APPENDIX L: ALTERNATIVE LAND USE ECONOMIC ASSESSMENT REPORT

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MEMORANDUM

To: Alex Pfeiffer, SLR Environmental Engineers

From: Gerrie Muller, Strategy4Good Partners

Date: 1 September 2014

Re: **Tharisa alternative land-use economic impact assessment**

For ease of reference we outline this memorandum as follows:

1 Background and objectives

Tharisa Minerals (Pty) Ltd (Tharisa) produces chrome and platinum group metals concentrate near Marikana and is located within the Rustenburg and Madibeng Local Municipalities, North West Province.

Tharisa has an approved environmental impact assessment (EIA) and management programme (EMP) and this application is the first amendment.

Tharisa plans the following developments at its Mine[1]:

- Deepening and widening of the open pits;
- Construct and operate a chrome sand drying plant;
- Changes to the tailings dams and waste rock dumps;
- Changes to the general surface infrastructure layout and operations at the mine; and
- Waste rock dump in the north east

The project components require authorisation on the basis of an environmental assessment process, which comprises two phases: the scoping phase and environmental impact assessment (EIA)/environmental management programme (EMP) phase.

2 Regulation 50

As part of the EIA/EMP process, an economic land use alternative analysis needs to be undertaken to determine whether Tharisa's mining expansion is to the net benefit of the economy.

The requirements of this a straight analysis of the economic value of land between a mining project and the predominant alternative land-use, and the second being an opinion on the sustainable development quality of the project relative to the alternative land-use.

The latter requires the integration of all the social, environmental and economic impacts on a cost-benefit basis. The wording of this requirement is ambiguous and we interpret this as an assessment of the better land-use alternative for this generation without compromising the needs of the next generation.[2]

Based on Regulation 50(c), the first task required in terms of this analysis is to report on the property values that would potentially be lost and gained in the continuation of the mining project.

The second task with respect to the alternative land use valuation is the calculation of the Net Present Value of future income streams to determine which alternative land-use yields the most positive economic results for this generation.

[1] For full details see the EIA published by SLR Consulting.
[2] The most common definition of Sustainable Development is: 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Although not stated in Regulation 50(c) as a requirement to analyse, we deem the net employment gained and lost as an important factor and added this component as well.

3 Assumption and limitation

a) This study is limited in its scope as we worked mainly with "inferred economic data", thus we limited ourselves to desktop research, telephonic interviews and relied on independent information from the project promotor and the environmental consultants.

4 Key Findings

4.1 Introduction

The basic premise of the economic impact assessment is to compare the additional 6 years of mining to the potential loss of 276 hectares of agricultural land over an economic generation, in terms of both employment and income. Our finding is that in both cases, mining is economically a better option than using 276 hectares for agricultural land.

Table 1: Alternative Land-Use Analysis

Row ID	Mining Investment/Property (2012 Rand)	Tharisa	Agriculture	Net difference
1	Agricultural hectares displaced		(276.00)	
2	Estinated market value for agricultural land ph		R 75 000.0	
3	Mine Investment (less amortisation)	R 72.50	R -20.70	R 51.8
4	Net Employment	Tharisa	Agriculture	Net difference
5	Initial construction employment	100		
6	Economic Generation (Life expectancy less 18 years.)	6	32	
7	Adjust for 2 years construction	19		
8	Add new employment/jobs retained vs opportunity losses	2 406	(6)	
9	Life of mine / economic generation (years)	6.00	32.00	
10	FTE Total Jobs Created / Retained (Lost)	470	(6)	464
11	Economic Value Added (GDP)	Tharisa	Agriculture	Net difference
12	No of direct jobs	2406	(6)	
13	GDP pe (in respective industries) (2014)	542 941	R 108 423	
14	GDP added/lost (Rm) (perm jobs x GDP pe)	R 248	R -0.60	
15	Discount Rate	20%	12%	
16	Economic Period	6.00	32.00	
17	Present Value of EVA (GDP) (Rm)	R 823	R -4.85	R 818
18	Total	Tharisa	Agriculture	Net difference
19	Estimate Value of property at investment Rm	R 72.5	R -20.7	R 51.8
20	Present Value of EVA (GDP) (Rm)	R 823.3	R -4.9	R 818.5
21	Total Present Value of EVA + Property value(Rm)	R 895.8	R -25.6	R 870.3

The conclusion from the above table is the following:

- Based on the analysis of this report, using conservative amounts for the mine land and being more robust on the potential agricultural property lost, the economy ought to gain property value to an estimated R51.8 million.

- The total economic value gained based on a net present value basis amounts to R 870.3 million in favour of mining. This is a significant benefit to the economy.
- The net employment to the economy is adjusted by the additional life of mine, being 6 years over an economic generation of 32 years. The economic generation is calculated as SA life expectancy less 18 years of age. The net employment benefit to the economy is substantial at 464 jobs

The calculations above are based on the following:

Item	Assumptions
Initial construction employment	Initial construction employment of 100.
Add new employment/jobs retained vs opportunity losses	456 permanent employees and 1950 subcontractors. Tharisa retain their jobs for a further 6 years as a result of the mine expansion.
Life of mine / economic generation	The life of mine is extended by 6 years, which becomes the additional economic value added, compared to a 32 year economic generation.
FTE Total Jobs Created / Retained Lost	Adjusted for the life of mine, 470 full time equivalent jobs are retained by the mine (6/32*2406), compared to a potential loss of 6 agricultural jobs. The agricultural sector employs on average 2 jobs per 100 hectare in South Africa.
No of direct jobs	Actual jobs retained by Tharisa vs potential jobs lost.
GDP per employee	Information obtained from Quantec on a national average basis per industry.
GDP added/lost (Rm)	No of permanent jobs x GDP per employee per industry.
Discount Rate	Rate GDP is discounted to the present day to accommodate for inflation and risk.

4.1.1 Multipliers

The benefits to the mine development is substantial and the use of multipliers will make very little difference in the outcome of this analysis.

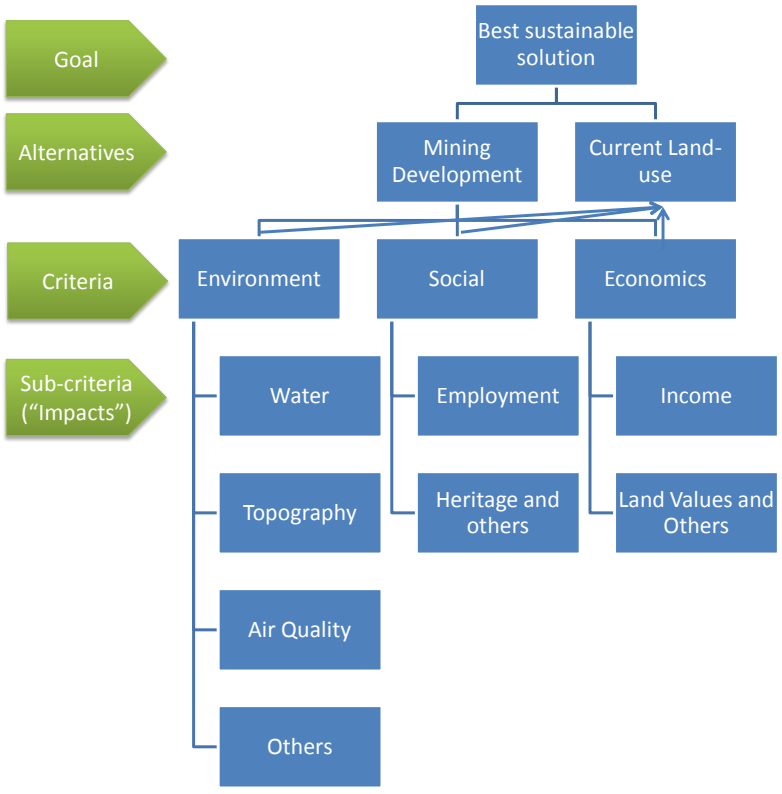
5 Integrated Development Analysis

Our approach to Regulation 50 (d) 9 is to evaluate all the sustainable development impacts (social, economic and environmental) to determine the best land-use for this and the next generation.

In arriving at the better sustainability option of land-use, we use the Analytical Hierarchical Process (AHP), which is a structured technique for organizing and analysing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s, and has been extensively studied and refined since then. It has particular application in group decision making and is used around the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare, and education.

The figure below outlines this methodology.

Figure 1: AHP Decision Making Process



The first issue to establish in the Analytical Hierarchical Process is to define the decision-making goal. In this case, it is to decide the better land-use for this and the next generation between the mine development and existing land-use. The criteria used are the generally accepted sustainability categories, namely Environment, Social and Economics with each having their own sub-criteria (being the impacts as identified by SLR.)

6 Results and Findings

The Analytical Hierarchical Process was designed and executed by us in the following manner:

a. We used the SLR socio-economic and environment impact assessment as a basis for the significance of risks and opportunities. The assessment considers the cumulative on-site impact taking into account the approved operations together with the project components. These impacts have been described in the main Environmental Impact Assessment document as undertaken by SLR Consulting. These impacts have been described in the main Environmental Impact Assessment document as undertaken by SLR Consulting.

b. Our final result is based on the mitigated impacts as it is assumed that mitigation will take place. In this regard, the role of monitoring by the regulator is critical for the sustainable development success of this application.

c. We converted the above ratings into numerical scales. This is necessary in order to assign weightings for the purposes of weighted averages. The conversion was done on the basis outlined below.

Figure 2: Conversion of impact rating to Percentage Scale

Rating	%	Direction
FF (fatal flaw)	100%	Positive
H	90%	Positive
H-M	66%	Positive
M-H	100%	Positive
M	50%	Positive
M-L	22%	Positive
L	10%	Positive
N		Neutral
(L)	-10%	Negative
(M-L)	-22%	Negative
(M)	-50%	Negative
(H-M)	-66%	Negative
(M-H)	-66%	Negative
(H)	-90%	Negative
(FF)	-100%	Negative

d. The next task was to assign weightings to different aspects in order to ensure that the most important ones have a higher impact on the overall rating. Each category is weighted equally, hence the aspects within each category is weighted relative to each other. Each category by definition has to add up to 100%.

e. The result of the above impacts, changed to scales and weighted by importance results in the matrix below. This matrix shows the weighted averages and the net results.

f. Using the above table, we summed all the impacts below.

Table 2: Integrated Development AHP Analysis

	A	B	C	D	E
1	Row Labels	Average of Unweighted Unmitigated	Average of Unweighted Mitigated	Sum of W Avg - Unmitigated	Sum of W Avg Mitigated
2	Economic	0.50	0.50	0.50	0.50
3	Environment	(0.86)	(0.40)	(0.86)	(0.39)
4	Social	(0.55)	(0.11)	(0.20)	0.09
5	Total	(0.30)	(0.00)	(0.19)	0.07
6	Rating	(M)	(L)	(M-L)	VL

6.1 Interpreting the above results:

- Referring to Cell E6 above, the overall post-mitigated weighted average of the development is positive VL, which on average is most often where most mine developments are categorised. Based on this, all things being equal, this development ought to be beneficial on an integrated development basis to society. An obiter dictum is that the above rating has been undertaken by SLR Environmental Consulting and it is this specialist view that the positive economic and social impacts ought to be rated higher. Thus this final outcome of VL positive on an integrated development basis ought to be seen as very conservative in favour of the socio-environment.
- Focussing on column E, furthermore Cell E6 is the sum of the positive economic score (0.5 with 1 being maximum), the environment (a negative 0.39) and Social (a positive 0.09). The positive social rating is because Employment is part of this category and Employment has a relatively high weighting. Social thus moves from (0.20) – brackets denotes negative – to a

positive 0.07. Its relative low rating is because of the change in the sense of place, inward migration and road and traffic impacts.

- Focussing on Row 3, it can be seen that the environmental impacts show major fluctuations from unmitigated to mitigated. This is for the obvious reason that unmitigated impacts are generally high in negative terms, and again shows the importance of thorough mitigation.
- Row E, the weighted column, is better than Row C, the un-weighted column for the reason that both Economic Income generation and Employment have high weightings and this aspect results in higher weighted scores.

7 Conclusion

A total of 464 FTE jobs over a six year period relative to very few job-losses in agriculture, and a significant increase in GDP, with a positive integrated development rating, are good reasons to continue this proposed development. Considering that Tharisa may discontinue its operations, or that alternatives may be very costly, the retention of jobs (in an optimal year just over 2000), is regarded as very valuable to society. The economic contribution in GDP to the economy is equally significant in an optimal year (compared to an economic generation's GDP it is much less significant.)

In conclusion this development should be viewed as an effective measure against "downscaling". Downscaling in mines is inevitable and once environmental disruptions have taken place and are being mitigated to acceptable levels, the ideal is for a mine to continue its activities as long as possible.