GREENBASE
ENVIRONMENTAL ACCOUNTANTS

ACH Minerals Pty Ltd

Ravensthorpe Gold Project GHG Projection

Summary Report

October 2018

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1 Introduction

ACH Minerals Pty Ltd (ACH Minerals) is preparing an Environmental Review Document for the Ravensthorpe Gold Project for submission to the EPA and other relevant decision making authorities. ACH Minerals has been requested to include the following additional works:

- *Characterise sources of greenhouse gas emissions from the proposal and estimate the expected direct and indirect greenhouse gas emissions in accordance with the National Greenhouse and Energy Reporting Act 2007.*

- *Analyse the intensity of greenhouse gas emissions (i.e. quantify the Carbon Dioxide generated per tonne of product produced) and compare with published benchmarked practice for equivalent operations.*

ACH Minerals has engaged Greenbase to estimate the Greenhouse Gas (GHG) Emissions from the Ravensthorpe Gold Project during the life of mine (8 years).

*Note: the life of mine extends to 8 years; however, it stretches over 9 calendar years; thus, Greenbase estimated GHG emissions for 9 calendar years.

1.1 Scope of Work

The scope of work for this arrangement was to:

1. Identify the main GHG emission sources at the Ravensthorpe Gold Project during the life of mine (8 years).
2. Collate all required data to estimate the GHG emissions.
   a. Estimated annual diesel consumption figures for the power station, plant and equipment.
   b. Estimated annual production figures.
3. Prepare a projection for GHG emissions from the Ravensthorpe Gold Project, showing:
   a. Main GHG emission sources,
   b. Projected GHG emission calculations,
   c. Projected GHG emission intensity calculations,
   d. Methodology used and sequence of logic supporting the calculations.
4. Prepare a brief summary report.

2 Facility Description

2.1 Location

The Ravensthorpe Gold Project is located between Ravensthorpe and Hopetoun in the south of Western Australia, approximately 525km by road from Perth.

The project consists of the Kundip mine site located 17 kilometres south-east of the town of Ravensthorpe.

2.2 Description

The project was acquired by ACH Minerals from Silver Lake Resources Ltd in July 2016.

The project life is estimated at 8 years based on known resources and planned production rates.

Ore will be mined from open pit and underground and will be treated on-site to produce gold doré and a high value concentrate.

The project is not proximal to established grid power; consequently, the project will have a diesel fired power station (approximately 6.0MW installed capacity).

3 Methodology

3.1 Emissions forecasting

3.1.1 Scope 1 emissions (direct emissions)

The GHG projection provides Scope 1 emissions (direct emissions) as per the National Greenhouse and Energy Reporting (NGER) Scheme rules for a 9 year period.

All emissions factors and diesel energy content were obtained from the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

In order to estimate the Scope 1 emissions, the following assumptions were made:

- 83.5% of the total diesel combusted not for electricity production will be combusted by non-road registered vehicles, and the other 16.5% will be combusted by road registered vehicles.

- Based on analysis when activity is at its most intense, no more than 0.25% of the total Scope 1 emissions will come from LPG, acetylene, oils and greases. Thus, 99.75% of the emissions will come from diesel usage.

This summary report presents the results and discussions. All methodology used and sequence of logic supporting the calculations are presented in the document 'Ravensthorpe Gold Project GHG Projection 2018 – worksheet.pdf'.

3.1.2 Scope 2 and Scope 3 emissions (indirect emissions)

No Scope 2 emissions (indirect emissions) were identified for this project. According to the National Greenhouse and Energy Reporting Regulation 2008, Scope 2 emission of greenhouse gas means *"the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility".*

As Scope 3 emissions are not included in the NGER Scheme, they were excluded from this report. Scope 3 emissions are all indirect emissions not included in Scope 2. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business.

3.2 Emissions Intensity Comparison

ACH Minerals has been requested to include in this report a comparison of its emissions intensities with published benchmarked emissions intensities for equivalent operations.

To date, no benchmark emissions intensities have been published.

Therefore, Greenbase has taken a sample of seven gold mines that produced their own electricity and saleable gold during the FY2017 from the Greenbase database and calculated their emissions intensities (TCO2-e/oz). Then, they were compared to the Ravensthorpe Gold Project emissions intensities calculated for the 9 year period.

As the calculated emissions intensities for these gold mines have not been published, Greenbase did not reveal the name of the facilities in this report.

4 Forecasting

The following forecasting has been made by ACH Minerals:

Table 1 Forecast Fuel Usage (kL) & Saleable Gold Production (koz)

Year	Diesel (Electricity)	Diesel (Open Pit Mobile Fleet)	Diesel (Underground Mobile Fleet)	Diesel (Plant and Equipment)*	Diesel (Non-transport)**	Diesel (Transport)***	Saleable Gold Production
	(kL)	(kL)	(kL)	(kL)	(kL)	(kL)	(koz)
Year 1	3,043	2,707	16	2,723	2,274	449	10.197
Year 2	12,059	5,383	364	5,748	4,800	948	44.538
Year 3	12,073	2,742	509	3,250	2,714	536	45.292
Year 4	11,619	2,733	485	3,218	2,687	531	46.135
Year 5	11,201	2,733	509	3,242	2,707	535	48.723
Year 6	11,070	2,733	495	3,228	2,695	533	43.337
Year 7	10,776	1,935	93	2,028	1,693	335	36.370
Year 8	10,716	1,596	-	1,596	1,333	263	35.726
Year 9	1,138	257	-	257	214	42	3.462
Total	**83,694**	**22,818**	**2,471**	**25,290**	**21,117**	**4,173**	**313.781**

Diesel (Plant and Equipment) is diesel combusted by all vehicles used in both open pit and underground operations (diesel not for electricity production).

**Diesel (Non- transport) is diesel combusted by non – registered vehicles (83.5% of diesel not for electricity production).*

***Diesel (Transport) is diesel combusted by road registered vehicles (16.5% of diesel not for electricity production).*

4.1 Estimated Greenhouse Gas Emissions

From the fuel usage figures provided, the following GHG emissions have been estimated for the Ravensthorpe Gold Project:

Table 2 Forecast GHG Emissions from diesel usage (TCO2-e)

Year	Diesel CO2-e Emissions (Electricity)	Diesel CO2-e Emissions (Non-transport)	Diesel CO2-e Emissions (Transport)
	(TCO2-e)	(TCO2-e)	(TCO2-e)
Year 1	8,245	6,161	1,223
Year 2	32,675	13,005	2,581
Year 3	32,715	7,354	1,459
Year 4	31,484	7,281	1,445
Year 5	30,352	7,335	1,456
Year 6	29,996	7,303	1,449
Year 7	29,199	4,589	911
Year 8	29,039	3,611	717
Year 9	3,083	581	115
Total	**226,788**	**57,220**	**11,355**

Table 3 Forecast Total GHG Emissions at the facility (TCO2-e)

Year	Total CO2-e from diesel	Total CO2-e from other sources*	Total Scope 1 CO2-e Facility Emissions
	(TCO2-e)	(TCO2-e)	(TCO2-e)
Year 1	15,628	39	15,667
Year 2	48,261	121	48,382
Year 3	41,529	104	41,633
Year 4	40,210	101	40,311
Year 5	39,142	98	39,240
Year 6	38,749	97	38,846
Year 7	34,699	87	34,786
Year 8	33,366	84	33,450
Year 9	3,779	9	3,789
Total	295,363	740	296,104

Other sources are LPG, acetylene, oils and greases (0.25% of total emissions)

The Ravensthorpe Gold Project will have the highest emissions in the second year of the operation, as more diesel will be used.

According to the published NGER data for the 2017 Financial Year, corporations reported a total of 336 million tonnes of Scope 1 emissions. Western Australian corporations contributed to 19.6% of these Scope 1 emissions.

The average total GHG emissions at the Ravensthorpe Gold Project are 32,900 TCO2-e per annum over the 9 year period. This represents 0.05% of Western Australia's total Scope 1 emissions compared to the FY2017 data.

For more information about the FY2017 published data see the '2016–17 published data highlights' in the Clean Energy Regulator website.

4.2 Estimated Emissions Intensity

From the above estimates the following emissions intensities for the Ravensthorpe Gold Project have been derived:

Table 4 Emissions Intensities (TCO2-e/oz)

Year	Emissions Intensity
	(TCO2-e/oz)
Year 1	1.536
Year 2	1.086
Year 3	0.919
Year 4	0.874
Year 5	0.805
Year 6	0.896
Year 7	0.956
Year 8	0.936
Year 9	1.094
Overall	**0.944**

From Figure 1 and Figure 2 shown below, it is clear that Ravensthorpe Gold Project will have the lowest emissions intensity in Year 5.

It addition, the facility will have the highest emissions intensities at the beginning and at the end of the operation, as less gold will be produced in Year 1 and Year 9.
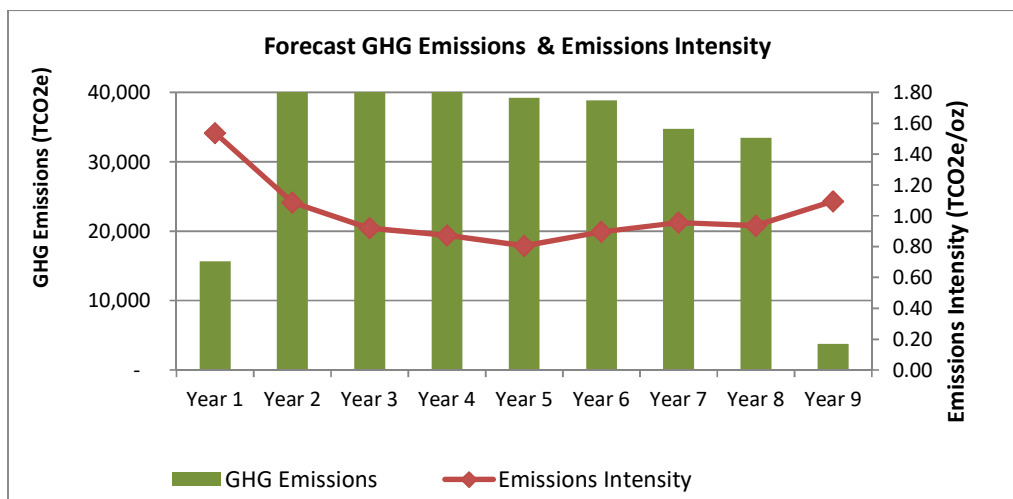

Figure 1 Forecast GHG Emissions & Emissions Intensity for Ravensthorpe Gold Project

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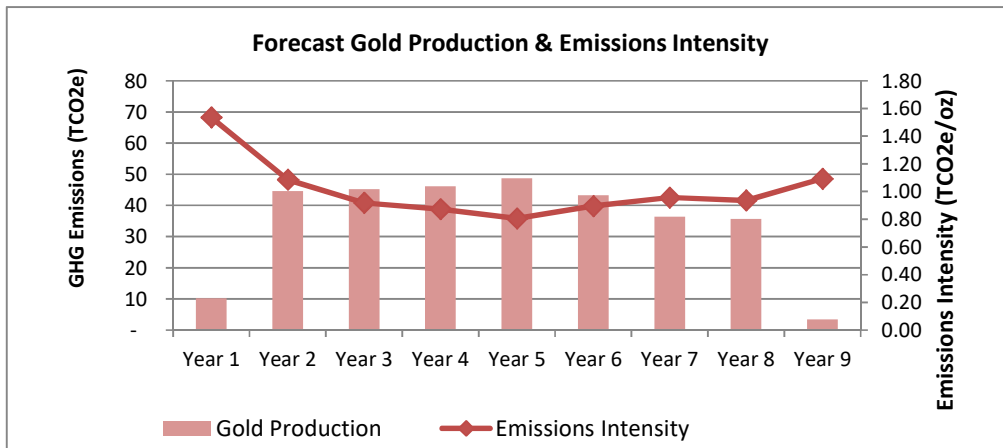
Figure 2 Forecast Gold Production & Emissions Intensity for Ravensthorpe Gold Project

5   Emissions Intensity Comparison

Table 5 presents the gold production and GHG emission figures for FY2017 for seven established Australian gold mines. The figures were obtained from the Greenbase database.

The table also shows the emissions intensity calculated for those facilities.

Table 5 Production, GHG Emissions and Emissions Intensity for seven established gold mines in FY2017

Facility	Gold produced	CO2-e Emissions	Emissions Intensity
	(oz)	(TCO2-e)	(TCO2-e/oz)
Gold Mine A	434,679	239,862	0.552
Gold Mine B	226,350	101,565	0.449
Gold Mine C	55,491	37,081	0.668
Gold Mine D	221,572	119,170	0.538
Gold Mine E	124,747	57,625	0.462
Gold Mine F	53,720	25,087	0.467
Gold Mine G	285,580	95,374	0.334

From the FY2017 gold mine examples, the lowest emissions intensity was 0.334 TCO2-e/oz and the highest emissions intensity was 0.668 TCO2-e/oz.

Based on the data provided by ACH Minerals, during the life of mine of the Ravensthorpe Gold Project, the lowest emissions intensity for the facility will be 0.805 TCO2-e/oz (Year 5). As shown in Figure 3, the emissions intensities for Year 4 to Year 6 are closer to the emissions intensities for the gold mine examples, when the Ravensthorpe Gold Project is expected to be in steady state production.

In Year 1, the emissions intensity for the Ravensthorpe Gold Project is higher than the gold mine examples (1.536 TCO2-e/oz). The Ravensthorpe Gold Project will be ramping up in Year 1 and the open pit strip ratios and underground development rates will be at their highest relative to the gold production.

In Year 9, the emissions intensity for the Ravensthorpe Gold Project is also higher than the gold mine examples (1.094 TCO2-e/oz). By Year 9 it is expected that the project will reach the end of the known reserves and the low grade stockpiles and marginal material will be treated at the end of the project life, resulting in lower gold production and higher emissions intensity.
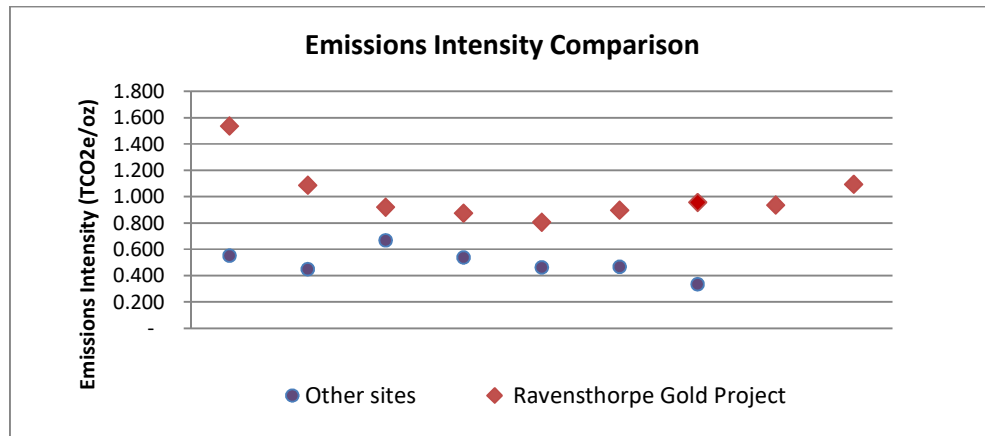
Figure 3 Emissions Intensity Comparison

6 Conclusions

1. The main GHG emission sources at the Ravensthorpe Gold Project will be:
   - Diesel combusted by the power generators,
   - Diesel combusted by non-road registered vehicles, and
   - Diesel combusted by road registered vehicles.

2. The Ravensthorpe Gold Project will produce Scope 1 emissions (direct emissions) from diesel and other minor sources such as LPG, acetylene, oils and greases.

3. No Scope 2 emissions (indirect emissions) were identified.

4. Scope 3 emissions (indirect emissions) are not included in the NGER Scheme; therefore, Scope 3 emissions were excluded from this report.

5. Emissions Intensity Comparison:
   - To date, no benchmark emissions intensities have been published. Therefore, Greenbase took a sample of seven established gold mines that produced their own electricity and saleable gold during the FY2017 from the Greenbase database.
   - Emissions intensities for these sites were calculated and compared to the Ravensthorpe Gold Project emissions intensities. It is important to note that these emissions intensities are not currently published.
   - The lowest emissions intensity for the Ravensthorpe Gold Project will be 0.805 TCO2-e/oz, during Year 5.
   - The emissions intensities for Year 4 to Year 6 are closer to the emissions intensities for the gold mine examples, when the Ravensthorpe Gold Project is expected to be in steady state production.
   - The project will have the highest emissions intensities in Year 1 and Year 9.
     - The project will be ramping up in Year 1 and the open pit strip ratios and underground development rates will be at their highest relative to the gold production.
     - By Year 9 it is expected that the project will reach the end of the known reserves and the low grade stockpiles and marginal material will be treated at the end of the project life, resulting in lower gold production and higher emissions intensity.
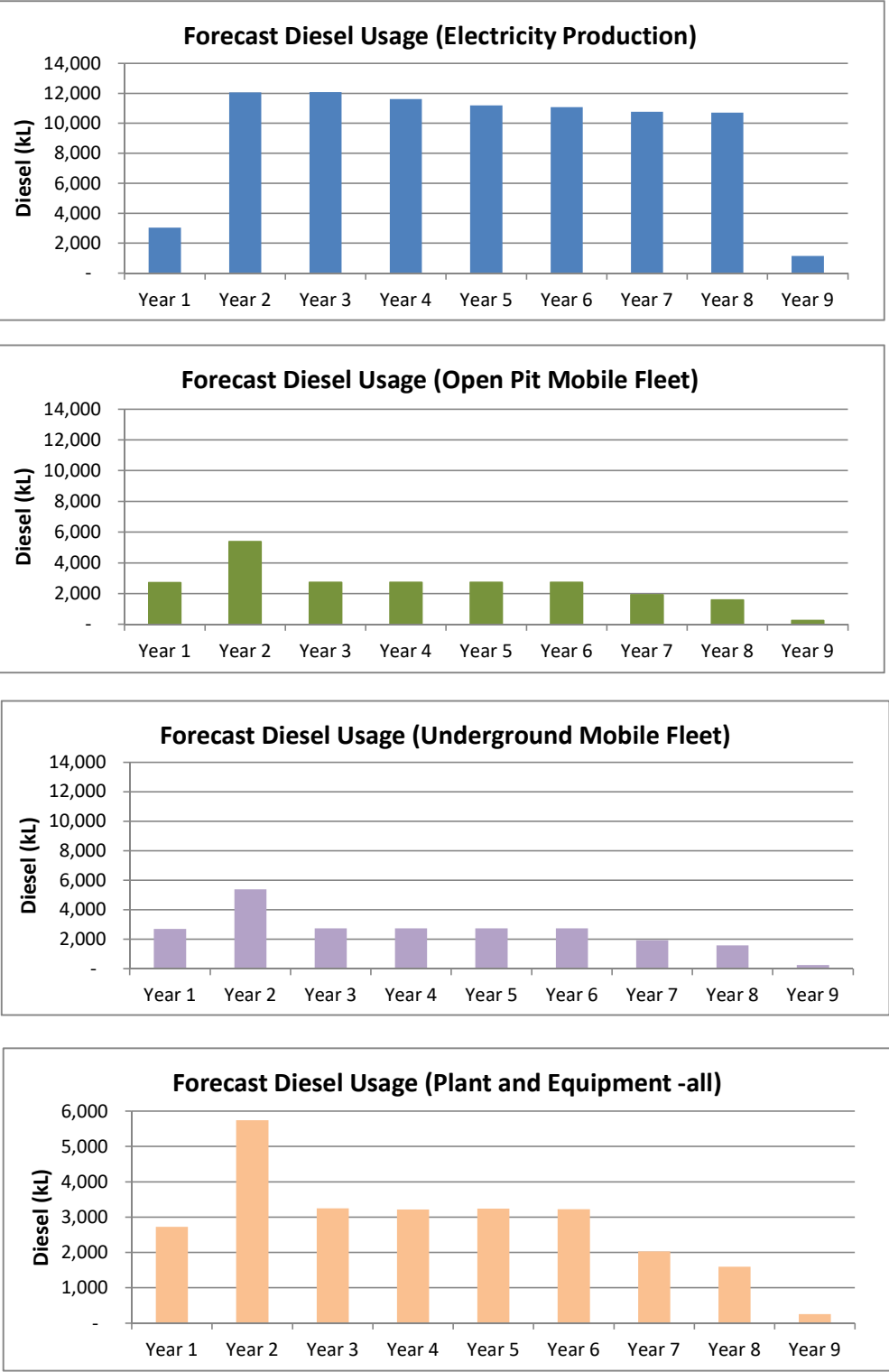
CLIENT:	**ACH Minerals Pty Ltd**
LOCATION:	**Ravensthorpe Gold Project**
REASON:	**Greenhouse Gas Emissions Projection**

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Reviewed by: Anne Smith

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ITEM N°	ITEM	VALUE	UNITS	COMMENT
Forecast Fuel Usage				
1 -	Forecast Diesel Usage (Electricity Production)			
1a	- Year 1	3,043	kL	*Annual diesel consumption at the power station (estimated)*
1b	- Year 2	12,059	kL	*Annual diesel consumption at the power station (estimated)*
1c	- Year 3	12,073	kL	*Annual diesel consumption at the power station (estimated)*
1d	- Year 4	11,619	kL	*Annual diesel consumption at the power station (estimated)*
1e	- Year 5	11,201	kL	*Annual diesel consumption at the power station (estimated)*
1f	- Year 6	11,070	kL	*Annual diesel consumption at the power station (estimated)*
1g	- Year 7	10,776	kL	*Annual diesel consumption at the power station (estimated)*
1h	- Year 8	10,716	kL	*Annual diesel consumption at the power station (estimated)*
1i	- Year 9	1,138	kL	*Annual diesel consumption at the power station (estimated)*
1j	**Forecast Diesel Usage (Electricity):**	**83,694**	**kL**	
2 -	Forecast Diesel Usage (Open Pit Mobile Fleet)			
2a	- Year 1	2,707	kL	*Annual diesel consumption open pit operations (estimated)*
2b	- Year 2	5,383	kL	*Annual diesel consumption open pit operations (estimated)*
2c	- Year 3	2,742	kL	*Annual diesel consumption open pit operations (estimated)*
2d	- Year 4	2,733	kL	*Annual diesel consumption open pit operations (estimated)*
2e	- Year 5	2,733	kL	*Annual diesel consumption open pit operations (estimated)*
2f	- Year 6	2,733	kL	*Annual diesel consumption open pit operations (estimated)*
2g	- Year 7	1,935	kL	*Annual diesel consumption open pit operations (estimated)*
2h	- Year 8	1,596	kL	*Annual diesel consumption open pit operations (estimated)*
2i	- Year 9	257	kL	*Annual diesel consumption open pit operations (estimated)*
2j	**Forecast Diesel Usage (Plant and Equipment):**	**22,818**	**kL**	
3 -	Forecast Diesel Usage (Underground Mobile Fleet)			
3a	- Year 1	16	kL	*Annual diesel consumption underground operations (estimated)*
3b	- Year 2	364	kL	*Annual diesel consumption underground operations (estimated)*
3c	- Year 3	509	kL	*Annual diesel consumption underground operations (estimated)*
3d	- Year 4	485	kL	*Annual diesel consumption underground operations (estimated)*
3e	- Year 5	509	kL	*Annual diesel consumption underground operations (estimated)*
3f	- Year 6	495	kL	*Annual diesel consumption underground operations (estimated)*
3g	- Year 7	93	kL	*Annual diesel consumption underground operations (estimated)*
3h	- Year 8	-	kL	*Annual diesel consumption underground operations (estimated)*
3i	- Year 9	-	kL	*Annual diesel consumption underground operations (estimated)*
3j	**Forecast Diesel Usage (Plant and Equipment):**	**2,471**	**kL**	
4 -	Forecast Diesel Usage (Plant and Equipment - open pit & underground operations)			
4a	- Year 1	2,723	kL	*Annual diesel consumption not for electricity production (estimated)*
4b	- Year 2	5,748	kL	*Annual diesel consumption not for electricity production (estimated)*
4c	- Year 3	3,250	kL	*Annual diesel consumption not for electricity production (estimated)*
4d	- Year 4	3,218	kL	*Annual diesel consumption not for electricity production (estimated)*
4e	- Year 5	3,242	kL	*Annual diesel consumption not for electricity production (estimated)*
4f	- Year 6	3,228	kL	*Annual diesel consumption not for electricity production (estimated)*
4g	- Year 7	2,028	kL	*Annual diesel consumption not for electricity production (estimated)*
4h	- Year 8	1,596	kL	*Annual diesel consumption not for electricity production (estimated)*
4i	- Year 9	257	kL	*Annual diesel consumption not for electricity production (estimated)*
4j	**Forecast Diesel Usage (Plant and Equipment):**	**25,290**	**kL**	
5 -	Diesel Usage (Plant and Equipment) - Percentage allocation			
5a	- % allocation for Diesel (Non-transport)	83.5%		*Percentage of diesel combusted by non-road registered vehicles*
5b	- % allocation for Diesel (Transport)	16.5%		*Percentage of diesel combusted by road registered vehicles*

Forecast Diesel Usage (Electricity Production)

Forecast Diesel Usage (Open Pit Mobile Fleet)

Forecast Diesel Usage (Underground Mobile Fleet)

Forecast Diesel Usage (Plant and Equipment -all)

CLIENT: **ACH Minerals Pty Ltd**
LOCATION: **Ravensthorpe Gold Project**
REASON: **Greenhouse Gas Emissions Projection**

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ITEM N°	ITEM	VALUE	UNITS	COMMENT
6 -	**Forecast Diesel Usage (Non-transport)**			
6a	- Year 1	2,274	kL	*= 4a * 5a*
6b	- Year 2	4,800	kL	*= 4b * 5a*
6c	- Year 3	2,714	kL	*= 4c * 5a*
6d	- Year 4	2,687	kL	*= 4d * 5a*
6e	- Year 5	2,707	kL	*= 4e * 5a*
6f	- Year 6	2,695	kL	*= 4f * 5a*
6g	- Year 7	1,693	kL	*= 4g * 5a*
6h	- Year 8	1,333	kL	*= 4h * 5a*
6i	- Year 9	214	kL	*= 4i * 5a*
6j	**Forecast Diesel Usage (Non-transport):**	**21,117**	**kL**	
7 -	**Forecast Diesel Usage (Transport)**			
7a	- Year 1	449	kL	*= 4a * 5b*
7b	- Year 2	948	kL	*= 4b * 5b*
7c	- Year 3	536	kL	*= 4c * 5b*
7d	- Year 4	531	kL	*= 4d * 5b*
7e	- Year 5	535	kL	*= 4e * 5b*
7f	- Year 6	533	kL	*= 4f * 5b*
7g	- Year 7	335	kL	*= 4g * 5b*
7h	- Year 8	263	kL	*= 4h * 5b*
7i	- Year 9	42	kL	*= 4i * 5b*
7j	**Forecast Diesel Usage (Transport):**	**4,173**	**kL**	

Forecast Production

ITEM N°	ITEM	VALUE	UNITS	COMMENT
8 -	**Forecast Saleable Gold Production**			
8a	- Year 1	10.197	koz	*Annual gold production (estimated)*
8b	- Year 2	44.538	koz	*Annual gold production (estimated)*
8c	- Year 3	45.292	koz	*Annual gold production (estimated)*
8d	- Year 4	46.135	koz	*Annual gold production (estimated)*
8e	- Year 5	48.723	koz	*Annual gold production (estimated)*
8f	- Year 6	43.337	koz	*Annual gold production (estimated)*
8g	- Year 7	36.370	koz	*Annual gold production (estimated)*
8h	- Year 8	35.726	koz	*Annual gold production (estimated)*
8i	- Year 9	3.462	koz	*Annual gold production (estimated)*
8j	**Forecast Saleable Gold Production:**	**313.781**	**koz**	
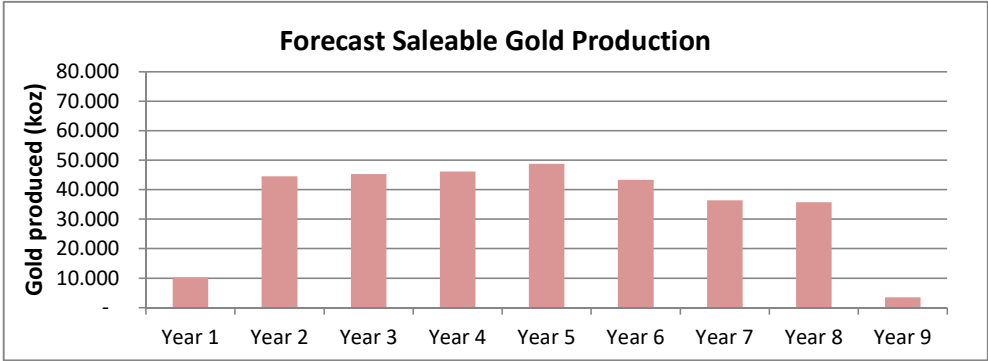
Forecast Saleable Gold Production

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ITEM N°	ITEM	VALUE	UNITS	COMMENT		CO2	CH4	N2O
Forecast Scope 1 CO2e Emissions from diesel usage								
9 -	**Forecast Diesel CO2e Emissions (Electricity)**					CO2	CH4	N2O
9a	- Emission Factor	70.20	kg/GJ	*Method 1 - NGER Determination - Schedule 1 Item 40*		69.90	0.10	0.20
9b	- Diesel Energy Content	38.60	GJ/KL	*Method 1 - NGER Determination - Schedule 1 Item 40*				
9c	- Year 1	8,245	TCO2e	$=1a \times 9b \times 9a \div 1{,}000$		8,209	12	23
9d	- Year 2	32,675	TCO2e	$=1b \times 9b \times 9a \div 1{,}000$		32,536	47	93
9e	- Year 3	32,715	TCO2e	$=1c \times 9b \times 9a \div 1{,}000$		32,575	47	93
9f	- Year 4	31,484	TCO2e	$=1d \times 9b \times 9a \div 1{,}000$		31,349	45	90
9g	- Year 5	30,352	TCO2e	$=1e \times 9b \times 9a \div 1{,}000$		30,222	43	86
9h	- Year 6	29,996	TCO2e	$=1f \times 9b \times 9a \div 1{,}000$		29,868	43	85
9i	- Year 7	29,199	TCO2e	$=1g \times 9b \times 9a \div 1{,}000$		29,074	42	83
9j	- Year 8	29,039	TCO2e	$=1h \times 9b \times 9a \div 1{,}000$		28,914	41	83
9k	- Year 9	3,083	TCO2e	$=1i \times 9b \times 9a \div 1{,}000$		3,070	4	9
9l	**Forecast Diesel CO2e Emissions (Electricity):**	**226,788**	**TCO2e**					
10 -	**Forecast Diesel CO2e Emissions (Non-transport)**					CO2	CH4	N2O
10a	- Emission Factor	70.20	kg/GJ	*Method 1 - NGER Determination - Schedule 1 Item 40*		69.90	0.10	0.20
10b	- Diesel Energy Content	38.60	GJ/KL	*Method 1 - NGER Determination - Schedule 1 Item 40*				
10c	- Year 1	6,161	TCO2e	$=6a \times 10b \times 10a \div 1{,}000$		6,134	9	18
10d	- Year 2	13,005	TCO2e	$=6b \times 10b \times 10a \div 1{,}000$		12,950	19	37
10e	- Year 3	7,354	TCO2e	$=6c \times 10b \times 10a \div 1{,}000$		7,323	10	21
10f	- Year 4	7,281	TCO2e	$=6d \times 10b \times 10a \div 1{,}000$		7,250	10	21
10g	- Year 5	7,335	TCO2e	$=6e \times 10b \times 10a \div 1{,}000$		7,303	10	21
10h	- Year 6	7,303	TCO2e	$=6f \times 10b \times 10a \div 1{,}000$		7,272	10	21
10i	- Year 7	4,589	TCO2e	$=6g \times 10b \times 10a \div 1{,}000$		4,569	7	13
10j	- Year 8	3,611	TCO2e	$=6h \times 10b \times 10a \div 1{,}000$		3,596	5	10
10k	- Year 9	581	TCO2e	$=6i \times 10b \times 10a \div 1{,}000$		579	1	2
10l	**Forecast Diesel CO2e Emissions (Non-transport):**	**57,220**	**TCO2e**					
11 -	**Forecast Diesel CO2e Emissions (Transport)**					CO2	CH4	N2O
11a	- Emission Factor	70.50	kg/GJ	*Method 1 - NGER Determination - Schedule 1 Item 54*		69.90	0.10	0.50
11b	- Diesel Energy Content	38.60	GJ/KL	*Method 1 - NGER Determination - Schedule 1 Item 54*				
11c	- Year 1	1,223	TCO2e	$=7a \times 11b \times 11a \div 1{,}000$		1,212	2	9
11d	- Year 2	2,581	TCO2e	$=7b \times 11b \times 11a \div 1{,}000$		2,559	4	18
11e	- Year 3	1,459	TCO2e	$=7c \times 11b \times 11a \div 1{,}000$		1,447	2	10
11f	- Year 4	1,445	TCO2e	$=7d \times 11b \times 11a \div 1{,}000$		1,433	2	10
11g	- Year 5	1,456	TCO2e	$=7e \times 11b \times 11a \div 1{,}000$		1,443	2	10
11h	- Year 6	1,449	TCO2e	$=7f \times 11b \times 11a \div 1{,}000$		1,437	2	10
11i	- Year 7	911	TCO2e	$=7g \times 11b \times 11a \div 1{,}000$		903	1	6
11j	- Year 8	717	TCO2e	$=7h \times 11b \times 11a \div 1{,}000$		710	1	5
11k	- Year 9	115	TCO2e	$=7i \times 11b \times 11a \div 1{,}000$		114	0	1
11l	**Forecast Diesel CO2e Emissions (Transport):**	**11,355**	**TCO2e**					

CLIENT: **ACH Minerals Pty Ltd**
LOCATION: **Ravensthorpe Gold Project**
REASON: **Greenhouse Gas Emissions Projection**

ENVIRONMENTAL ACCOUNTING WORKSHEET
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Landscape
Prepared by: Gina Vanesa Alba Vega
Reviewed by: Anne Smith

GREENBASE ENVIRONMENTAL ACCOUNTANTS

ITEM N°	ITEM	VALUE	UNITS	COMMENT

Forecast Total Scope 1 CO2e Facility Emissions

12 - **Forecast CO2e Facility Emissions from fuel usage (Diesel)**

						CO2	CH4	N2O
12a	- Year 1	15,628	TCO2e	= 9c + 10c + 11c		15,556	22	50
12b	- Year 2	48,261	TCO2e	= 9d + 10d + 11d		48,044	69	148
12c	- Year 3	41,529	TCO2e	= 9e + 10e + 11e		41,345	59	125
12d	- Year 4	40,210	TCO2e	= 9f + 10f + 11f		40,032	57	121
12e	- Year 5	39,142	TCO2e	= 9g + 10g + 11g		38,969	56	118
12f	- Year 6	38,749	TCO2e	= 9h + 10h + 11h		38,577	55	117
12g	- Year 7	34,699	TCO2e	= 9i + 10i + 11i		34,546	49	103
12h	- Year 8	33,366	TCO2e	= 9j + 10j + 11j		33,220	48	98
12i	- Year 9	3,779	TCO2e	= 9k + 10k + 11k		3,763	5	11
12j	**Forecast CO2e Facility Emissions from fuel usage (Diesel):**	**295,363**	**TCO2e**					

13 - **Forecast all other emissions (LPG, acetylene, oils and greases)**

For calculating forecasted emissions, it will be assumed that no more than 0.25% of the total emissions come from LPG, acetylene, oils and greases, and that 99.75% of the emissions come from diesel usage

						CO2	CH4	N2O
13a	- Scaling Factor	0.25%		*Based on analysis when activity is at its most intense*		CO2	CH4	N2O
13b	- Year 1	39	TCO2e	= 12a * 13a / (1 - 13a)		39	0.1	0.1
13c	- Year 2	121	TCO2e	= 12b * 13a / (1 - 13a)		120	0.2	0.4
13d	- Year 3	104	TCO2e	= 12c * 13a / (1 - 13a)		104	0.1	0.3
13e	- Year 4	101	TCO2e	= 12d * 13a / (1 - 13a)		100	0.1	0.3
13f	- Year 5	98	TCO2e	= 12e * 13a / (1 - 13a)		98	0.1	0.3
13g	- Year 6	97	TCO2e	= 12f * 13a / (1 - 13a)		97	0.1	0.3
13h	- Year 7	87	TCO2e	= 12g * 13a / (1 - 13a)		87	0.1	0.3
13i	- Year 8	84	TCO2e	= 12h * 13a / (1 - 13a)		83	0.1	0.2
13j	- Year 9	9	TCO2e	= 12i * 13a / (1 - 13a)		9	0.0	0.0
13k	**Forecast all other emissions :**	**740**	**TCO2e**					

14 - **Forecast Total Scope 1 CO2e Facility Emissions**

						CO2	CH4	N2O
14a	- Year 1	15,667	TCO2e	= 12a + 13b		15,595	22	50
14b	- Year 2	48,382	TCO2e	= 12b + 13b		48,165	69	149
14c	- Year 3	41,633	TCO2e	= 12c + 13b		41,449	59	125
14d	- Year 4	40,311	TCO2e	= 12d + 13b		40,133	57	121
14e	- Year 5	39,240	TCO2e	= 12e + 13b		39,067	56	118
14f	- Year 6	38,846	TCO2e	= 12f + 13b		38,674	55	117
14g	- Year 7	34,786	TCO2e	= 12g + 13b		34,633	50	103
14h	- Year 8	33,450	TCO2e	= 12h + 13b		33,304	48	98
14i	- Year 9	3,789	TCO2e	= 12i + 13b		3,772	5	11
14j	**Forecast Total Scope 1 CO2e Facility Emissions:**	**296,104**	**TCO2e**					
14k	**Highest Scope 1 CO2e Facility Emissions:**	**48,382**	**TCO2e**					

CLIENT: **ACH Minerals Pty Ltd**
LOCATION: **Ravensthorpe Gold Project**
REASON: **Greenhouse Gas Emissions Projection**

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GREENBASE
ENVIRONMENTAL ACCOUNTANTS

ITEM N°	ITEM	VALUE	UNITS	COMMENT

Forecast Emissions Intensity (TCO2e/oz)

15 -	Forecast Emissions Intensity (TCO2e/oz)			
15a	- Year 1	1.536	TCO2e/oz	= 14a / (8a * 1000)
15b	- Year 2	1.086	TCO2e/oz	= 14b / (8b * 1000)
15c	- Year 3	0.919	TCO2e/oz	= 14c / (8c * 1000)
15d	- Year 4	0.874	TCO2e/oz	= 14d / (8d * 1000)
15e	- Year 5	0.805	TCO2e/oz	= 14e / (8e * 1000)
15f	- Year 6	0.896	TCO2e/oz	= 14f / (8f * 1000)
15g	- Year 7	0.956	TCO2e/oz	= 14g / (8g * 1000)
15h	- Year 8	0.936	TCO2e/oz	= 14h / (8h * 1000)
15i	- Year 9	1.094	TCO2e/oz	= 14i / (8i * 1000)
15j		**0.944**	**TCO2e/oz**	**= 14j / (8j * 1000)**
15k	Lowest Emission Intensity:	**0.805**	**TCO2e/oz**	
15l	Highest Emission Intensity for:	**1.536**	**TCO2e/oz**	

Forecast GHG Emissions & Emissions Intensity

Forecast Gold Production & Emissions Intensity
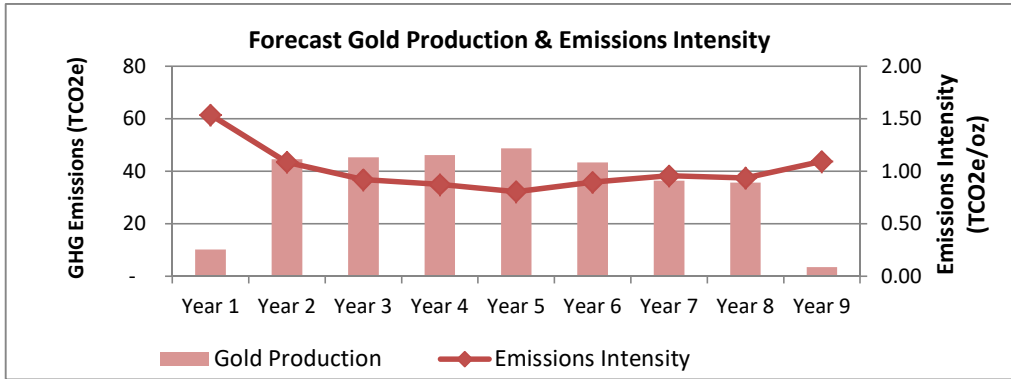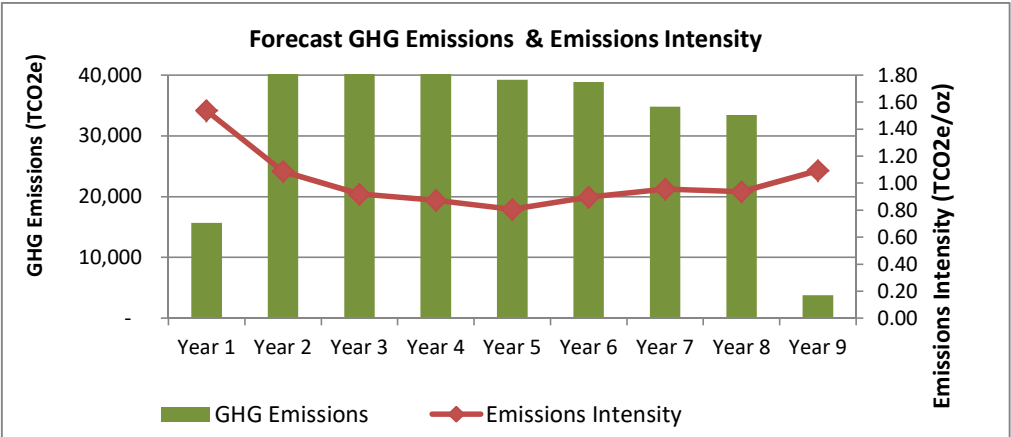
CLIENT: **ACH Minerals Pty Ltd**
LOCATION: **Ravensthorpe Gold Project**
REASON: **Emissions Intensity Comparison**

ENVIRONMENTAL ACCOUNTING WORKSHEET
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GREENBASE ENVIRONMENTAL ACCOUNTANTS

ITEM Nº	ITEM	VALUE	UNITS	COMMENT

Gold produced at seven Australian gold mines during FY2017

The following facilities produce their own electricity and saleable gold. The production figures were taken from the Greenbase database.

16 - Gold produced at seven Australian gold mines during FY2017

16a	- Gold Mine A	434,679	oz	*From the Greenbase database*
16b	- Gold Mine B	226,350	oz	*From the Greenbase database*
16c	- Gold Mine C	55,491	oz	*From the Greenbase database*
16d	- Gold Mine D	221,572	oz	*From the Greenbase database*
16e	- Gold Mine E	124,747	oz	*From the Greenbase database*
16f	- Gold Mine F	53,720	oz	*From the Greenbase database*
16g	- Gold Mine G	285,580	oz	*From the Greenbase database*
16h				

Gold produced at seven gold mines during FY2017

Total GHG Emissions from seven Australian gold mines during FY2017

The following facilities produce their own electricity and saleable gold. The GHG emissions figures were taken from the Greenbase database.

17 - Total GHG Emissions seven Australian gold mines during FY2017

17a	- Gold Mine A	239,862	TCO2e	*From the Greenbase database*
17b	- Gold Mine B	101,565	TCO2e	*From the Greenbase database*
17c	- Gold Mine C	37,081	TCO2e	*From the Greenbase database*
17d	- Gold Mine D	119,170	TCO2e	*From the Greenbase database*
17e	- Gold Mine E	57,625	TCO2e	*From the Greenbase database*
17f	- Gold Mine F	25,087	TCO2e	*From the Greenbase database*
17g	- Gold Mine G	95,374	TCO2e	*From the Greenbase database*
17h				

GHG emissions from seven gold mines during FY2017

Emissions Intensity (TCO2e/oz) comparison

18 - Forecast Emissions Intensity (TCO2e/oz) for seven Australian gold mines during FY017

18a	- Gold Mine A	0.552	TCO2e/oz	*= 17a / 16a*
18b	- Gold Mine B	0.449	TCO2e/oz	*= 17b / 16b*
18c	- Gold Mine C	0.668	TCO2e/oz	*= 17c / 16c*
18d	- Gold Mine D	0.538	TCO2e/oz	*= 17d / 16d*
18e	- Gold Mine E	0.462	TCO2e/oz	*= 17e / 16e*
18f	- Gold Mine F	0.467	TCO2e/oz	*= 17f / 16f*
18g	- Gold Mine G	0.334	TCO2e/oz	*= 17g / 16g*
18h	**Lowest Emission Intensity:**	**0.334**	**TCO2e/oz**	
18i	**Highest Emission Intensity:**	**0.668**	**TCO2e/oz**	

GHG Emissions & Emissions Intensity

19 - Forecast Emissions Intensity (TCO2e/oz) for Ravensthorpe Gold Project

19a	- Year 1	1.536	TCO2e/oz	*= 15a*
19b	- Year 2	1.086	TCO2e/oz	*= 15b*
19c	- Year 3	0.919	TCO2e/oz	*= 15c*
19d	- Year 4	0.874	TCO2e/oz	*= 15d*
19e	- Year 5	0.805	TCO2e/oz	*= 15e*
19f	- Year 6	0.896	TCO2e/oz	*= 15f*
19g	- Year 7	0.956	TCO2e/oz	*= 15g*
19h	- Year 8	0.936	TCO2e/oz	*= 15h*
19i	- Year 9	1.094	TCO2e/oz	*= 15i*
19j	**Lowest Emission Intensity for Ravensthorpe Gold Project :**	**0.805**	**TCO2e/oz**	
19k	**Highest Emission Intensity for Ravensthorpe Gold Project :**	**1.536**	**TCO2e/oz**	

Emissions Intensity Comparison

NOTES:

This report was prepared in January 2018 and then updated in Ocotber 2018. To date, no benchmark emissions intensities have been published.

Greenbase has taken a sample of seven gold mines that produced their own electricity and saleable gold during FY2017 from the Greenbase database and calculated their emissions intensities. It is important to note that these emissions intensities are not currently published.