

Technical Addendum: Lake Vermont Meadowbrook Project - Fugitive Methane

Prepared for:

Jellinbah Group Pty Ltd

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FINAL

Prepared by:

Katestone Environmental Pty Ltd

ABN 92 097 270 276

Level 4, 154 Melbourne Street, South Brisbane
Queensland, 4101, Australia

www.katestone.global
admin@katestone.com.au
Ph +61 7 3369 3699

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Prepared by: Craig Miller

Reviewed by: Natalie Shaw

Approved by:



Natalie Shaw

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Glossary

Term or abbreviation	Definition
CH ₄	Methane
CO ₂	carbon dioxide
CO ₂ -e	carbon dioxide equivalents
EP Act	<i>Environmental Protection Act 1994</i>
EIS	Environmental Impact Statement
GWP	Global warming potential
LOM	Life of mine
Mtpa	Million tonnes per annum
RTO	Regenerative thermal oxidiser
ROM	Run of mine
t CO ₂ -e	Tonnes carbon dioxide equivalent
VAM	Ventilation air methane

EXECUTIVE SUMMARY

A voluntary Environmental Impact Statement (EIS) was submitted by the Jellinbah Group Pty Ltd (Jellinbah) under the *Environmental Protection Act 1994* (EP Act) for the Lake Vermont Meadowbrook Project (the Project), near Dysart in central Queensland.

The Project is an extension of the existing Lake Vermont Mine (open cut) and addresses the forecast reduction in coal production that will occur at the Lake Vermont Mine, by combining output from the existing open cut operations and the Project extension. This will enable total coal product to be maintained at the currently approved output for an extended period (of approximately 20 years) while also increasing the existing mine life by approximately 35 years.

The Project involves the construction and operation of an underground multi-seam, longwall coal mine as well as an additional small-scale open-cut pit. Extraction rates are forecast to be up to 7 Mtpa of ROM coal, equivalent to approximately 5.5 Mtpa of metallurgical product coal. An infrastructure corridor will link the Project mining area to the Lake Vermont Mine processing area to utilise the existing processing plant and train loadout facility.

Katestone Environmental prepared the greenhouse gas assessment (Appendix L of the EIS) as part of the "Lake Vermont Meadowbrook Project: Air Quality and Greenhouse Gas Assessment Report (2022)", document reference D20040-7.

The Department of Environment and Science (DES) prepared a submission regarding the EIS. As part of the submission, DES raised issues in relation to the fugitive methane emission factor used for the underground component of the Project and possible mitigation.

This technical addendum presents a revised fugitive methane emission factor for the underground component of the Project and an update to the overall greenhouse gas emissions due to the Project because of that change.

The emissions factor for the underground aspect of the Project is 0.29 t CO₂-e/t ROM, ranging from 0.02–1.9 t CO₂-e/t ROM per year. This is slightly higher than reported for the Oaky Creek Mine (0.23) and significantly less than the Moranbah North Mine (0.63).

The Project will be subject to the Safeguards Mechanism and will be expected to progressively reduce or offset its production-weighted emissions intensity by 4.9% per annum until 2030 and then by a factor yet to be decided.

Jellinbah intends to offer pre drainage gas to Arrow Energy which would remove 20 Mt CO₂-e from the Project life of (underground) mine (LOM). Otherwise, Jellinbah will mitigate fugitive methane emissions by capturing and combusting drainage methane, goaf methane, and ventilation air methane (VAM). Maximum abatement of fugitive methane emissions will be achieved if Jellinbah can capture and combust 90% of the drainage methane, goaf methane, and ventilation air methane (VAM).

Over the 24 years LOM, 31.54 Mt CO₂-e would be released under the unmitigated scenario (or 1.26 Mt CO₂-e per year). This reduces to 5.97Mt CO₂-e for the LOM under the maximum mitigation scenario (or 0.24 Mt CO₂-e per year).

The Project would add 0.20% to per annum to Australia's current GHG emissions (463.9 Mt CO₂-e) and 0.66% per annum to Queensland's current GHG emissions (139.7 Mt CO₂-e) if fugitive methane were unmitigated. This reduces to 0.05% and 0.17% respectively if 90% of the fugitive methane is abated (maximum mitigated).

1. INTRODUCTION

A voluntary Environmental Impact Statement (EIS) was submitted by the Jellinbah Group Pty Ltd (Jellinbah) under the *Environmental Protection Act 1994* (EP Act) for the Lake Vermont Meadowbrook Project (the Project), near Dysart in central Queensland.

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The Project involves the construction and operation of an underground multi-seam, longwall coal mine as well as an additional small-scale open-cut pit. Extraction rates are forecast to be up to 7 Mtpa of ROM coal, equivalent to approximately 5.5 Mtpa of metallurgical product coal. An infrastructure corridor will link the Project mining area to the Lake Vermont Mine processing area to utilise the existing processing plant and train loadout facility.

Katestone Environmental prepared the greenhouse gas assessment (Appendix L of the EIS) as part of the "Lake Vermont Meadowbrook Project: Air Quality and Greenhouse Gas Assessment Report (2022)", document reference D20040-7.

The Department of Environment and Science (DES) prepared a submission regarding the EIS. As part of the submission, DES raised the following issues in relation to the fugitive methane emission factor used for the underground component of the Project and possible mitigation.

Issue 52:

The emissions intensity of 0.023 t CO₂-e per tonne ROM coal selected for estimating fugitive methane emissions in Table 19 of Appendix L appears a lot lower than that of neighbouring underground mining operations and of underground coal mines in the Bowen Basin, as summarised in the table below.

<i>Underground mining operation</i>	<i>Total ROM produced (Mt)</i>	<i>Total Scope 1 emissions (Mt CO₂-e)</i>	<i>Emissions intensity factor (t CO₂-e/t ROM)</i>
<i>This project¹</i>			<i>0.023</i>
<i>Red Hill mine²</i>	<i>234</i>	<i>22.94</i>	<i>0.098</i>
<i>Broadmeadow Underground mine²</i>	<i>138</i>	<i>10.63</i>	<i>0.077</i>
<i>Oaky Creek³</i>	<i>3.72</i>	<i>0.86</i>	<i>0.23</i>
<i>Moranbah North³</i>	<i>3.16</i>	<i>2</i>	<i>0.63</i>
<i>Emissions factor for underground coal mines in Bowen Basin⁴</i>			<i>0.14-0.295</i>
<i>1: Appendix L BBC_Meadowbrook EIS_Air Quality and Greenhouse Gas Assessment 2: Red Hill Mining Lease Environmental Impact Statement 3: National Energy and Energy Reporting database for the period of 2021-2022 4: National inventory report 2019. Page 126, Figure 3.22</i>			

It is also noted that the emissions factor selected for this proposed project is based on emissions factors for open-cut mines in Queensland as provided in the National Greenhouse Accounts Factors 2021. However, this proposed project is an underground coal operation, which generally has much higher emissions intensity compared to open-cut operations.

Recommendation: *Conduct a thorough review and reconsideration of the methane emissions factor for estimating greenhouse gas (GHG) emissions over the lifetime of the proposed project. To reduce the level*

of uncertainties, it is recommended that the proponent uses a mine-specific emissions factor for estimation.

Using this representative emissions factor, update the projections in the amended EIS and re-assess the potential effect of the proposed project on both the state and national GHG inventories and emissions commitments.

Issue 53

The EIS does not provide sufficient detail regarding the decarbonisation plan to abate GHG.

Considering that the proposed project falls under the purview of the Commonwealth Safeguard Mechanism, which is expected to come into effect from the 1st of July 2023, it is imperative that additional information be provided in a decarbonisation plan to assess how the project aligns with the Safeguard Mechanism's requirements with respect to the proposed decline rate up to 2030 and longer-term target to achieve zero net emissions by 2050.

The following measures and technologies have been commonly applied in underground coal mines in Queensland and worldwide:

- *Power generation from coal mine waste gas (i.e., pre-drainage gas and goaf gas) using gas engines or gas turbines*
- *Flaring of coal mine waste gas (i.e., pre-drainage gas and goaf gas) to reduce GHG emissions.*
- *Commercially available technology, such as regenerative thermal oxidisers (RTOs), can be used to abate ventilation air methane, which typically constitute a significant share of the total fugitive methane emissions from underground coal mines.*

Recommendation. *Provide comprehensive details of a decarbonisation plan in the amended EIS, with additional mitigation measures to reduce GHG emissions.*

This Technical Addendum to the EIS addresses the submissions above for the underground aspect of the Project.

2. FUGITIVE METHANE

The original calculation of fugitive methane in the submitted EIS applied the emissions factor for open cut fugitive emissions (0.023 t CO₂-e/t ROM) to both the underground and the open-cut aspects of the Project. This technical addendum provides an updated average emissions factor for the underground aspect of the Project (Table 1) and recalculates the fugitive emissions with and without mitigation through flaring (Table 2).

The estimated volume of methane in the target mining area has been provided in million cubic metres (Mm³) (GeoGas, 2021). A conservative value of 100% methane to CO₂ in the gas is assumed, although it is less in some seams. Potential fugitive methane emissions are calculated using methane density of 0.716 kg/m³ (at 15°C) and a global warming potential (GWP) of 28, and are reported in tCO₂-e.

The emissions factor for the Project Mine is 0.29 t CO₂-e/t ROM (Table 1) ranging from 0.02 – 1.9 t CO₂-e/t ROM per year. This is slightly higher than reported for the Oaky Creek Mine (0.23) and significantly less than the Moranbah North Mine (0.63).

Table 1 Emissions factor (t CO₂-e/t ROM) for the underground aspect of the Project

Total ROM (Mt)	Total fugitive methane (Mt CO ₂ -e)	Emissions factor (t CO ₂ -e/t ROM)	Emissions factor range (t CO ₂ -e/t ROM)
108.57	31.54	0.29	0.02–1.9

The Project will be subject to the Safeguards Mechanism and will be expected to progressively reduce or offset its production-weighted emissions intensity by 4.9% per annum until 2030 and then by a factor yet to be decided.

Jellinbah intends to offer pre drainage gas to Arrow Energy, who has legal rights to this gas by way of the Overlapping Tenure laws and related agreements. This would remove 20 Mt CO₂-e from the Project LOM. If Arrow elects not to accept the gas, then Jellinbah could capture and combust 90% of the drainage methane, goaf methane, and ventilation air methane (VAM), and this approach will be reported in a separate Scope 1 and Scope 2 decarbonisation strategy. Consequently, values are reported for both unmitigated and a maximum mitigated scenario:

- 100% methane released to the atmosphere
- 90% methane combusted and released as CO₂ to the atmosphere with 10% released to the atmosphere as methane (Table 2).

Over the 24 years life of (underground) mine (LOM), 31.54 Mt CO₂-e would be released under the unmitigated scenario (Table 1, Table 2) for an average of 1.22 Mt CO₂-e per year. This reduces to 5.97 Mt CO₂-e for the LOM under the maximum mitigation scenario, or 0.24 Mt CO₂-e per year.

Updated Scope 1 and Scope 2 emissions calculations are provided for the Project (open cut and underground) in Table A1. The Project would add 0.20% to per annum to Australia's current GHG emissions (463.9 Mt CO₂-e) and 0.66% per annum to Queensland's current GHG emissions (139.7 Mt CO₂-e) if fugitive methane were unmitigated (Table A2). This reduces to 0.05% and 0.17% respectively if 90% of the fugitive methane is combusted (maximum mitigated) (Table A2).

Table 2 Fugitive methane emissions (t CO₂-e) per year for total fugitive methane (unmitigated) and 10% fugitive methane (90% maximum mitigated)

Year	t CO₂-e (unmitigated)	t CO₂-e (90% mitigated)
2024	206,494	38,865
2025	228,547	43,015
2026	198,475	37,355
2027	773,853	145,648
2028	1,649,950	310,539
2029	1,419,398	267,147
2030	1,014,429	190,927
2031	884,117	166,401
2032	1,074,573	202,247
2033	1,984,752	373,553
2034	1,780,262	335,065
2035	1,904,560	358,460
2036	3,043,286	572,781
2037	2,339,602	440,339
2038	2,373,683	484,486
2039	3,041,282	572,403
2040	1,984,752	373,553
2041	679,627	127,913
2042	1,152,760	216,962
2043	994,381	187,154
2044	1,054,525	198,473
2045	667,598	125,650
2046	384,922	72,447
2047	653,565	123,008
2048	48,115	9,056
Total	31,537,509	5,973,446
Average	1,261,500	238,938

3. CONCLUSION

This technical addendum addresses submissions received regarding the emissions factor, fugitive methane emissions, and mitigation of fugitive methane, to the voluntary Environmental Impact Statement (EIS) submitted by the Jellinbah Group Pty Ltd for the underground aspect of the Project.

The emissions factor for the project is 0.29 t CO₂-e/t ROM (Table , ranging from 0.02–1.9 t CO₂-e/t ROM per year. This is slightly higher than reported for the Oaky Creek Mine (0.23) and significantly less than the Moranbah North Mine (0.63).

The Project will be subject to the Safeguards Mechanism and will be expected to progressively reduce or offset its production-weighted emissions intensity by 4.9% per annum until 2030 and then by a factor yet to be decided.

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The Project would add 0.20% to per annum to Australia's current GHG emissions (463.9 Mt CO₂-e) and 0.66% per annum to Queensland's current GHG emissions (139.7 Mt CO₂-e) if fugitive methane were unmitigated. This reduces to 0.05% and 0.17% respectively if 90% of the fugitive methane is abated (maximum mitigated).

4. REFERENCE

GeoGas (2021). Meadowbrook – Gas Emission, Ventilation and Gas Management Assessment for EIS Layout. Unpublished Report Number: 2021-1811. GeoGas, Mackay.

APPENDIX A SCOPE 1 AND SCOPE 2 EMISSIONS

Table A1 Updated summary of projected annual Scope 1 and Scope 2 GHG emissions (tCO₂-e) and energy use (GJ) for the Project including unmitigated fugitive methane emissions from the underground aspect

Project Year	Energy	Scope 1					Scope 2	TOTAL (Scope 1 + Scope 2)	
		Diesel (mining)	Fugitive gas ^a	Blasting	Land clearing	Total	Electricity	Including LULUCF	Excluding LULUCF
	GJ	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e
2024	118,320	3,261	206,494	-	4,813	42,904	16,000	230,568	225,755
2025	154,320	3,261	228,547	-	4,813	214,568	24,000	260,621	255,808
2026	186,250	4,242	198,475	-	-	232,789	28,000	230,717	230,717
2027	246,070	4,651	773,853	-	-	203,127	40,000	818,504	818,504
2028	382,729	10,075	1,649,950	-	-	783,927	53,250	1,713,275	1,713,275
2029	591,803	13,695	141,9398	-	-	1,663,645	88,283	1,521,377	1,521,377
2030	618,018	14,149	101,4429	-	-	1,433,547	92,676	1,121,254	1,121,254
2031	636,233	14,464	884,117	-	-	1,028,893	95,728	994,309	994,309
2032	,587,712	13,624	1,074,573	-	-	897,741	87,598	1,175,795	1,175,795
2033	504,994	12,192	1,984,752	-	-	1,086,764	73,737	2,070,681	2,070,681
2034	506,621	12,220	1,780,262	-	-	1,996,972	74,010	1,866,492	1,866,492
2035	466,334	11,522	1,904,560	-	-	1,791,785	67,259	1,983,341	1,983,341
2036	514,017	12,348	3,043,286	-	-	1,916,908	75,249	3,130,883	3,130,883
2037	389,094	10,185	2,339,602	-	-	3,053,471	54,317	2,404,103	2,404,103
2038	465,775	11,513	2,373,683	-	-	2,351,114	67,165	2,452,361	2,452,361
2039	508,288	12,249	3,041,282	-	-	2,385,932	74,289	3,127,819	3,127,819
2040	546,846	12,538	1,984,752	-	-	3,053,819	81,946	2,079,235	2,079,235
2041	428,017	10,480	679,627	-	-	1,995,232	62,034	752,141	752,141
2042	448,553	10,836	1,152,760	-	-	690,463	65,475	1,229,071	1,229,071

Project Year	Energy	Scope 1					Scope 2	TOTAL (Scope 1 + Scope 2)	
		Diesel (mining)	Fugitive gas ^a	Blasting	Land clearing	Total	Electricity	Including LULUCF	Excluding LULUCF
	GJ	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e
2043	475,492	11,302	994,381	-	-	1,164,062	69,989	1,075,672	1,075,672
2044	435,212	10,604	1,054,525	-	-	1,004,985	63,240	1,128,369	1,128,369
2045	1,025,839	50,097	673,549	1,403	14,013	1,120,038	65,401	804,463	790,450
2046	1,278,079	63,262	409,457	1,655	10,671	749,137	79,102	564,147	553,477
2047	1,207,708	63,893	683,961	1,823	8,350	483,523	60,942	818,969	810,619
2048	1,048,397	58,998	77,477	1,827	4,857	749,643	40,978	184,137	179,280
2049	736,950	50,111	32,246	1,771	4,586	133,944	-	88,713	84,127
2050	775,915	52,836	34,228	1,789	11,788	98,658	-	100,640	88,852
2051	841,312	57,379	33,187	1,849	3,233	96,689	-	95,648	92,415
2052	768,371	52,245	30,286	1,848	3,486	90,766	-	87,866	84,380
2053	731,586	49,730	33,375	1,774	2,890	84,680	-	87,768	84,878
2054	589,690	40,191	44,264	1,323	806	75,695	-	86,585	85,779
2055	67,951	4,669	9,100	115	-	49,048	-	13,884	13,884
2056	171,963	12,106	-	-	-	21,207	-	12,106	12,106
2057	196,130	13,808	-	-	-	13,808	-	13,808	13,808
2058	191,070	13,451	-	-	-	13,451	-	13,451	13,451
2059	160,640	11,309	-	-	-	11,309	-	11,309	11,309
2060	23,352	1,644	-	-	-	1,644	-	1,644	1,644
TOTAL	19,025,652	815,136	31,844,438	17,178	74,305	32,751,056	1,600,669	34,351,726	34,277,422
Average	514,207	22,031	936,601	464	2,008	886,194	43,261	928,425	926,417
%	Scope 1	2%	97%	0.1%	0.2%	100%	-	-	-
	Scope 1 + 2	2%	93%	0.0%	0.2%	95%	5%	100%	-

Table note:

^a fugitive gas from underground and open cut operations

Table A2 Updated contribution of the Project to Australia and Queensland’s current GHG emissions (Mt CO₂-e) with unmitigated and maximum mitigated fugitive methane emissions

Category	Project ¹	Australia ²		Queensland ²	
	Emissions (Mt CO ₂ -e)	Emissions (Mt CO ₂ -e)	Project %	Emissions (Mt CO ₂ -e)	Project %
Inventory total (unmitigated)	0.88	463.9	0.20	139.7	0.66
Inventory total (maximum mitigated)	0.22	463.9	0.05	139.7	0.17

Notes:¹ Mean annual GHG emissions ² <https://www.dceew.gov.au/climate-change/publications/national-greenhouse-accounts-2021>