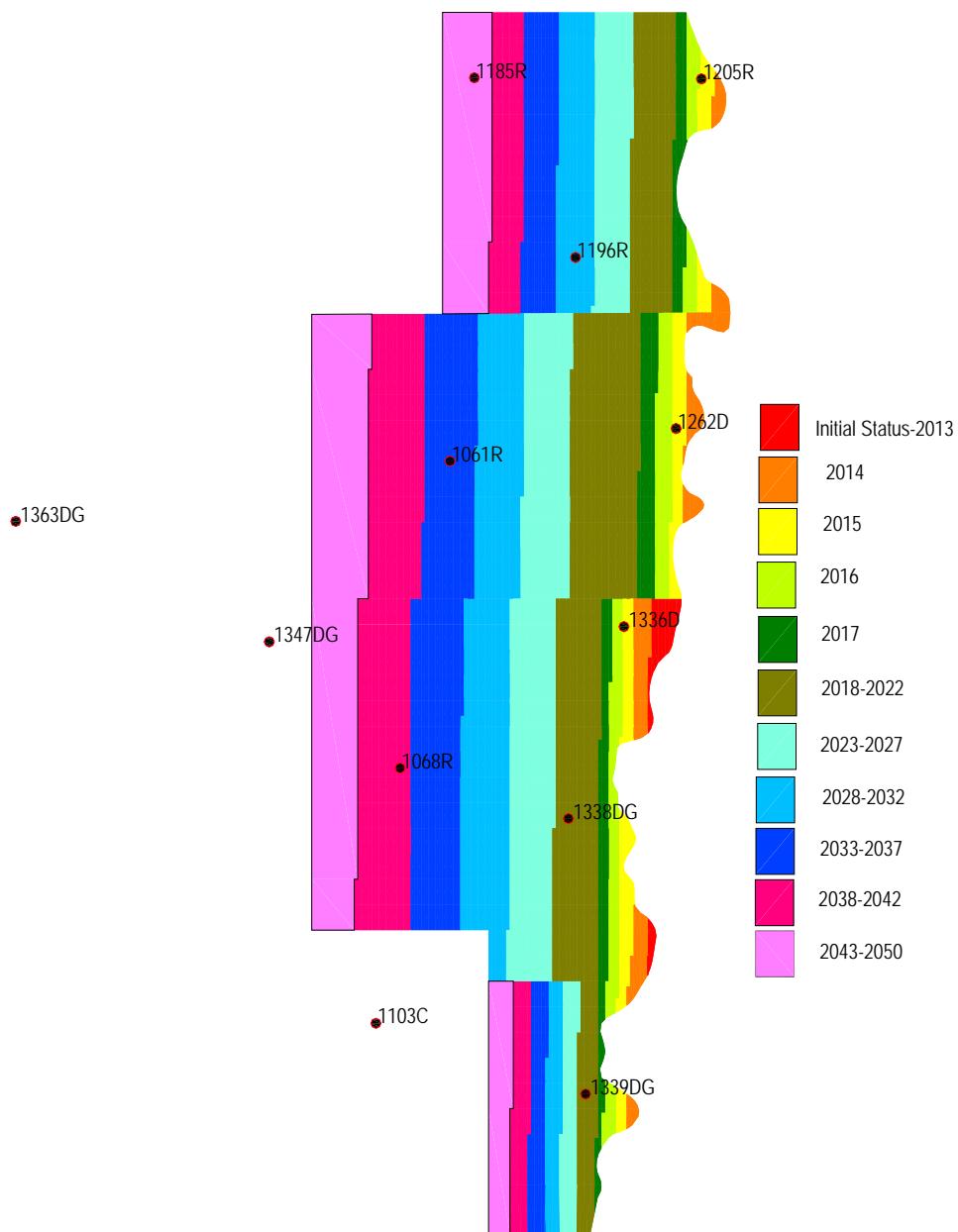


Figure 12 Selected Boreholes for CO₂-e Emission Calculation

Gas Reservoir Size (GRS) for CH₄ and CO₂ is calculated for each carbonaceous lithological unit in every borehole, according to the following formula:

$$\text{GRS (m}^3/\text{m}^2\text{)} = \text{Gas Content (m}^3/\text{t}\text{)} * \text{Relative Density (t/m}^3\text{)} * \text{Unit Thickness (m)} * \text{Gas Composition}$$

The mass of the strata is calculated from the unit thickness multiplying by relative density. After GRS is calculated for each unit, the CO₂-e emission can be summarily calculated for the borehole strata, per square metre, for Method 2 ($S_{jz} = M_z \times \beta \times GC_{jz}$ from page 10).

An example of the calculations for borehole 1185R is given below (Figure 13, Table 5 and Figure 14). [GHG emission reports for all boreholes are presented in Appendix A.](#)

Figure 13 Borehole 1185R Lithology, Density, Gas Bearing Strata, Gas Contents (m³/t)

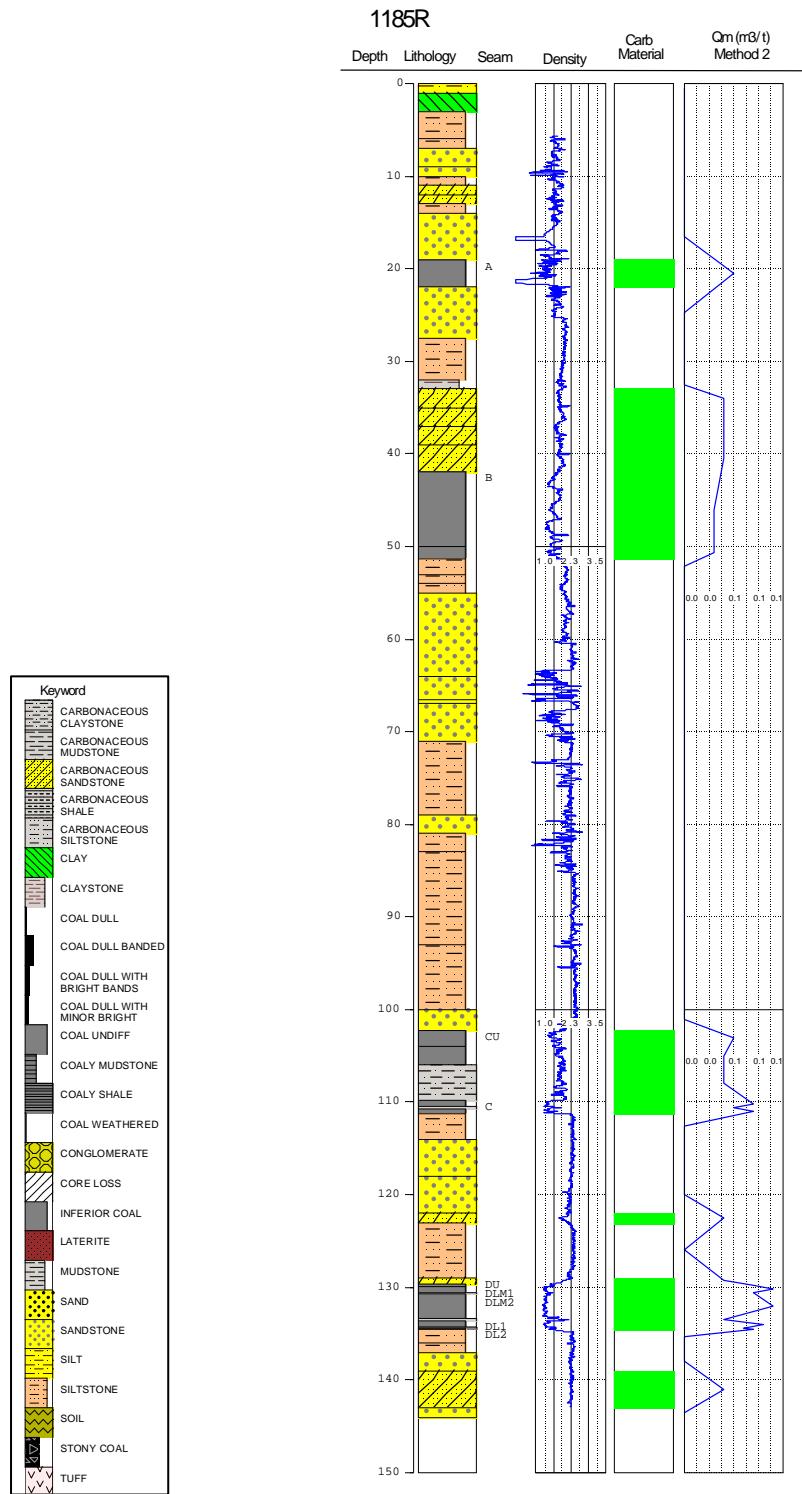


Table 5 Borehole 1185R Lithology and Gas Data

Lithology 1185R	Depth To Base (m)	Thickness (m)	RD from LAS (t/m ³)	Calculated Ash (%)	Carbonaceous Material (Y/N)	Mass of the Gas Bearing Strata (M _s) (t/m ²)	Coefficient β	Qm-Depth Relationship Option
SILT (SI)	1.0	1.0	3.00	99	N	-	-	0.0000
CLAY (CL)	3.0	2.0	3.00	99	N	-	-	0.0000
SILTSTONE (SL)	6.0	3.0	3.00	99	N	-	-	0.0000
SILTSTONE (SL)	7.0	1.0	1.75	40	N	-	-	0.0000
SANDSTONE (SS)	9.0	2.0	1.66	34	N	-	-	0.0000
SANDSTONE (SS)	10.0	1.0	1.55	25	N	-	-	0.0000
SILTSTONE (SL)	11.0	1.0	1.76	41	N	-	-	0.0000
CARBONACEOUS SANDSTON	12.0	1.0	1.77	42	N	-	-	0.0000
CARBONACEOUS SANDSTON	13.0	1.0	1.67	35	N	-	-	0.0000
SILTSTONE (SL)	14.0	1.0	1.75	41	N	-	-	0.0000
SANDSTONE (SS)	19.0	5.0	1.49	19	N	-	-	0.0000
COAL UNDIFF (CO)	21.9	2.9	1.30	3	Y	3.8	1.0	0.05 0 0 0.183 0.0003
SANDSTONE (SS)	27.5	5.6	1.86	48	N	-	-	0.0003
SILTSTONE (SL)	32.0	4.5	1.99	57	N	-	-	0.0003
CLAYSTONE (CS)	33.0	1.0	1.92	53	N	-	-	0.0003
CARBONACEOUS SANDSTON	35.0	2.0	1.85	48	Y	3.7	1.0	0.04 0 0 0.148 0.0006
CARBONACEOUS SANDSTON	37.0	2.0	1.91	52	Y	3.8	1.0	0.04 0 0 0.153 0.0009
CARBONACEOUS SANDSTON	39.0	2.0	1.83	46	Y	3.7	1.0	0.04 0 0 0.146 0.0012
CARBONACEOUS SANDSTON	42.0	3.0	1.90	51	Y	5.7	1.0	0.04 0 0 0.227 0.0016
INFERIOR COAL (IC)	50.0	8.0	1.64	32	Y	13.1	1.0	0.03 0 0 0.393 0.0023
INFERIOR COAL (IC)	51.4	1.4	1.64	32	Y	2.2	1.0	0.03 0 0 0.069 0.0024
SILTSTONE (SL)	53.0	1.7	2.07	62	N	-	-	0.0024
SILTSTONE (SL)	54.0	1.0	2.08	63	N	-	-	0.0024
SILTSTONE (SL)	55.0	1.0	1.96	55	N	-	-	0.0024
SANDSTONE (SS)	64.0	9.0	2.12	66	N	-	-	0.0024
SANDSTONE (SS)	66.5	2.5	1.77	42	N	-	-	0.0024
SANDSTONE (SS)	67.0	0.5	1.87	49	N	-	-	0.0024
SANDSTONE (SS)	71.0	4.0	1.91	52	N	-	-	0.0024
SILTSTONE (SL)	79.0	8.0	2.17	68	N	-	-	0.0024
SANDSTONE (SS)	81.0	2.0	2.16	68	N	-	-	0.0024
SILTSTONE (SL)	83.0	2.0	1.94	54	N	-	-	0.0024
SILTSTONE (SL)	93.0	10.0	2.31	76	N	-	-	0.0024
SILTSTONE (SL)	100.0	7.0	2.39	80	N	-	-	0.0024
SANDSTONE (SS)	102.2	2.2	2.30	76	N	-	-	0.0024
COAL UNDIFF (CO)	104.0	1.8	1.70	37	Y	3.1	1.0	0.05 0 0 0.158 0.0027
INFERIOR COAL (IC)	106.0	2.0	1.88	50	Y	3.8	1.0	0.04 0 0 0.151 0.0030
CARBONACEOUS CLAYSTON	109.8	3.8	1.91	52	Y	7.2	1.0	0.04 0 0 0.290 0.0035
COAL UNDIFF (CO)	110.5	0.7	1.43	15	Y	1.0	1.0	0.07 1 0 0.072 0.0037
CARBONACEOUS CLAYSTON	110.7	0.2	1.69	36	Y	0.3	1.0	0.05 0 0 0.018 0.0037
COAL UNDIFF (CO)	111.2	0.5	1.48	19	Y	0.7	1.0	0.07 1 0 0.051 0.0038
SILTSTONE (SL)	114.0	2.8	2.31	77	N	-	-	0.0038
SANDSTONE (SS)	118.0	4.0	2.32	77	N	-	-	0.0038
SANDSTONE (SS)	122.0	4.0	2.22	71	N	-	-	0.0038
CARBONACEOUS SANDSTON	123.0	1.0	2.06	62	Y	2.1	1.0	0.04 0 0 0.082 0.0039
SILTSTONE (SL)	129.0	6.0	2.32	77	N	-	-	0.0039
CARBONACEOUS SANDSTON	129.6	0.6	1.99	58	Y	1.2	1.0	0.04 0 0 0.048 0.0040
COAL UNDIFF (CO)	129.9	0.3	1.58	27	Y	0.5	1.0	0.07 1 0 0.032 0.0041
COAL UNDIFF (CO)	130.6	0.7	1.36	8	Y	0.9	1.0	0.09 1 0 0.075 0.0042
CARBONACEOUS CLAYSTON	130.7	0.1	1.56	25	Y	0.2	1.0	0.07 1 0 0.011 0.0043
COAL UNDIFF (CO)	133.4	2.8	1.37	9	Y	3.8	1.0	0.09 1 0 0.321 0.0049
CARBONACEOUS CLAYSTON	133.6	0.2	1.97	56	Y	0.4	1.0	0.04 0 0 0.016 0.0049
COAL UNDIFF (CO) Pit Floor	134.3	0.7	1.40	11	Y	1.0	1.0	0.08 1 0 0.081 0.0051
COALY SHALE (ZH) Pit Floor	134.4	0.1	1.69	36	Y	0.2	1.0	0.06 1 0 0.010 0.0051
INFERIOR COAL (IC) Pit Floor	134.6	0.2	1.55	25	Y	0.3	1.0	0.07 1 0 0.022 0.0051
SILTSTONE (SL)	136.0	1.4	2.26	74	N	-	-	0.0051
SILTSTONE (SL)	137.0	1.0	2.33	77	N	-	-	0.0051
SANDSTONE (SS)	139.0	2.0	2.27	74	N	-	-	0.0051
CARBONACEOUS SANDSTON	143.0	4.0	2.27	74	Y	9.1	0.6	0.04 0 0 0.211 0.0055
SANDSTONE (SS)	144.0	1.0	2.21	71	N	-	-	0.0055

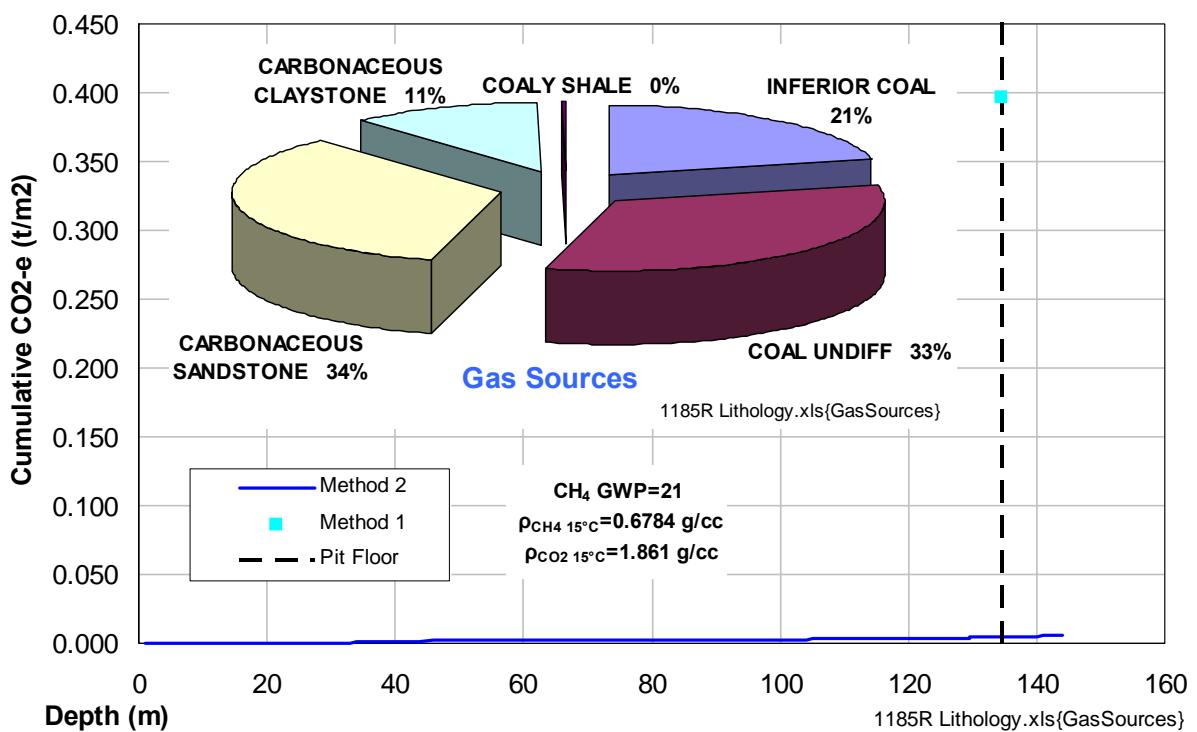


Figure 14 Cumulative Plot of Fugitive Gas Emissions for Borehole 1185R

Calculated CO₂-e GHG emissions from the selected boreholes (t/m²) were contoured (Table 6 and Figure 15).

Table 6 CO₂-e Emissions per Borehole

Borehole	Deepest Mining Seam	Mining Seam Depth (m)	Method 2 CO ₂ -e (t/m ²)
1061R	DL2	105	0.0030
1068R	DL2	97	0.0030
1103C	DL2	123	0.0041
1185R	DL2	135	0.0055
1196R	DL2	101	0.0022
1205R	DL2	34	0.0006
1262D	DL2	36	0.0004
1336D	DL2	64	0.0018
1338DG	DL2	70	0.0018
1339DG	DL2	63	0.0014
1347DG	DL2	138	0.0055
1363DG	DL2	199	0.0072

Production.xls{Data}

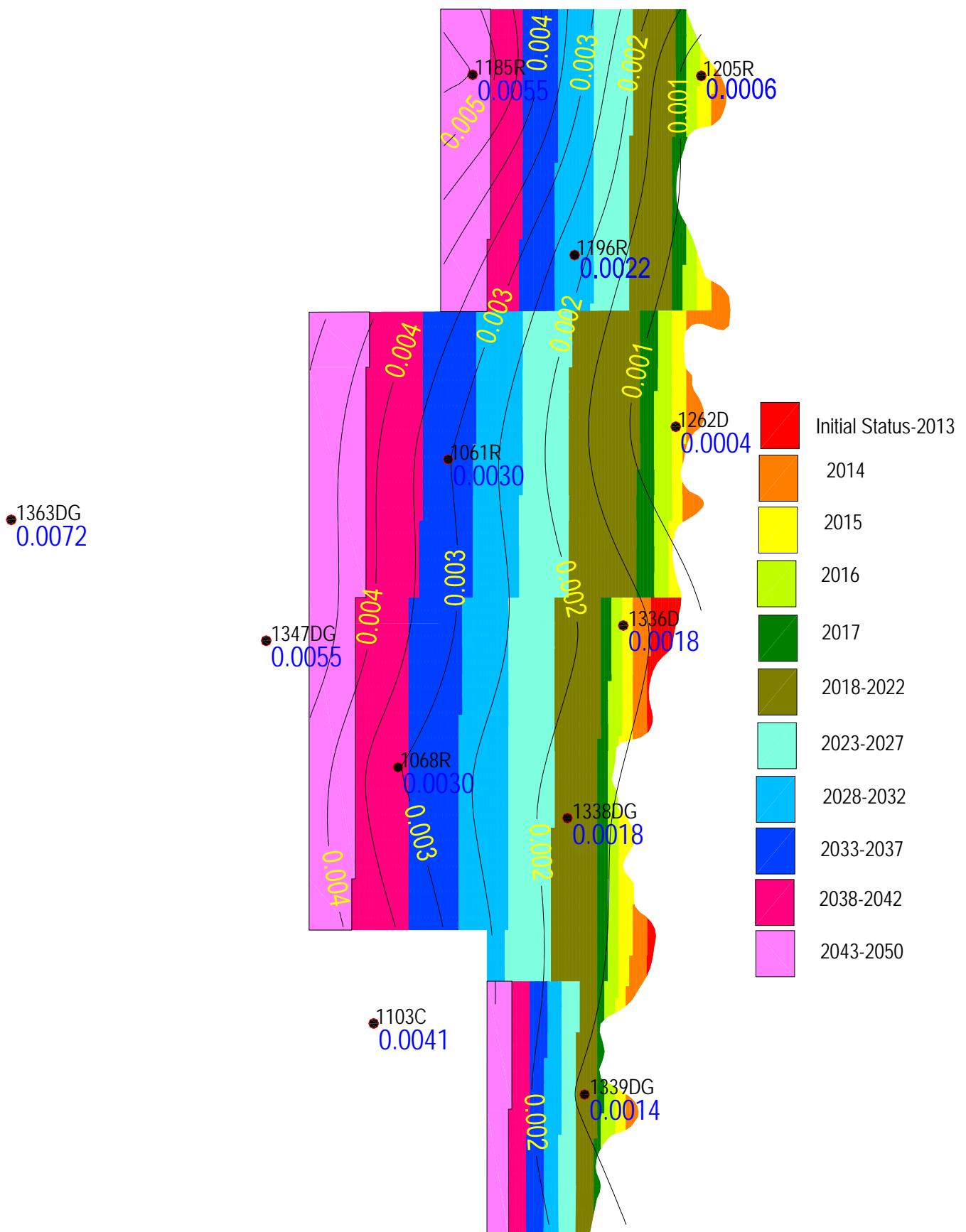


Figure 15 CO₂-e GHG Emission Contours (t/m²)

$\text{CO}_2\text{-e}$ emission increases with depth and shows a reasonable correlation with pit bottom seam depth (Figure 16).

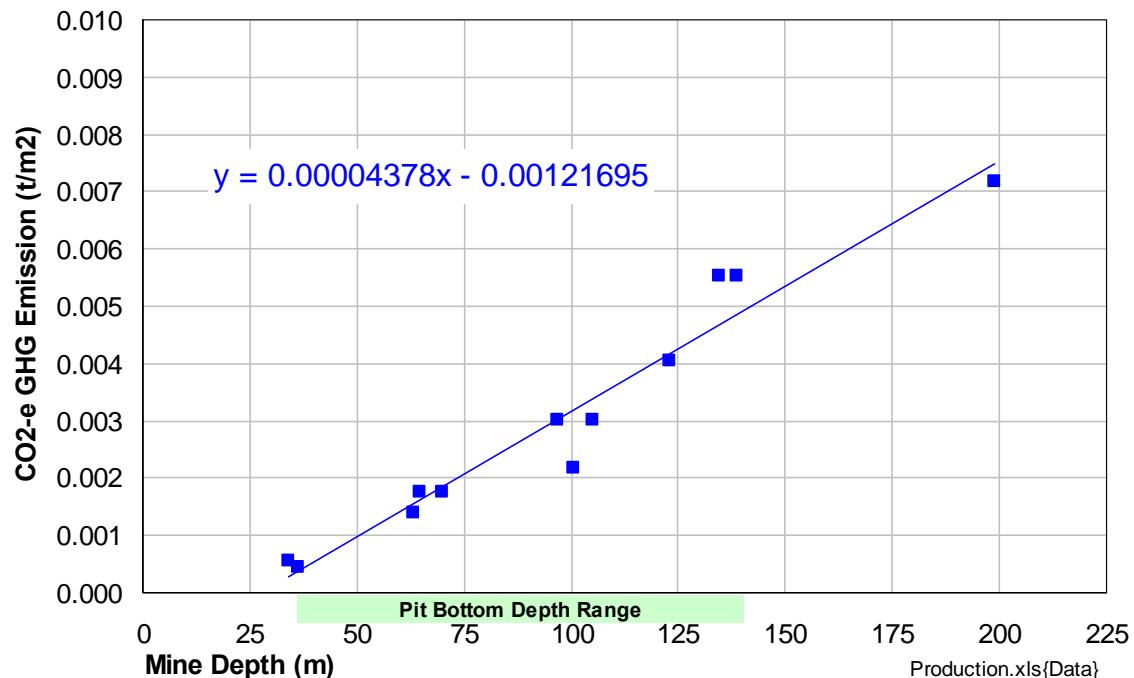


Figure 16 $\text{CO}_2\text{-e}$ GHG Emission vs Pit Bottom Seam Depth Relationship

$\text{CO}_2\text{-e}$ emission relationship with depth was utilised to calculate the annual $\text{CO}_2\text{-e}$ GHG emissions.

5.2 Open Cut $\text{CO}_2\text{-e}$ Emission Annual GHG Assessment

$\text{CO}_2\text{-e}$ emissions were assessed using the supplied mining schedule. DL seam mined areas and depths from the XPAC data¹² were utilised to calculate $\text{CO}_2\text{-e}$ emission (Table 7). **Salva Resources can update in-house GHG emission using “ $\text{CO}_2\text{-e}$ Emissions-Mining Depth” relationship for any changes in production scheduled areas.**

Method 1 yields an open cut **average** GHG emission of 690,352 tonnes for the years 2013 to 2050. Method 2 yields an **average** emission of 11,817 tonnes during the same time span. Compared to Method 2, the default Method 1 yields **58 times** more GHG emissions.

¹² File “Geogas Coal Details.xls”, email from Ashley John, Salva Resources, Sent: Fri 20/08/2010 1:59 PM.
GeoGAS Pty Ltd
Report No. 2010-712 / September, 2010

Table 7 Annual CO2-e GHG Emission

Parameter		Year												
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
ROM Production (t)		4,814,044	16,617,228	25,352,308	35,056,777	43,099,935	43,807,889	43,960,709	45,495,956	45,195,086	44,822,563	45,149,697	45,623,721	45,875,078
Area Mined (m ²)		1,071,057	2,928,985	3,832,670	4,784,526	5,251,001	4,566,004	4,418,710	4,243,644	4,125,353	4,123,335	3,794,032	3,868,739	3,776,426
Pit Floor (m)		58	51	53	55	57	59	63	66	70	73	76	79	81
CO2-e (t/m ²)		0.0013	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0017	0.0018	0.0020	0.0021	0.0023	0.0023
CO2-e Emission (t)	Method 1	81,839	282,493	430,989	595,965	732,699	744,734	747,332	773,431	768,316	761,984	767,545	775,603	779,876
	Method 2	1,400	2,952	4,188	5,723	6,696	6,312	6,735	7,144	7,588	8,250	7,993	8,713	8,865

Parameter		Year												
		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ROM Production (t)		45,607,197	45,642,931	45,407,453	45,256,931	45,408,861	45,406,454	45,832,180	46,199,298	46,548,001	46,719,768	46,055,257	45,998,651	45,686,232
Area Mined (m ²)		3,813,895	3,956,592	4,195,526	4,170,689	4,246,819	4,398,422	4,342,440	4,447,391	4,678,154	4,807,283	4,789,604	4,726,133	4,632,657
Pit Floor (m)		84	86	89	92	93	96	98	100	103	106	107	110	112
CO2-e (t/m ²)		0.0025	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035	0.0036	0.0037
CO2-e Emission (t)	Method 1	775,322	775,930	771,927	769,368	771,951	771,910	779,147	785,388	791,316	794,236	782,939	781,977	776,666
	Method 2	9,398	10,137	11,185	11,725	12,136	13,052	13,374	14,132	15,395	16,428	16,706	16,971	17,012

Parameter		Year												
		2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
ROM Production (t)		46,131,527	46,367,727	46,730,789	46,411,503	46,351,821	46,857,708	46,663,226	46,523,936	46,778,118	30,613,233	12,239,782	831,236	
Area Mined (m ²)		4,800,925	5,026,929	5,081,472	5,038,978	4,697,093	4,752,680	4,373,767	4,172,945	4,189,558	2,980,308	1,266,056	44,812	
Pit Floor (m)		114	116	117	119	120	121	123	125	127	127	130	134	
CO2-e (t/m ²)		0.0038	0.0039	0.0039	0.0040	0.0040	0.0041	0.0042	0.0043	0.0043	0.0043	0.0045	0.0047	
CO2-e Emission (t)	Method 1	784,236	788,251	794,423	788,996	787,981	796,581	793,275	790,907	795,228	520,425	208,076	14,131	
	Method 2	18,024	19,372	19,817	20,071	18,977	19,483	18,289	17,793	18,199	12,936	5,660	209	

CO2-e Emissions Summary.xls{CO2e Sum Report}

The GHG emissions progressively rise with the increase of the mining seam depth to a maximum value of 20,071 tonnes in year 2042 and afterwards decline with a reduction in the mines production (Figure 17 and Figure 18).

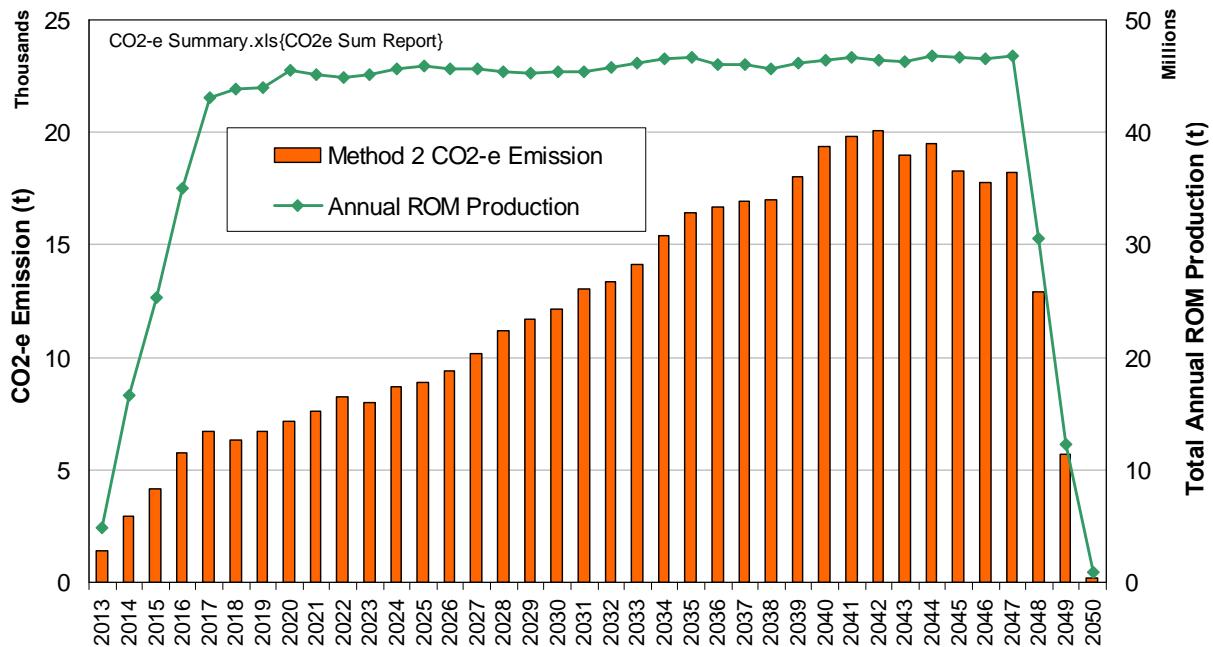


Figure 17 Methods 2 CO₂-e GHG Emissions and ROM Production

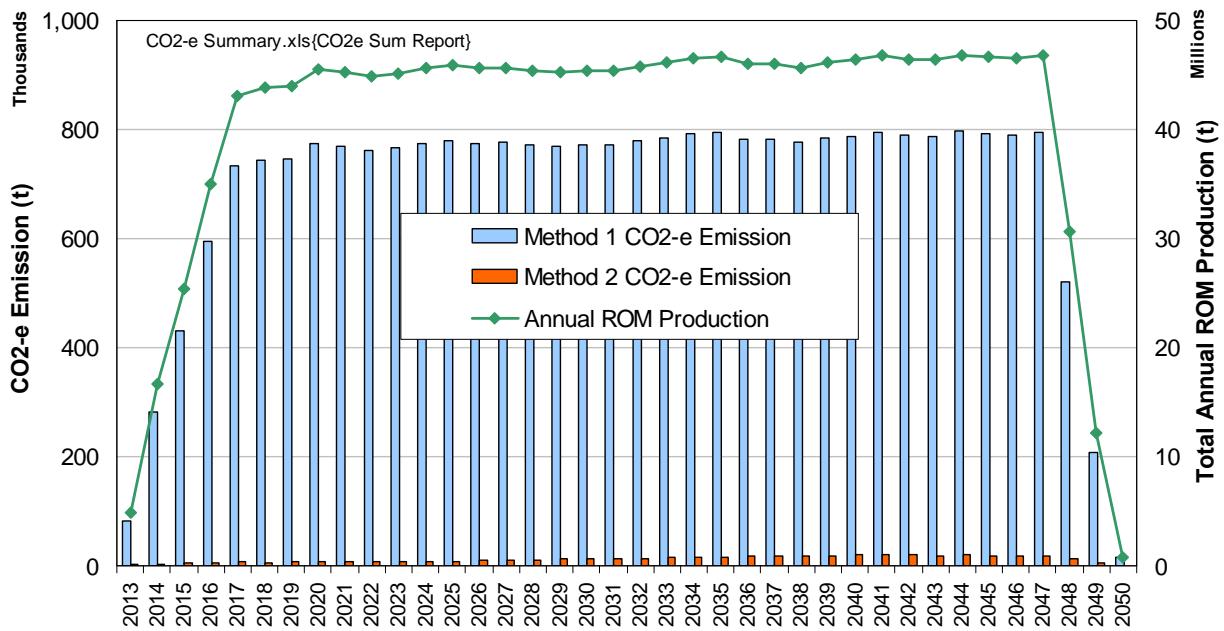


Figure 18 Method 1 and Method 2 CO₂-e GHG Emissions Comparison

Appendices

APPENDIX A - GHG EMISSION REPORTS

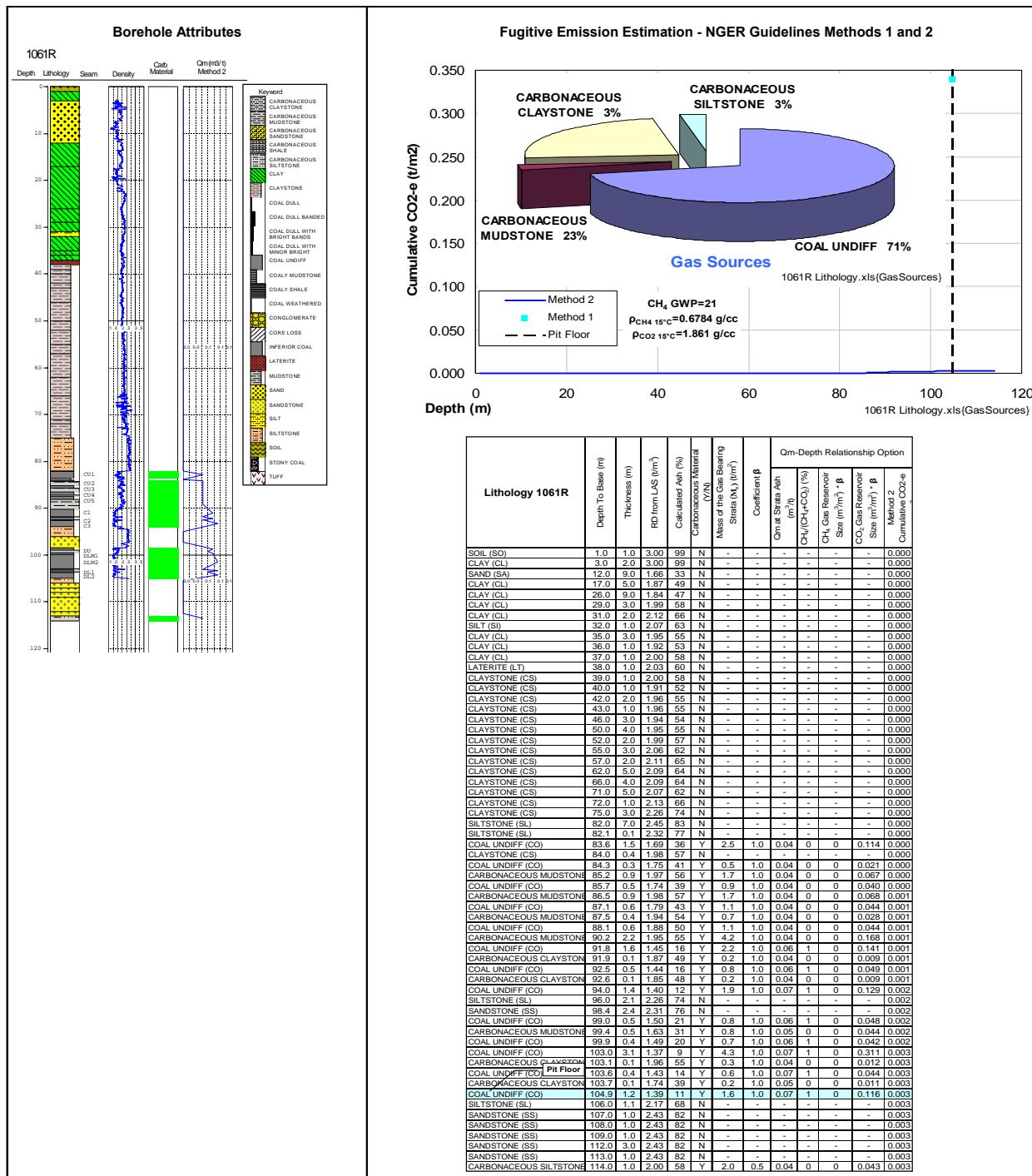
GeoGAS Pty Ltd

GeoGAS

Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1061R
Eastng	443236
Northng	7435199
Pit Floor (m)	105
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

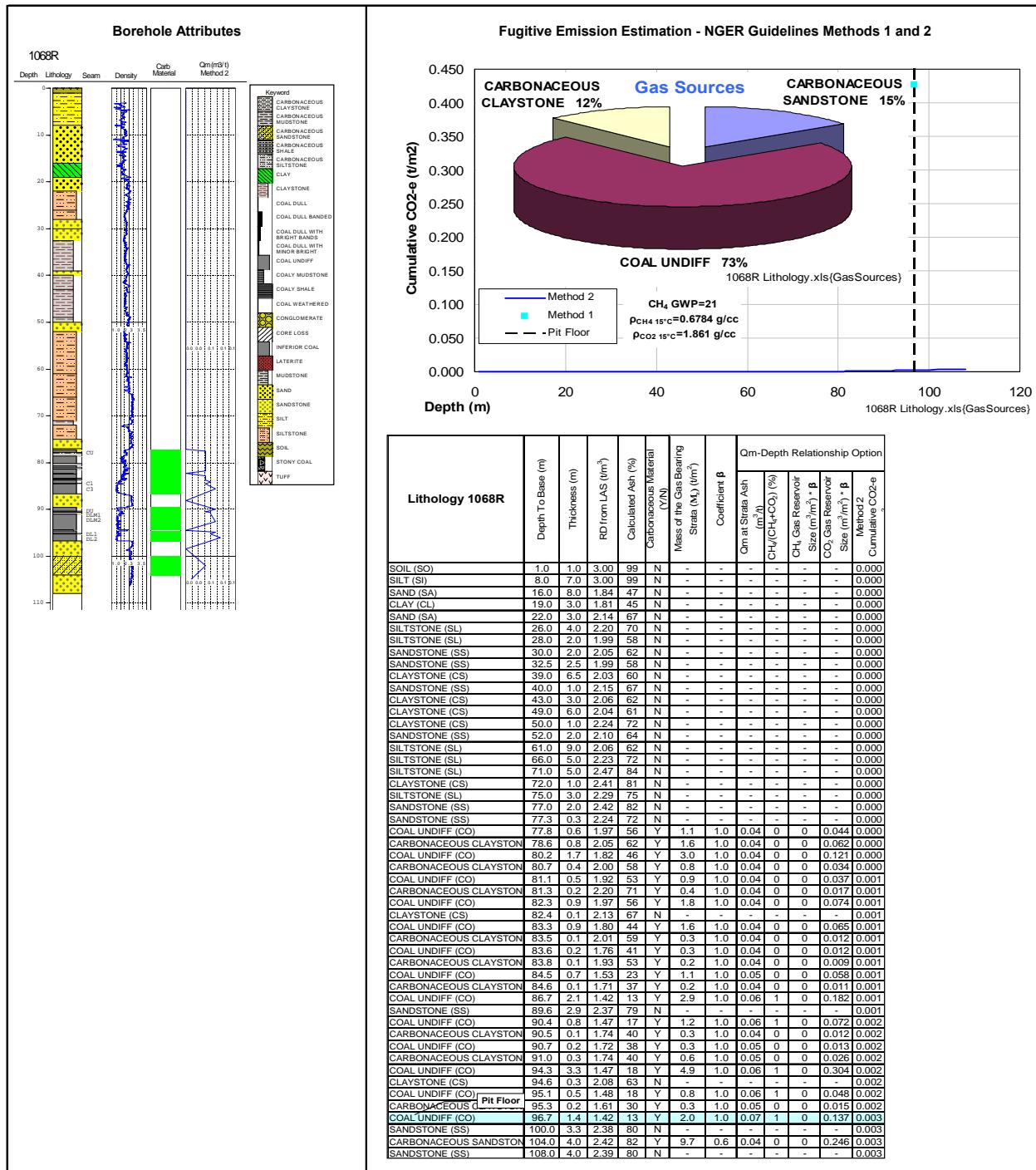
Total Coal Production (t/m ²)	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
19.96	0.017	0.3393
Qm-Depth Relationship Option	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)
	0.007	1.602
Method 2		CO ₂ -e Emissions (t/m ²)
		0.0030



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1068R
Easting	442251
Northing	7429180
Pit Floor (m)	97
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

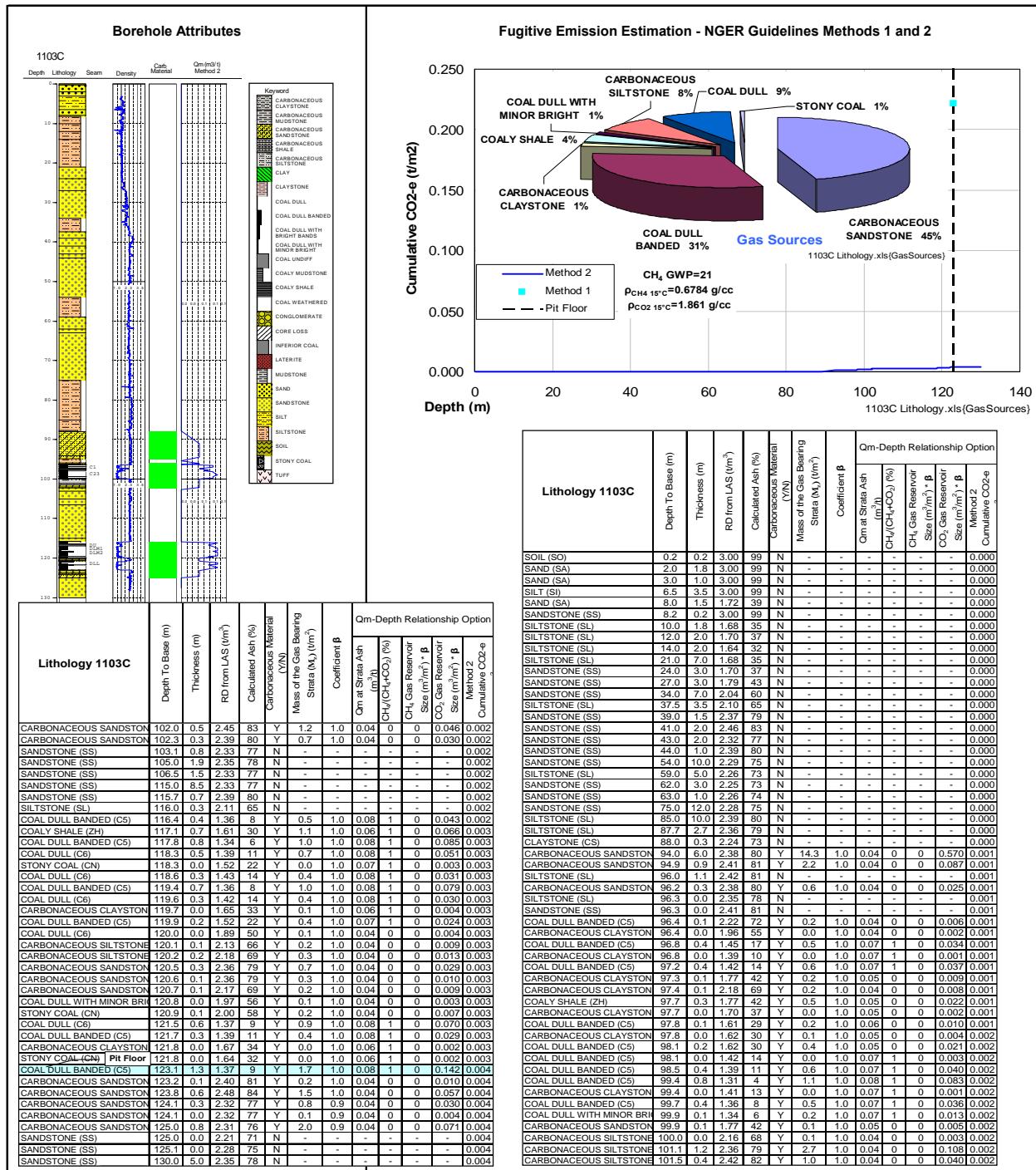
Qm-Depth Relationship Option	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
Qm-Depth Relationship Option	25.07	0.017 0.4263
	0.005	1.611 0.0030



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1103C
Easting	441771
Northing	7424174
Pit Floor (m)	123
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

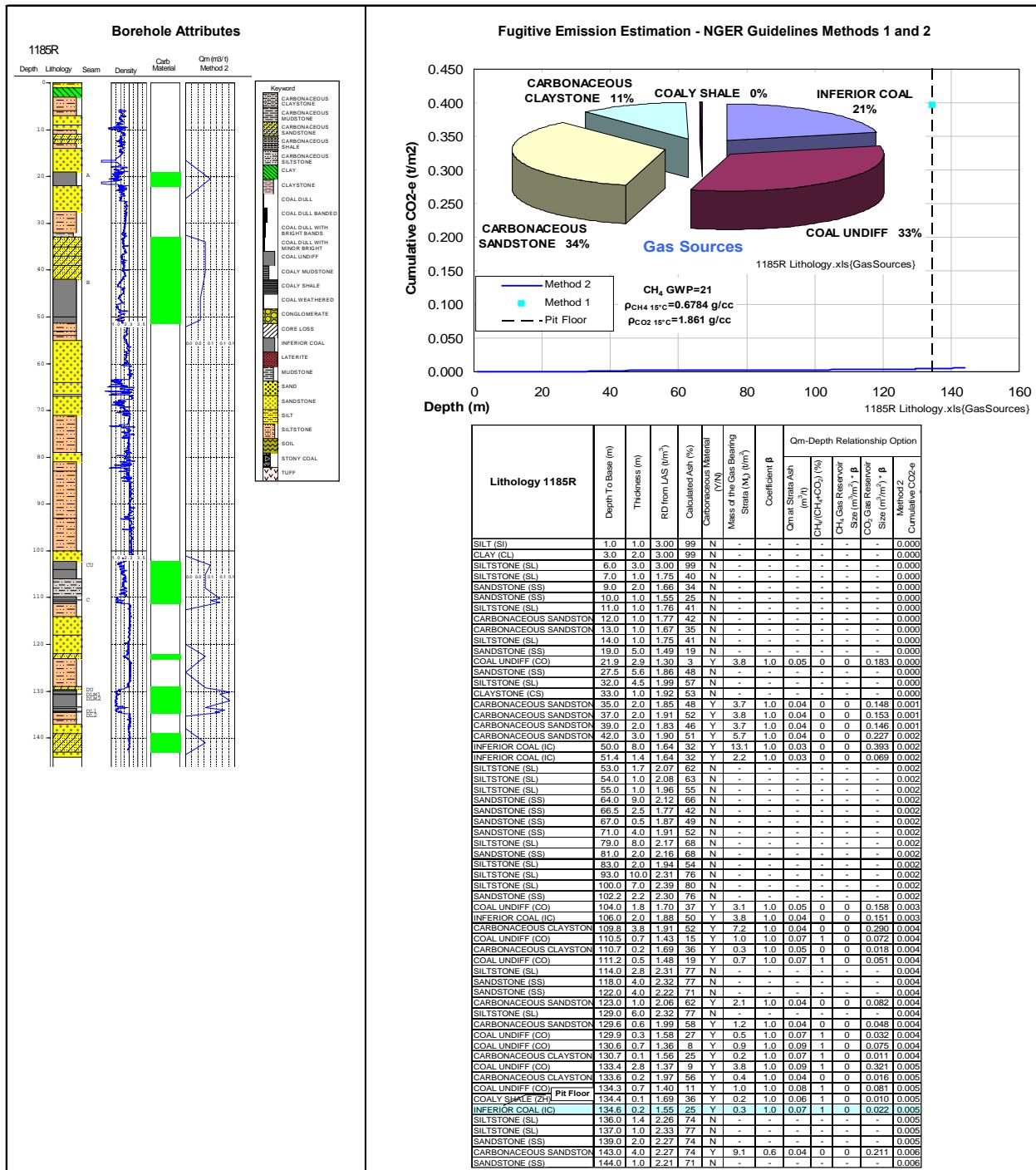
Qm-Depth Relationship Option	Total Coal Production (t/m ²)	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)	
	13.02	0.017	0.2213
Qm-Depth Relationship Option	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)	Method 2
	0.007	2.164	0.0041



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1185R
Eastings	443718
Northings	7442717
Pit Floor (m)	135
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

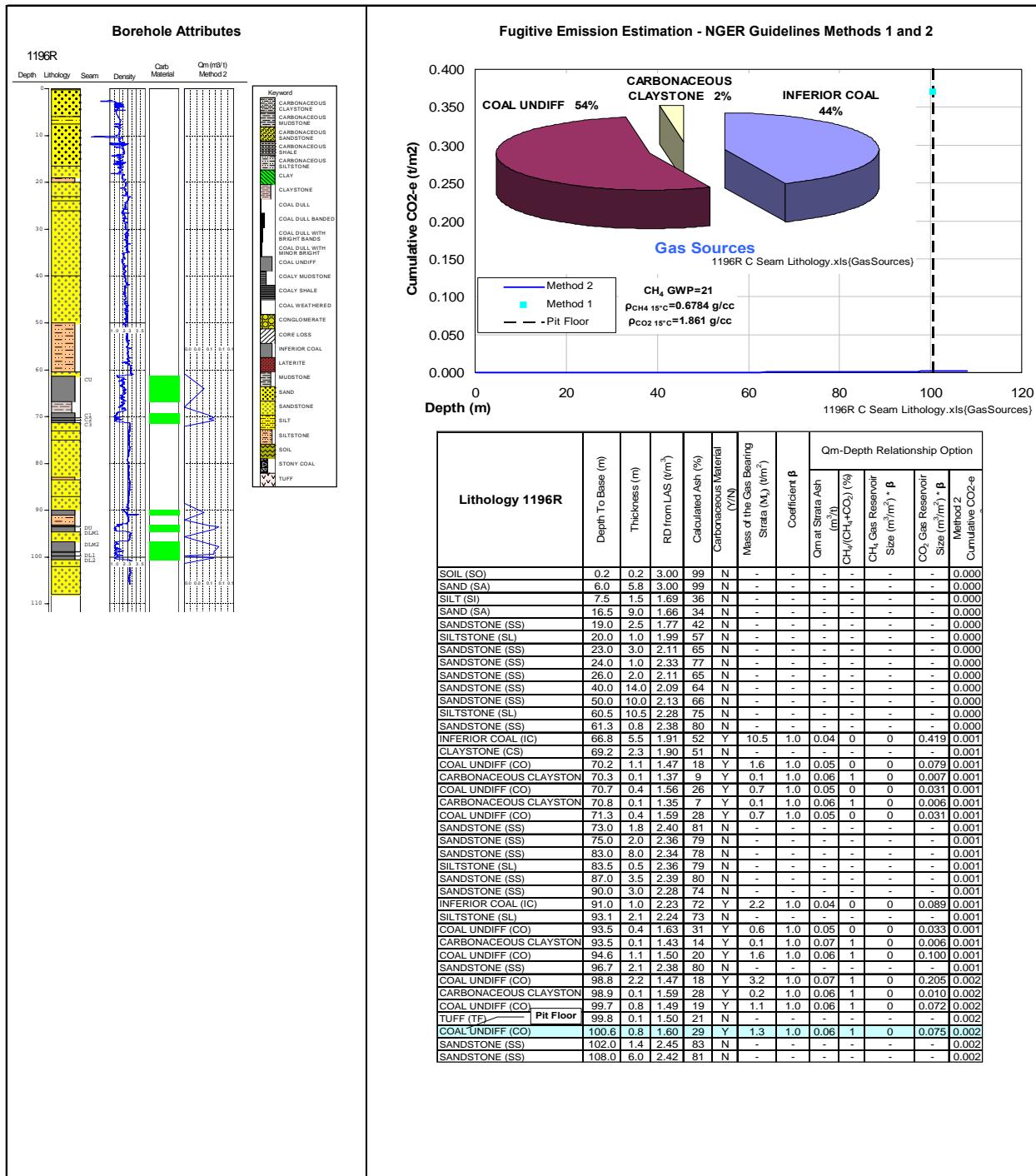
Qm-Depth Relationship Option	Total Coal Production (t/m ²)	Method 1	
	23.29	Emission Factor	CO ₂ -e Emissions (t/m ²)
Qm-Depth Relationship Option		CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)
		0.006	2.968
		Method 2	
		CO ₂ -e Emissions (t/m ²)	0.0055



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1196R
Easting	445723
Northing	7439193
Pit Floor (m)	101
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

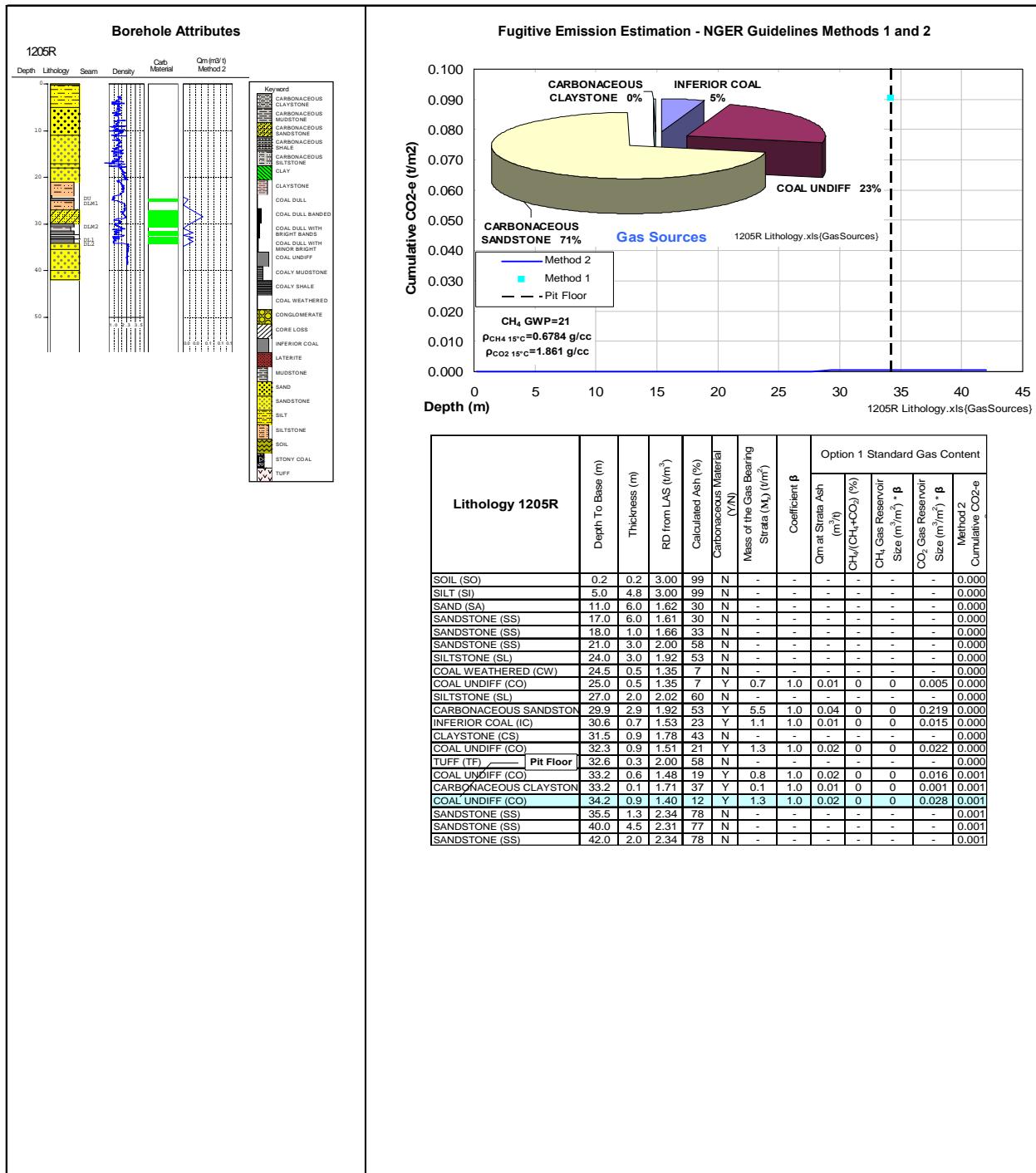
Qm-Depth Relationship Option	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)	Method 1
			Emission Factor
	0.004	1.163	0.3703
			Method 2
			CO ₂ -e Emissions (t/m ²)
			0.0022



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1205R
Eastings	448213
Northings	7442696
Pit Floor (m)	34
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

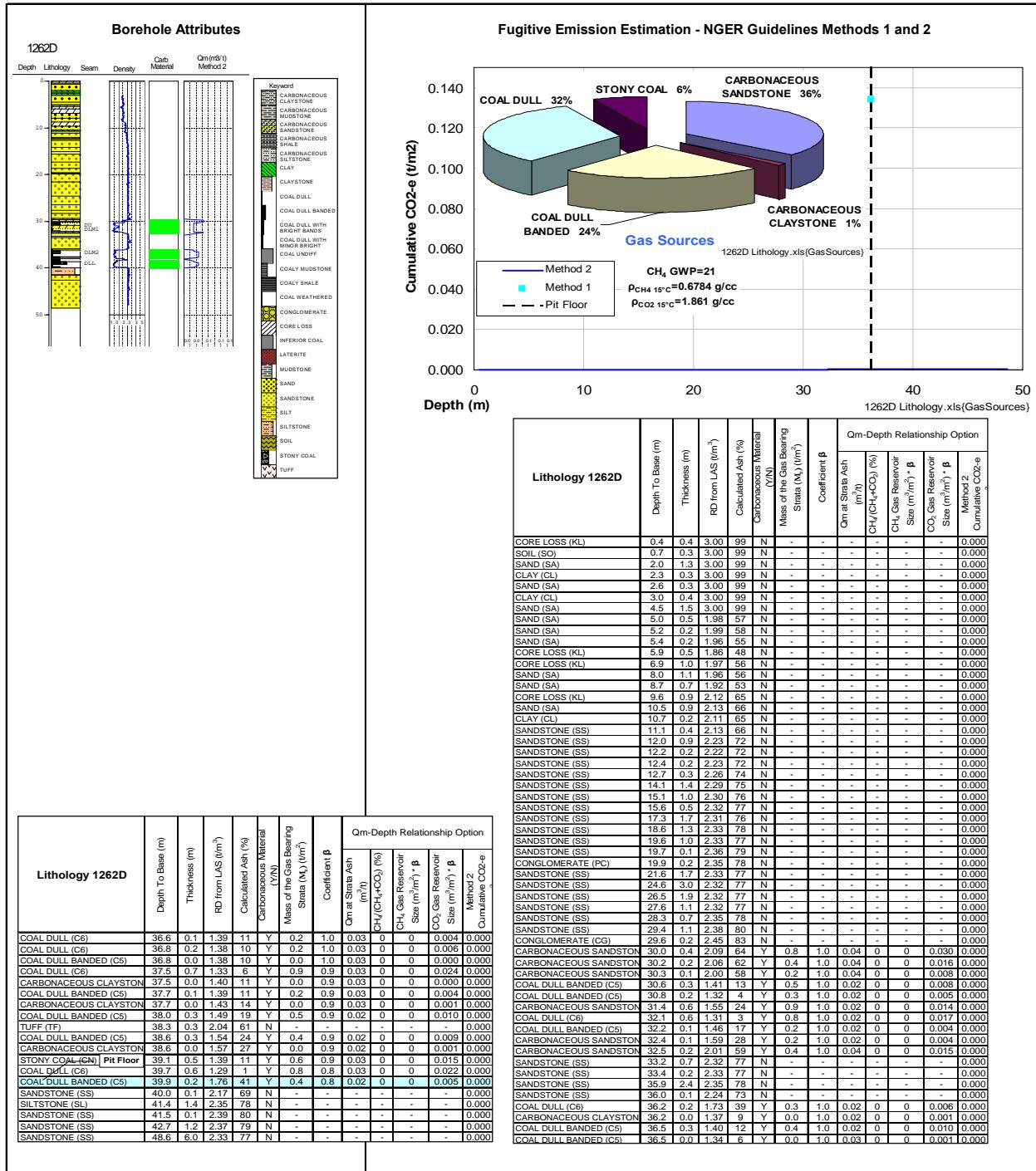
Qm-Depth Relationship Option	Total Coal Production (t/m ²)	Method 1	
	5.32	Emission Factor	CO ₂ -e Emissions (t/m ²)
CH ₄ GRS (m ³ /m ²)	0.017	0.0904	
CO ₂ GRS (m ³ /m ²)	0.308		0.0006



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1262D
Easting	447712
Northing	7435838
Pit Floor (m)	36
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

Qm-Depth Relationship Option	Total Coal Production (t/m ²)	Method 1	
	7.89	Emission Factor	CO ₂ -e Emissions (t/m ²)
		0.017	0.1342
Qm-Depth Relationship Option	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)	Method 2
	0.000	0.241	0.0004

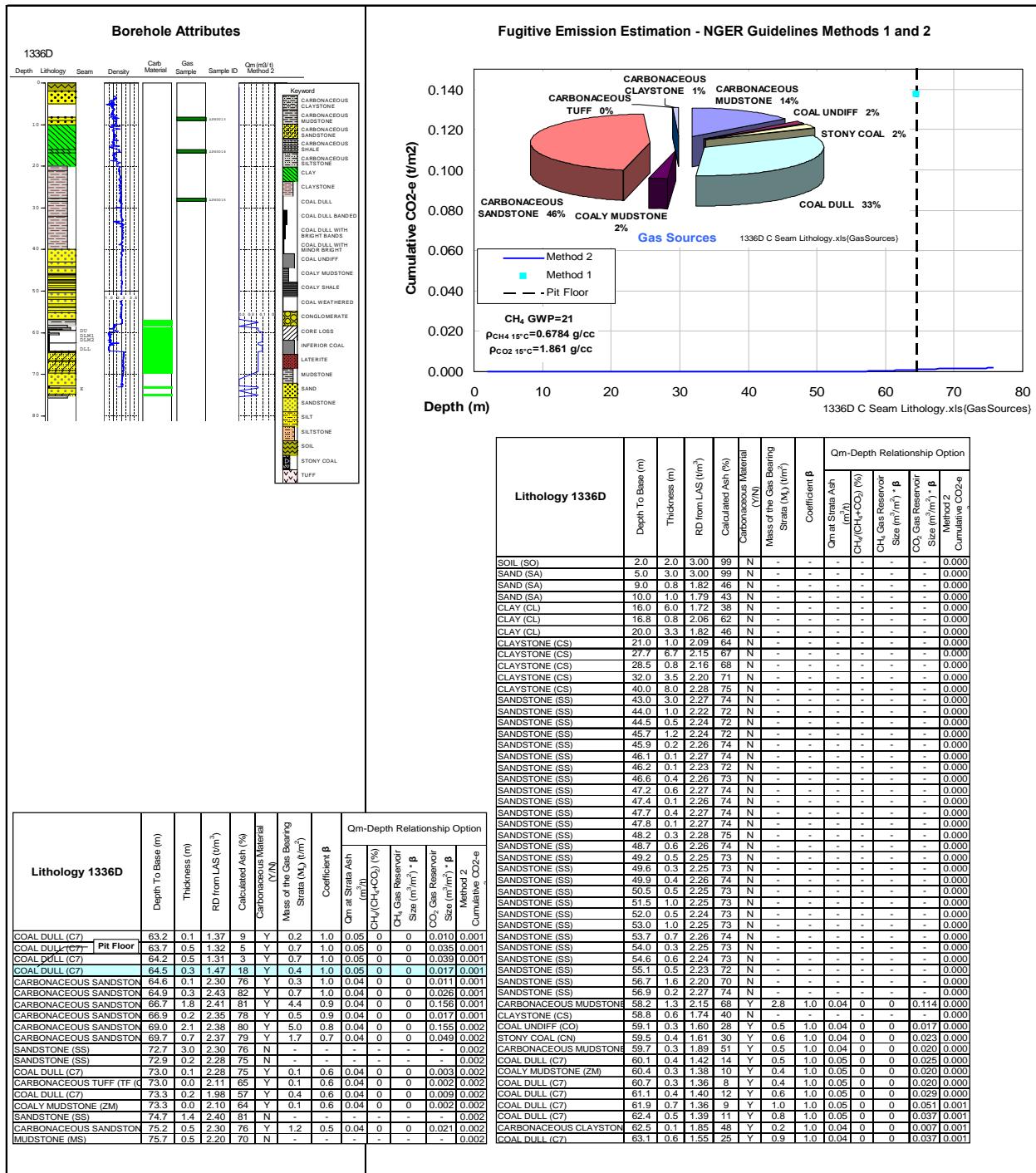


Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1336D
Eastings	446681
Northings	7431953
Pit Floor (m)	64
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

Qm-Depth Relationship Option	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
Qm-Depth Relationship Option	8.08	0.017
	0.001	0.951

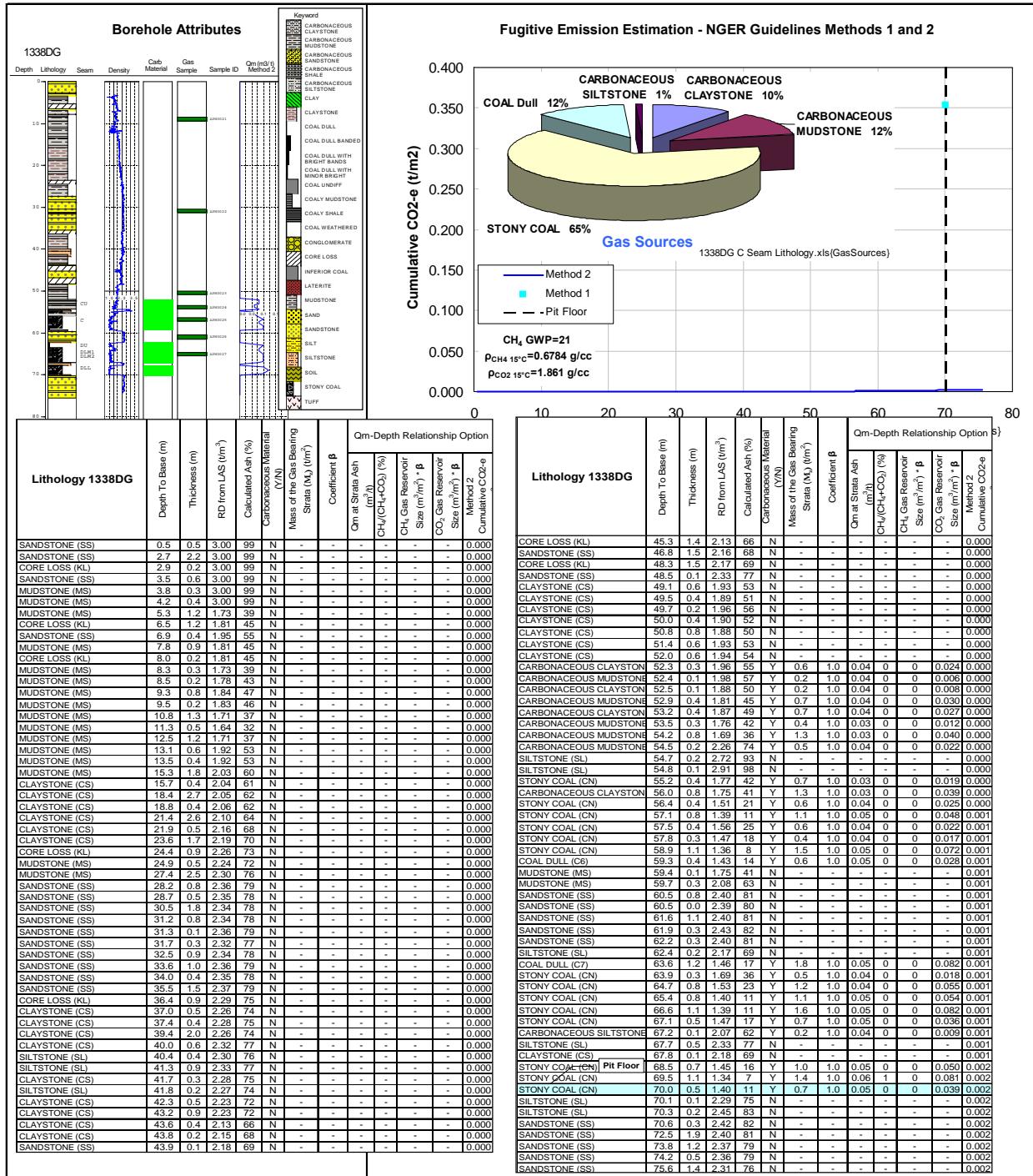
Qm-Depth Relationship Option	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)	Method 2
	CO ₂ -e Emissions (t/m ²)		
Qm-Depth Relationship Option	0.001	0.951	0.0018
	0.001	0.951	0.0018



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project		Alpha
Borehole		1338DG
Easting		445582
Northing		7428189
Pit Floor (m)		70
Pit Floor Seam		DL2
Physical Parameters		
Density CH ₄ 0°C		0.716
Density CO ₂ 0°C		1.963
CH ₄ GWP		21
CO ₂ GWP		1

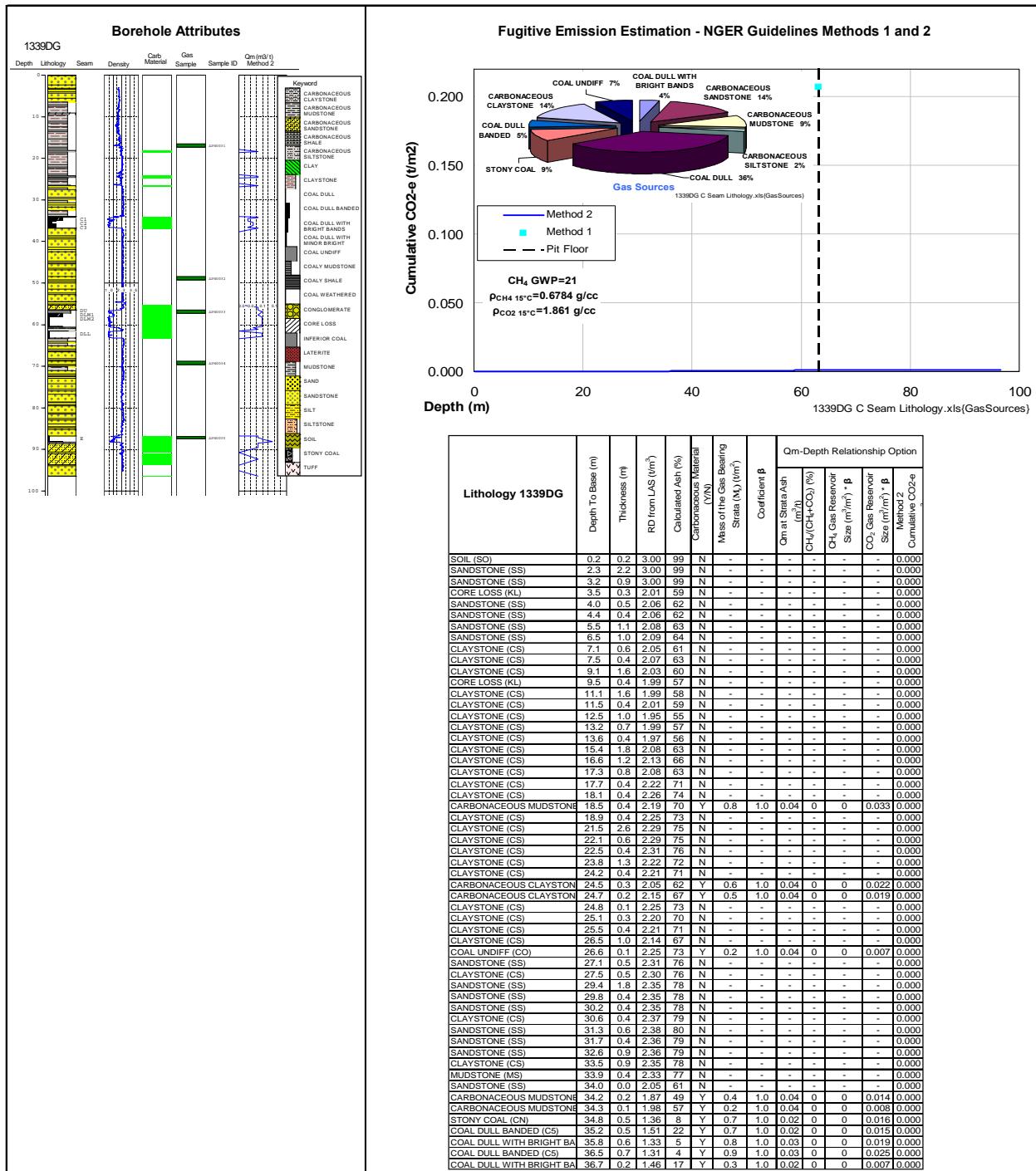
Total Coal Production (t/m ²)	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
20.81	0.017	0.3538
	CH ₄ GRS (m ³ /m ²)	CO ₂ GRS (m ³ /m ²)
Qm-Depth Relationship Option	0.002	0.943
		Method 2
		CO ₂ -e Emissions (t/m ²)
		0.0018



Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1339DG
Easting	445920
Northing	7422786
Pit Floor (m)	63
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

Qm-Depth Relationship Option	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
Qm-Depth Relationship Option	12.16	0.017 0.2066
	0.001	0.751 0.0014

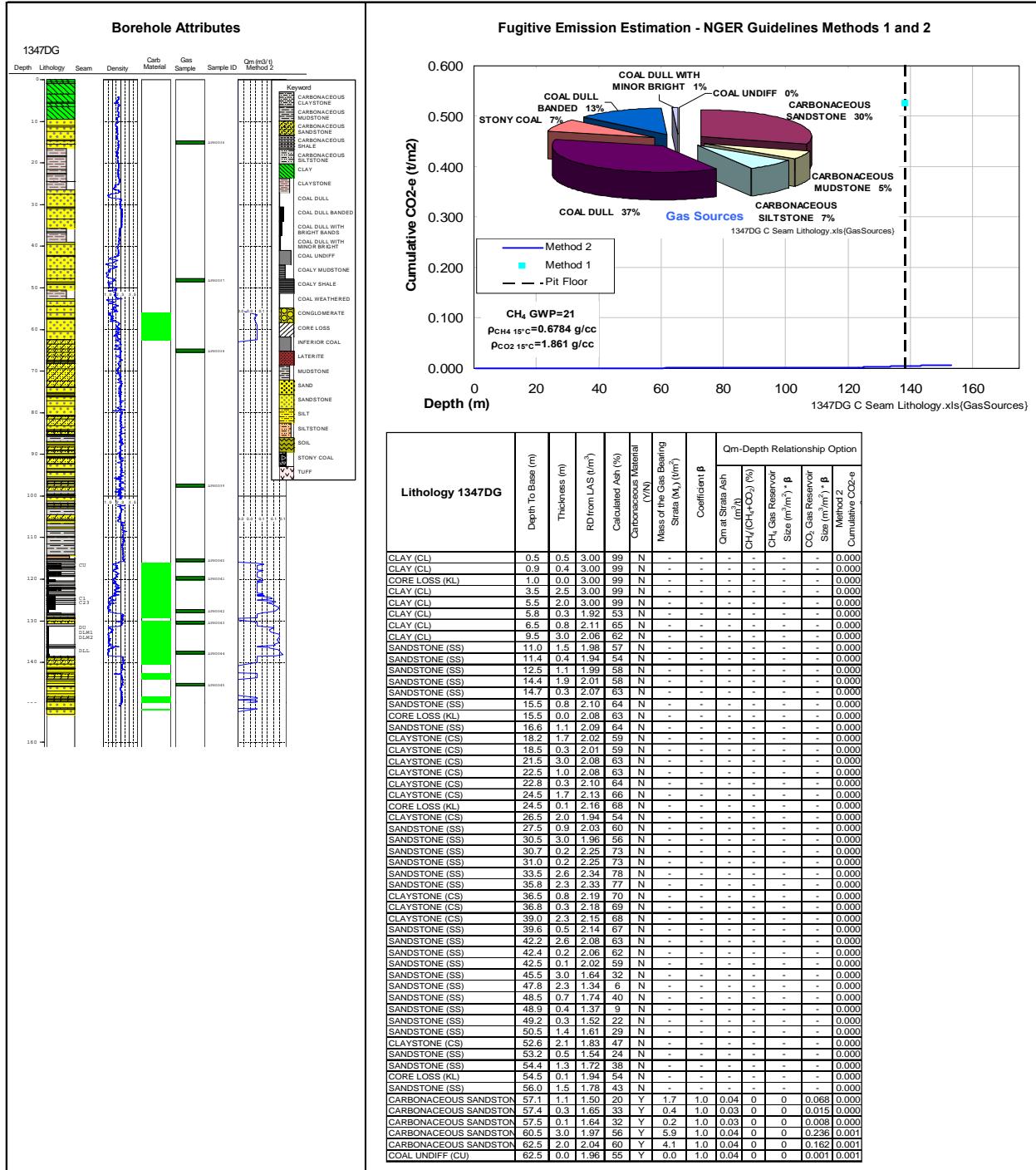


Lithology 1339DG	Depth To Base (m)	Thickness (m)	RD from US (m ³)	Calculated Ash (%)	Carbonaceous Material (Y/N)	Mass of Gas Bearing Strata (M ³)	Qm-Depth Relationship Option				
							Coefficient B	Qm at Strata Ash (m ³)	CH ₄ /CH ₄ +CO ₂ (%)	CH ₄ Gas Reservoir Size (m ³) ^a • b	CO ₂ Gas Reservoir Size (m ³) ^a • b
CARBONACEOUS SILTSTONE	36.8	0.1	2.12	66	Y	0.2	1.0	0.04	0	0.009	0.000
SANDSTONE (SS)	38.6	1.8	2.34	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	39.0	0.4	2.36	79	N	-	-	-	-	-	0.000
SANDSTONE (SS)	39.5	0.4	2.35	79	N	-	-	-	-	-	0.000
SANDSTONE (SS)	41.4	2.0	2.34	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	41.9	0.5	2.37	79	N	-	-	-	-	-	0.000
SANDSTONE (SS)	42.5	0.6	2.35	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	44.7	2.1	2.35	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	45.1	0.4	2.36	79	N	-	-	-	-	-	0.000
SANDSTONE (SS)	45.4	0.3	2.34	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	46.4	1.0	2.33	77	N	-	-	-	-	-	0.000
SANDSTONE (SS)	46.8	0.4	2.35	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	48.4	1.6	2.33	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	49.2	0.8	2.33	77	N	-	-	-	-	-	0.000
SANDSTONE (SS)	49.6	0.4	2.35	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	50.0	0.4	2.35	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	51.5	1.5	2.34	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	52.1	0.8	2.36	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	52.8	0.4	2.33	77	N	-	-	-	-	-	0.000
SANDSTONE (SS)	54.4	1.7	2.35	78	N	-	-	-	-	-	0.000
CORE LOSS (KL)	54.5	0.1	2.07	63	N	-	-	-	-	-	0.000
SANDSTONE (SS)	55.0	0.4	2.34	78	N	-	-	-	-	-	0.000
SANDSTONE (SS)	55.3	0.4	2.38	80	N	-	-	-	-	-	0.000
CARBONACEOUS SANDSTON	56.4	1.1	2.32	77	Y	2.6	1.0	0.04	0	0	0.104 0.001
CARBONACEOUS SILTSTONE	56.5	0.0	2.20	70	Y	0.1	1.0	0.04	0	0	0.004 0.001
CARBONACEOUS CLAYSTON	56.6	0.1	2.06	62	Y	0.1	1.0	0.04	0	0	0.006 0.001
COAL UNDIFF (CU)	57.3	0.7	1.39	11	Y	1.0	1.0	0.05	0	0	0.045 0.001
STONY COAL (CN)	58.0	0.7	1.62	30	Y	1.2	1.0	0.04	0	0	0.043 0.001
COAL DULL (C6)	58.5	0.5	1.36	8	Y	0.7	1.0	0.05	0	0	0.034 0.001
COAL DULL (C6)	59.4	0.9	1.35	7	Y	1.2	1.0	0.05	0	0	0.057 0.001
COAL DULL (C6)	60.4	1.0	1.37	9	Y	1.4	1.0	0.05	0	0	0.067 0.001
STONY COAL (CN)	60.4	0.0	1.35	8	Y	0.0	1.0	0.05	0	0	0.001 0.001
STONY COAL (CN)	60.6	0.1	1.36	8	Y	0.2	1.0	0.05	0	0	0.009 0.001
CARBONACEOUS MUDSTONE	60.8	0.2	1.72	38	Y	0.4	1.0	0.03	0	0	0.014 0.001
CARBONACEOUS CLAYSTON	61.5	0.7	2.22	72	Y	1.5	1.0	0.04	0	0	0.059 0.001
CLAYSTONE (CS) Pit Floor	61.6	0.1	2.15	68	N	-	-	-	-	-	0.001
COAL DULL (C6)	62.6	1.0	1.36	8	Y	1.4	1.0	0.05	0	0	0.070 0.001
COAL DULL (C6)	63.2	0.6	1.35	8	Y	0.9	1.0	0.05	0	0	0.044 0.001
CORE LOSS (KL)	63.4	0.2	2.27	74	N	-	-	-	-	-	0.001
MUDSTONE (MS)	64.0	0.6	2.41	81	N	-	-	-	-	-	0.001
SANDSTONE (SS)	64.4	0.4	2.43	82	N	-	-	-	-	-	0.001
MUDSTONE (MS)	65.1	0.6	2.41	81	N	-	-	-	-	-	0.001
SANDSTONE (SS)	65.9	0.1	1.36	71	N	-	-	-	-	-	0.001
SANDSTONE (SS)	66.3	0.4	2.31	76	N	-	-	-	-	-	0.001
SANDSTONE (SS)	66.5	0.2	2.35	78	N	-	-	-	-	-	0.001
SANDSTONE (SS)	66.8	1.7	2.34	78	N	-	-	-	-	-	0.001
SANDSTONE (SS)	68.5	0.3	2.33	77	N	-	-	-	-	-	0.001
SANDSTONE (SS)	68.8	0.3	2.38	80	N	-	-	-	-	-	0.001
SANDSTONE (SS)	69.5	0.7	2.35	78	N	-	-	-	-	-	0.001
SANDSTONE (SS)	69.8	0.3	2.31	76	N	-	-	-	-	-	0.001
SANDSTONE (SS)	70.2	0.4	2.22	72	N	-	-	-	-	-	0.001
MUDSTONE (MS)	71.0	0.8	2.32	77	N	-	-	-	-	-	0.001
SANDSTONE (SS)	71.8	0.8	2.39	80	N	-	-	-	-	-	0.001
SANDSTONE (SS)	72.2	0.4	2.39	80	N	-	-	-	-	-	0.001
SANDSTONE (SS)	72.5	0.3	2.37	79	N	-	-	-	-	-	0.001
SANDSTONE (SS)	72.9	0.4	2.39	80	N	-	-	-	-	-	0.001
SANDSTONE (SS)	74.2	1.3	2.33	77	N	-	-	-	-	-	0.001
SANDSTONE (SS)	75.5	1.3	2.27	74	N	-	-	-	-	-	0.001
SANDSTONE (SS)	76.0	0.4	2.28	75	N	-	-	-	-	-	0.001
SANDSTONE (SS)	76.7	0.8	2.27	74	N	-	-	-	-	-	0.001
SANDSTONE (SS)	78.5	1.8	2.27	74	N	-	-	-	-	-	0.001
SANDSTONE (SS)	78.8	0.2	2.26	74	N	-	-	-	-	-	0.001
SANDSTONE (SS)	79.2	0.5	2.35	78	N	-	-	-	-	-	0.001
SANDSTONE (SS)	79.5	0.3	2.32	77	N	-	-	-	-	-	0.001
SANDSTONE (SS)	81.2	1.7	2.32	77	N	-	-	-	-	-	0.001
SANDSTONE (SS)	81.5	0.3	2.36	79	N	-	-	-	-	-	0.001
SANDSTONE (SS)	82.5	1.0	2.38	80	N	-	-	-	-	-	0.001
SANDSTONE (SS)	82.9	0.4	2.45	81	-	-	-	-	-	-	0.001
SANDSTONE (SS)	83.8	0.6	2.36	79	N	-	-	-	-	-	0.001
SANDSTONE (SS)	84.0	0.7	2.29	75	N	-	-	-	-	-	0.001
SANDSTONE (SS)	84.8	0.3	2.26	74	N	-	-	-	-	-	0.001
SANDSTONE (SS)	85.2	0.4	2.30	76	N	-	-	-	-	-	0.001
SANDSTONE (SS)	86.8	1.5	2.22	72	N	-	-	-	-	-	0.001
SANDSTONE (SS)	86.8	0.0	1.91	52	N	-	-	-	-	-	0.001
COAL DULL (C6)	86.9	0.1	1.73	39	Y	0.1	0.0	0.04	0	0	0.000 0.001
COAL DULL (C6)	87.4	0.6	1.81	45	Y	1.0	0.0	0.04	0	0	0.000 0.001
COAL DULL (C6)	87.5	0.1	1.63	31	Y	0.1	0.0	0.05	0	0	0.000 0.001
COAL DULL (C6)	87.7	0.2	1.70	36	Y	0.3	0.0	0.05	0	0	0.000 0.001
COAL DULL (C6)	88.1	0.4	1.54	24	Y	0.6	0.0	0.06	1	0	0.000 0.001
COAL DULL (C6)	88.2	0.1	1.37	9	Y	0.1	0.0	0.07	1	0	0.000 0.001
STONY COAL (CN)	88.3	0.1	1.52	22	Y	0.2	0.0	0.06	1	0	0.000 0.001
CARBONACEOUS SILTSTONE	88.7	0.4	2.23	72	Y	1.0	0.0	0.04	0	0	0.000 0.001
CARBONACEOUS SANDSTON	90.6	1.9	2.30	76	Y	4.3	0.0	0.04	0	0	0.000 0.001
SANDSTONE (SS)	91.0	0.4	2.27	74	N	-	-	-	-	-	0.001
CARBONACEOUS SANDSTON	93.6	2.6	2.31	76	Y	6.0	0.0	0.04	0	0	0.000 0.001
SANDSTONE (SS)	94.0	0.4	2.36	79	N	-	-	-	-	-	0.001
SANDSTONE (SS)	96.4	2.4	2.34	78	N	-	-	-	-	-	0.001
CARBONACEOUS SILTSTONE	96.5	0.1	2.30	76	Y	0.3	0.0	0.04	0	0	0.000 0.001

Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1347DG
Eastings	439658
Northings	7431655
Pit Floor (m)	138
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

Qm-Depth Relationship Option	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
Qm-Depth Relationship Option	30.96	0.017 0.5263
	0.010	2.949 0.0055

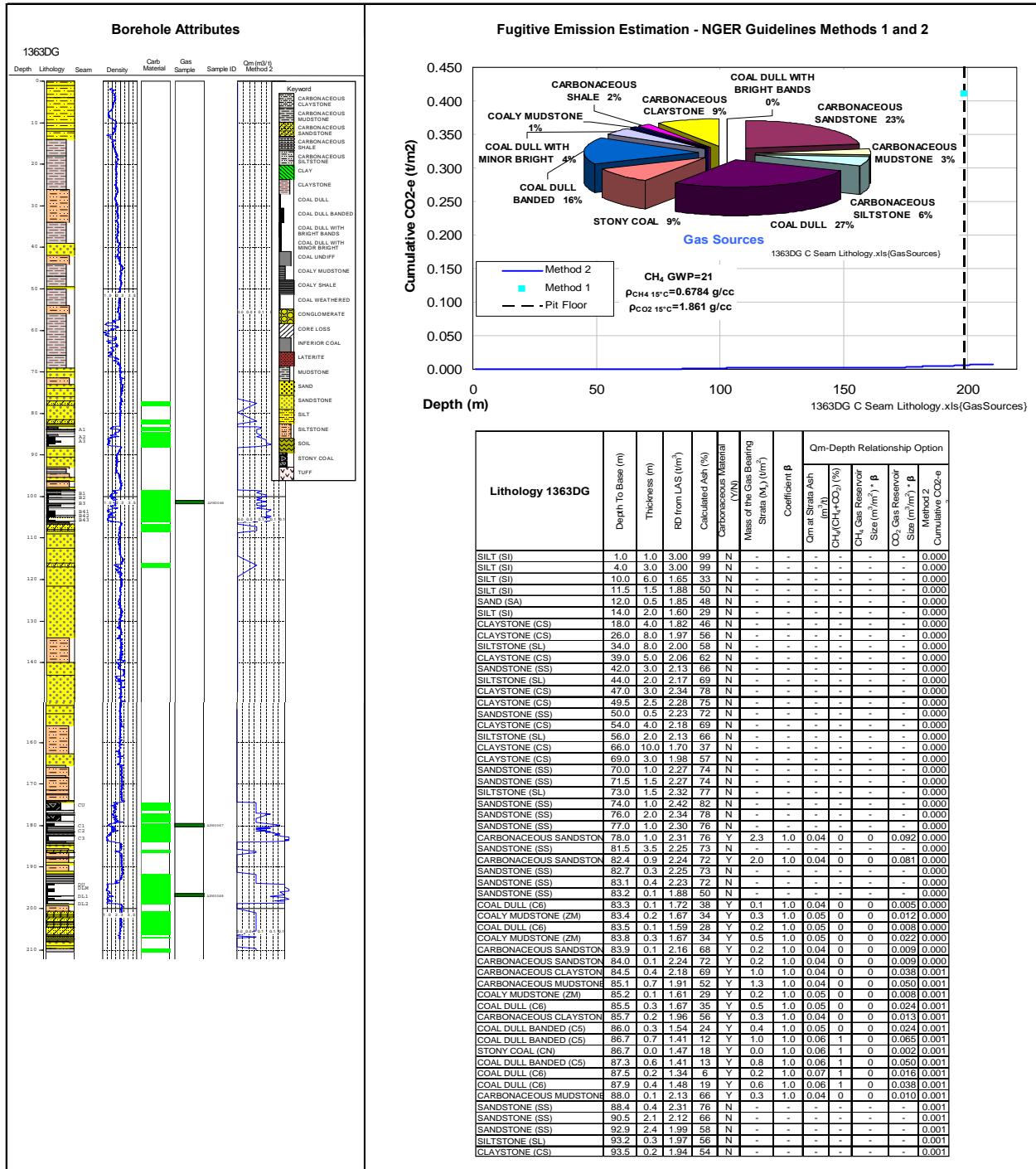


Lithology 1347DG												Lithology 1347DG													
Depth To Base (m)	Thickness (m)	RD from LAS (m ³)	Calculated Ash (%)	Carbonaceous Material (Y/N)	Mass of the Gas Bearing Strata (M) (m ³)	Coefficient β	Qm-Depth Relationship Option						Depth To Base (m)	Thickness (m)	RD from LAS (m ³)	Calculated Ash (%)	Carbonaceous Material (Y/N)	Mass of the Gas Bearing Strata (M) (m ³)	Coefficient β	Qm-Depth Relationship Option					
							Qm at Strata Ash (m ³ /h)	CH ₄ /(CH ₄ +CO ₂) (%)	Size (m ³ /m ³)	CO ₂ Gas Reservoir Size (m ³ /m ³)	Method 2	Cumulative CO ₂ -e								Qm at Strata Ash (m ³ /h)	CH ₄ /(CH ₄ +CO ₂) (%)	Size (m ³ /m ³)	CO ₂ Gas Reservoir Size (m ³ /m ³)	Method 2	Cumulative CO ₂ -e
SANDSTONE (SS)	63.5	1.0	2.15	67	N	-	-	-	-	-	-	-	-	118.5	0.2	1.99	57	Y	0.3	1.0	0.04	0	0	0.012	0.001
SANDSTONE (SS)	64.7	1.2	2.08	63	N	-	-	-	-	-	-	-	-	118.6	0.1	2.05	61	Y	0.3	1.0	0.04	0	0	0.011	0.001
SANDSTONE (SS)	65.5	0.8	2.19	70	N	-	-	-	-	-	-	-	-	118.7	0.1	2.10	64	Y	0.2	1.0	0.04	0	0	0.009	0.001
SANDSTONE (SS)	66.4	1.0	2.19	70	N	-	-	-	-	-	-	-	-	119.0	0.3	1.97	56	Y	0.6	1.0	0.04	0	0	0.023	0.001
SANDSTONE (SS)	67.3	0.9	2.18	69	N	-	-	-	-	-	-	-	-	119.2	0.2	1.95	55	Y	0.4	1.0	0.04	0	0	0.015	0.001
SANDSTONE (SS)	67.6	0.2	2.30	76	N	-	-	-	-	-	-	-	-	119.4	0.1	2.03	60	Y	0.3	1.0	0.04	0	0	0.011	0.001
SANDSTONE (SS)	67.9	0.3	2.17	69	N	-	-	-	-	-	-	-	-	119.4	0.1	2.03	60	Y	0.2	1.0	0.04	0	0	0.007	0.001
SANDSTONE (SS)	68.1	0.3	2.15	67	N	-	-	-	-	-	-	-	-	120.2	0.7	1.79	44	Y	1.3	1.0	0.05	0	0	0.065	0.002
SANDSTONE (SS)	68.2	0.1	2.11	65	N	-	-	-	-	-	-	-	-	120.4	0.3	1.74	40	Y	0.4	1.0	0.05	0	0	0.023	0.002
SANDSTONE (SS)	69.5	1.3	2.14	67	N	-	-	-	-	-	-	-	-	120.4	0.0	1.88	47	Y	0.0	1.0	0.04	0	0	0.001	0.002
SANDSTONE (SS)	72.4	2.9	2.14	67	N	-	-	-	-	-	-	-	-	120.5	0.1	1.88	50	Y	0.1	1.0	0.04	0	0	0.005	0.002
SANDSTONE (SS)	73.6	1.2	2.27	74	N	-	-	-	-	-	-	-	-	120.7	0.2	1.79	43	Y	0.3	1.0	0.05	0	0	0.017	0.002
SANDSTONE (SS)	73.9	0.2	2.25	73	N	-	-	-	-	-	-	-	-	120.8	0.1	1.84	47	Y	0.1	1.0	0.04	0	0	0.004	0.002
SANDSTONE (SS)	74.0	0.1	2.14	67	N	-	-	-	-	-	-	-	-	121.2	0.5	1.82	46	Y	0.9	1.0	0.04	0	0	0.034	0.002
SANDSTONE (SS)	75.2	1.2	2.20	71	N	-	-	-	-	-	-	-	-	121.4	0.2	1.95	65	Y	0.5	1.0	0.04	0	0	0.018	0.002
SANDSTONE (SS)	75.4	0.3	2.18	69	N	-	-	-	-	-	-	-	-	121.5	0.1	2.11	65	Y	0.1	1.0	0.04	0	0	0.005	0.001
SANDSTONE (SS)	75.6	0.2	2.26	74	N	-	-	-	-	-	-	-	-	121.6	0.0	2.06	65	Y	0.1	1.0	0.04	0	0	0.004	0.002
SANDSTONE (SS)	75.9	0.2	2.18	69	N	-	-	-	-	-	-	-	-	121.8	0.3	1.90	52	Y	0.5	1.0	0.04	0	0	0.021	0.002
SANDSTONE (SS)	76.1	0.3	2.19	70	N	-	-	-	-	-	-	-	-	122.0	0.2	2.10	65	Y	0.4	1.0	0.04	0	0	0.015	0.002
SANDSTONE (SS)	76.2	0.1	2.20	71	N	-	-	-	-	-	-	-	-	122.0	0.0	2.11	65	Y	0.1	1.0	0.04	0	0	0.003	0.002
SANDSTONE (SS)	77.1	0.9	2.23	72	N	-	-	-	-	-	-	-	-	122.1	0.0	2.07	62	Y	0.1	1.0	0.04	0	0	0.002	0.002
SANDSTONE (SS)	78.5	1.4	2.27	74	N	-	-	-	-	-	-	-	-	122.2	0.1	1.98	57	Y	0.2	1.0	0.04	0	0	0.010	0.002
SANDSTONE (SS)	80.6	2.1	2.23	72	N	-	-	-	-	-	-	-	-	122.3	0.1	2.07	63	Y	0.2	1.0	0.04	0	0	0.008	0.002
SANDSTONE (SS)	80.8	0.2	2.27	74	N	-	-	-	-	-	-	-	-	122.4	0.1	1.99	57	Y	0.2	1.0	0.04	0	0	0.007	0.002
SANDSTONE (SS)	80.9	0.1	2.30	76	N	-	-	-	-	-	-	-	-	122.4	0.0	1.92	53	Y	0.1	1.0	0.04	0	0	0.003	0.002
SANDSTONE (SS)	81.5	0.6	2.24	74	N	-	-	-	-	-	-	-	-	122.9	0.5	1.85	48	Y	0.9	1.0	0.04	0	0	0.034	0.002
SANDSTONE (SS)	82.1	1.1	2.27	71	N	-	-	-	-	-	-	-	-	123.0	0.1	2.09	65	Y	0.3	1.0	0.04	0	0	0.011	0.002
SANDSTONE (SS)	84.1	0.0	2.29	75	N	-	-	-	-	-	-	-	-	123.3	0.3	1.87	49	Y	0.6	1.0	0.04	0	0	0.025	0.002
SANDSTONE (SS)	84.3	0.3	2.28	75	N	-	-	-	-	-	-	-	-	123.4	0.0	1.88	50	Y	0.1	1.0	0.04	0	0	0.003	0.002
SILTSTONE (SL)	84.4	0.1	2.27	74	N	-	-	-	-	-	-	-	-	123.5	0.1	1.79	44	Y	0.2	1.0	0.04	0	0	0.011	0.002
SANDSTONE (SS)	84.5	0.1	2.34	78	N	-	-	-	-	-	-	-	-	123.6	0.2	1.76	41	Y	0.5	1.0	0.05	0	0	0.014	0.002
SANDSTONE (SS)	85.1	0.6	2.30	76	N	-	-	-	-	-	-	-	-	123.8	0.1	2.02	60	Y	0.3	1.0	0.04	0	0	0.011	0.002
SILTSTONE (SL)	85.2	0.0	2.33	77	N	-	-	-	-	-	-	-	-	123.9	0.1	1.86	56	Y	0.2	1.0	0.04	0	0	0.007	0.002
SANDSTONE (SS)	85.4	0.2	2.24	73	N	-	-	-	-	-	-	-	-	123.9	0.0	1.79	43	Y	0.0	1.0	0.05	0	0	0.001	0.002
SANDSTONE (SS)	85.6	0.2	2.21	71	N	-	-	-	-	-	-	-	-	124.0	0.1	1.73	36	Y	0.2	1.0	0.06	0	0	0.010	0.002
MUDSTONE (MS)	85.7	0.1	2.20	70	N	-	-	-	-	-	-	-	-	124.0	0.1	1.83	46	Y	0.1	1.0	0.04	0	0	0.005	0.002
MUDSTONE (MS)	87.0	1.3	2.27	74	N	-	-	-	-	-	-	-	-	124.7	0.6	1.56	25	Y	0.9	1.0	0.07	1	0	0.063	0.002
SANDSTONE (SS)	87.1	0.1	2.32	77	N	-	-	-	-	-	-	-	-	124.7	0.0	1.51	21	Y	0.0	1.0	0.07	1	0	0.001	0.002
SANDSTONE (SS)	87.5	0.5	2.33	77	N	-	-	-	-	-	-	-	-	125.0	0.1	1.61	30	Y	0.5	1.0	0.06	1	0	0.031	0.002
SANDSTONE (SS)	87.9	0.3	2.36	79	N	-	-	-	-	-	-	-	-	125.0	0.1	1.81	47	Y	0.1	1.0	0.04	0	0	0.005	0.002
SANDSTONE (SS)	88.2	0.3	2.23	72	N	-	-	-	-	-	-	-	-	125.2	0.2	1.69	36	Y	0.3	1.0	0.06	1	0	0.016	0.002
SANDSTONE (SS)	88.9	0.7	2.25	73	N	-	-	-	-	-	-	-	-	125.2	0.0	1.50	24	Y	0.0	1.0	0.07	1	0	0.002	0.002
SANDSTONE (SS)	89.1	0.2	2.33	77	N	-	-	-	-	-	-	-	-	125.7	0.5	1.41	13	Y	0.7	1.0	0.08	1	0	0.054	0.002
SANDSTONE (SS)	89.8	0.7	2.21	71	N	-	-	-	-	-	-	-	-	126.0	0.1	1.65	35	Y	0.1	1.0	0.06	1	0	0.004	0.002
SANDSTONE (SS)	93.5	1.2	2.29	75	N	-	-	-	-	-	-	-	-	126.1	0.1	1.43	21	Y	0.5	1.0	0.07	1	0	0.039	0.003
MUDSTONE (MS)	93.5	0.1	2.28	75	N	-	-	-	-	-	-	-	-	126.1	0.0	1.51	21	Y	0.0	1.0	0.07	1	0	0.067	0.004
SANDSTONE (SS)	96.9	0.4	2.39	80	N	-	-	-	-	-	-	-	-	126.2	0.6	1.61	30	Y	0.8	1.0	0.08	1	0	0.067	0.004
SANDSTONE (SS)	97.1	0.2	2.28	75	N	-	-	-	-	-	-	-	-	126.2	0.1	1.72	29	Y	0.6	1.0	0.08	1	0	0.043	0.004
SANDSTONE (SS)	97.6	0.5	2.22	71	N	-	-	-	-	-	-	-	-	126.5	0.6	1.36	8	Y	0.9						

Open Cut Mining CO₂-e Greenhouse Gas Emission Report

Project	Alpha
Borehole	1363DG
Easting	434643
Northing	7434018
Pit Floor (m)	199
Pit Floor Seam	DL2
Physical Parameters	
Density CH ₄ 0°C	0.716
Density CO ₂ 0°C	1.963
CH ₄ GWP	21
CO ₂ GWP	1

Total Coal Production (t/m ²)	Method 1	
	Emission Factor	CO ₂ -e Emissions (t/m ²)
24.15	0.017	0.4105
	0.014	0.0072



Lithology 1363DG												Lithology 1363DG																							
	Depth To Base (m)	Thickness (m)	RD from LAS (m³)			Calculated Ash (%)			Carbonaceous Material (t/m³)			Mass of the Gas-Bearing Strata (M _t) (t/m³)			Qm-Depth Relationship Option				Depth To Base (m)	Thickness (m)	RD from LAS (m³)			Calculated Ash (%)			Carbonaceous Material (t/m³)			Mass of the Gas-Bearing Strata (M _t) (t/m³)			Qm-Depth Relationship Option		
CLAYSTONE (CS)	94.0	0.5	1.97	56	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CLAYSTONE (CS)	94.4	0.4	1.98	57	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	95.4	1.0	2.17	69	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SS)	96.1	0.7	2.22	71	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	96.3	0.2	2.27	74	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SS)	96.5	0.1	2.26	74	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	97.8	1.4	2.30	76	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SS)	98.1	0.2	2.25	73	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	98.3	0.2	2.30	76	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SS)	98.4	0.1	2.31	76	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SS)	98.5	0.1	2.27	74	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	98.5	0.0	2.02	59	Y	0.1	1.0	0.04	0	0	0.004	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	98.6	0.1	1.83	46	Y	0.1	1.0	0.04	0	0	0.004	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	98.8	0.2	1.77	42	Y	0.4	1.0	0.05	0	0	0.019	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	99.3	0.4	1.90	51	Y	0.8	1.0	0.04	0	0	0.033	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	99.5	0.2	1.68	35	Y	0.3	1.0	0.05	0	0	0.016	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	99.7	0.2	1.57	26	Y	0.4	1.0	0.06	0	0	0.021	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	99.7	0.0	1.62	31	Y	0.0	1.0	0.06	0	0	0.003	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	100.2	0.5	1.58	27	Y	0.8	1.0	0.06	1	0	0.047	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	100.3	0.1	1.84	47	Y	0.1	1.0	0.04	0	0	0.005	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	100.3	0.0	1.81	45	Y	0.1	1.0	0.04	0	0	0.002	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	100.6	0.3	1.65	33	Y	0.5	1.0	0.05	0	0	0.028	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	100.9	0.3	1.94	54	Y	0.5	1.0	0.04	0	0	0.022	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	101.6	0.6	1.63	31	Y	1.0	1.0	0.06	0	0	0.058	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	101.7	0.1	2.29	75	Y	0.3	1.0	0.04	0	0	0.010	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	102.2	0.5	1.58	27	Y	0.8	1.0	0.06	1	0	0.047	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	102.1	0.4	1.94	54	Y	0.7	1.0	0.04	0	0	0.030	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
STONY COAL (CN)	102.1	0.0	1.84	47	Y	0.2	1.0	0.04	0	0	0.006	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	102.5	0.3	1.59	28	Y	0.5	1.0	0.06	1	0	0.031	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	102.7	0.2	1.59	28	Y	0.3	1.0	0.05	0	0	0.015	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C7)	103.5	0.5	1.41	12	Y	0.7	1.0	0.07	1	0	0.048	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL BANDED (C5)	104.2	0.8	1.54	23	Y	1.2	1.0	0.06	1	0	0.073	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL BANDED (C5)	104.5	0.3	1.56	28	Y	0.5	1.0	0.06	1	0	0.027	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS CLAYSTON	104.6	0.0	1.61	29	Y	0.1	1.0	0.06	1	0	0.005	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL BANDED (C5)	105.0	0.4	1.49	20	Y	0.6	1.0	0.07	1	0	0.040	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS SANDSTON	105.0	0.0	1.77	42	Y	0.1	1.0	0.05	0	0	0.003	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	105.4	0.4	1.40	11	Y	0.6	1.0	0.07	1	0	0.043	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL (C6)	105.7	0.3	1.32	4	Y	0.4	1.0	0.08	1	0	0.028	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL BANDED (C5)	106.0	0.3	1.46	17	Y	0.4	1.0	0.07	1	0	0.026	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
COAL DULL BANDED (C5)	106.2	0.1	1.76	41	Y	0.3	1.0	0.05	0	0	0.013	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	106.3	0.2	2.27	74	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	106.6	0.3	2.32	77	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	106.7	0.1	2.34	78	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS SANDSTON	108.0	1.3	2.26	74	Y	3.0	1.0	0.04	0	0	0.121	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CARBONACEOUS SANDSTON	108.4	0.3	2.20	70	Y	0.8	1.0	0.04	0	0	0.031	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	109.0	0.6	2.19	70	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	112.5	0.2	2.35	76	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	115.0	0.3	2.28	75	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	116.0	0.3	2.30	76	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	116.5	0.3	2.30	77	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SANDSTONE (SS)	116.6	0.2	2.38	89	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
SILTSTONE (SL)	116.8	0.2	2.39	80	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
CLAYSTONE (CS)	116.8	0.4	2.44	82	Y	0.1	1.0	0.04	0	0	0.003	0.0																							