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EXXARO RESOURCES LIMITED

Sustainable Development Investigation for NBC: Belfast Project: Final Report

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REPORT

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Executive Summary

Exxaro Resources Limited is currently evaluating the potential of a coal reserve found on the farms Zoekop, Blyvooruizicht and Leeuwbank in the Belfast area of Mpumalanga, South Africa. As part of the overall Environmental Impact Assessment for the development of a proposed opencast mine on these farms, Exxaro has commissioned Golder Associates Africa (Pty) Ltd to undertake a Sustainable Development Investigation for two development scenarios. These scenarios are outlined as follows:

- Scenario 1 - Coal mining for the life of the mine (38 years), rehabilitation and farming for the remainder of the 100 year horizon; and
- Scenario 2 - Agricultural production for 100 years (current land use).

The 100 year period for each Scenario was used to balance their long-term economic impacts and determine which Scenario represents the most sustainable development option. After collecting the relevant data for each of the scenarios and delineating the study area according to impact intensity, the Consultants used a Social Accounting Matrix (SAM) approach to assess the direct, indirect and induced impacts of each scenario on the local and regional economies of Mpumalanga.

The total economic impact of Scenario 1 was made up of the combined impact of agricultural activities for 4 years, construction of the mine for 3 years, mining operations for the life of the mine (38 years), decommissioning, rehabilitation and closure for 1 year, re-establishment of agriculture for 5 years and the impact of farming again for the remaining 50 years in the 100 year period. The results of the Investigation found that, in total, Scenario 1 had a total production impact of R121.5 billion, and a total GDP-R impact of R41.6 billion over the 100 year horizon. Scenario 1 will create 268 jobs annually when agriculture takes place, 1271 jobs will be created during the construction phase of the mine, and 2338 jobs will be created, indirectly, on an annual basis during the operational phase of the mine. After rehabilitation and re-establishment of agriculture (which will create another 1815 jobs indirectly), the intention is that the land will revert back to agricultural production.

The results of the investigation found that Scenario 2 had a much smaller economic impact relative to Scenario 1. The total production impact of R3.620 billion over the 100 year period ensuring an increase of R1.455 billion in GDP-R (regional Gross Domestic Product). Scenario 2 also provided employment for 268 individuals per annum.

Should Scenario 1 be implemented, it will have significant macroeconomic impacts on the local and regional economies of the primary and secondary study areas. This is due to elevated production, GDP, and employment at a local, provincial and national level. Scenario 1 could also ensure coal supply to Eskom's coal-fired stations in the Mpumalanga Province for the duration of its lifetime and also provide significant export revenue for the Country. It is important to note that the economic impact of Scenario 1 may be overstated due to the strong assumption that the quality of agricultural production will be the same after rehabilitation. Mines have, historically, often not restored mine land to its pre-mining productivity for numerous reasons and this is especially the case with large open cast mines.

In light of the Country's recent 'energy crisis' and towards generating employment opportunities Scenario 1 is a viable option to stimulate economic growth and creation of employment. From a sustainable development, however, the need for more mining development in this particular (high potential) farming area may be antagonistic to the Government's efforts in addressing the country's rural development and food insecurity problems. Reduced crop yields and increased production costs post closure also reduce the attractiveness of Scenario 1 from a sustainable development perspective. Add to this the potential negative externalities such as the removal or degradation of important ecosystem goods and services and Scenario 2 perhaps presents a more sustainable development alternative over the 100 year period. In a policy context, the shift in land use from agriculture to mining and the potential impact on food security should be weighed up by the Country's policymakers.

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1.0 INTRODUCTION

Exxaro Resources Limited is currently evaluating a potential coal reserve on several farms in the Belfast area of the Mpumalanga Province. The Belfast area falls under the jurisdiction of the Emakhazeni Local and Nkangala District Municipalities. The farms under the mining rights application are known as Leeuwbank, Zoekop and Blyvooruitzicht and current agricultural enterprises on these properties include extensive maize, soya bean, hay, beef, sheep and dairy operations. Adjacent to the proposed mining development are several other farms, one of which produces cherries for the export market.

The coal mining operations undertaken in the area will be a combination of throw blasting, dozing and conventional truck and shovel operations. The method of mining is more commonly known as “strip” or “rollover” mining. The Project, known as the NBC Belfast Project, will be undertaken in two separate phases:

- Phase 1: Establishment and operation of a 2 Million Tons per annum (MTpa) crushing and screening plant with an approximate life span of 38 years; and
- Phase 2: Establishment and operation of a 3 MTpa double stage washing plant also with an approximate life span of 38 years.

Exxaro has commissioned Golder Associates Africa to undertake the Sustainable Development Investigation for the NBC Belfast Project. The Investigation will assess the comparative economic impact of two development scenarios in the Belfast area within the Emakhazeni Local Municipality. These scenarios relate to;

- Scenario 1 - Coal mining for the life of the mine (38 years), rehabilitation and farming for the remainder of the horizon; and
- Scenario 2 - Agricultural production for 100 years (current land use).

Each scenario will have its own impacts on the local and regional economies and an input/output model approach is used to quantify the economic impact of each scenario. The input/output model is an application of the Social Accounting Matrix (SAM) and contains information on inter-sector relations, including tables that describe, for each sector included in the model, the amount of input a sector requires from other sectors to produce one unit of output. These models are able to estimate impacts within each industry in the model and thereby provide more detailed information than simple total economic impacts on income, output, and employment. The input/output table to be used for the purpose of this study is derived from the national input/output table which had been developed from the national accounting system. This model is a comprehensive source of information of all the industry transactions between the buyers, sellers and consumers in the economy and differentiates between 38 different industrial sectors.

The Consultants made use of both primary (through surveys) and secondary data for the impact analysis of each scenario. Primary data were collected from farmers within the mining rights application block as well as from Exxaro. These primary data were supplemented by secondary data gathered from Quantec, Statistics South Africa (Stats SA), GrainSA, the Abstract of Agricultural Statistics and other institutions.

This report is submitted to Exxaro by Golder Associates, as fulfilment of the Terms of Reference and is structured as follows: the first section presents the overall Project methodology used by the Consultants in undertaking the Investigation. The second section presents the delineated study area as well as the baseline economic and socio-economic profiles for the study area. The third section is a sectoral perspective section which presents and discusses the context of each of the major economic sectors within Mpumalanga, mining and agriculture. The fourth section presents an impact analysis for the baseline scenario data and the fifth section presents an evaluation of the impact scenarios. The report ends with an ecosystems services analysis, a discussion on the important findings and some recommendations.

It is important to note that the results and subsequent discussion presented in this report are based on the primary and secondary data collected, literature cited and the interpretation of the Consultants concerned.

2.0 METHODOLOGICAL APPROACH

Figure 1 below illustrates the methodological approach followed for the Sustainable Development Investigation. The Project was divided into three main components; data collection and base profile, modelling and interpretation and reporting. Each phase is discussed in greater detail below.

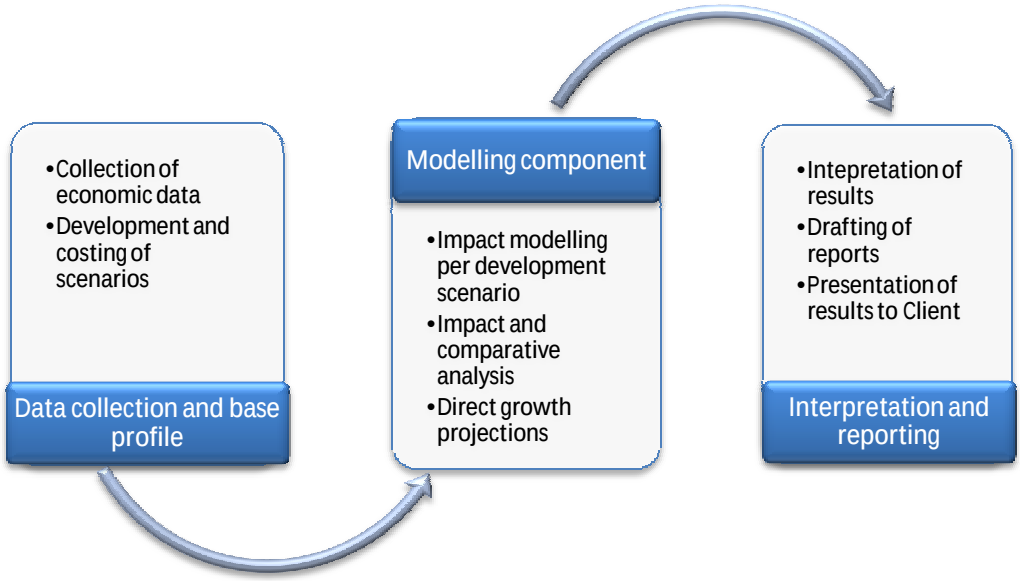

Figure 1: Overview of Project methodology

a) Data collection and establishment of a base profile for the study area

The objectives of this component were to review and collate all data relevant to the Investigation and to develop an accurate socio-economic profile of the study area, which were then used in later stages to assist in assessing the quantitative impacts of the project. All relevant data required for the next component, modelling, would need to be collected during this component. Farmers found within the mining rights application block as well as a **sample** of surrounding farmers would need to be surveyed and their production data captured. The relevant mining information required for each of the mine's phases of operation (construction, mining and closure), employment, skills requirements, start date, and operational life would be obtained directly from Exxaro. For the purposes of this Investigation, **the data obtained should represent the most accurate estimates of the construction and operation costs at the moment of the request and where the relevant data was not available, industry norms would then be used.**

b) Modelling component

The relevant data collected in the previous component would need to be collated and the model constructed. During the modelling component the Consultants would be able to assess and quantify the direct, indirect and induced impacts generated as a result of expenditure during the construction and operational phases of the proposed Belfast project. The impact assessments for the construction and operational phases of the project were separately stressed, as was necessitated by the different durations of the impacts associated with each phase. In addition, the impact of the farming alternative was estimated, as well as the potential loss in agriculture as a result of establishing a mine on the agricultural land. The following impacts were assessed for both the construction and operational phase of the Belfast project, as well as for the farming alternative:

- Impact on the level of production;
- Impact on the level of GDP-R;

- Impact on the level of employment;
- Impact on the level of personal income; and
- Impact on the level of tax revenue.

c) Interpretation and reporting

Interpretation of the model outputs forms a crucial component of the Investigation. The Consultants will need to assess the implications of the model results in terms of the potential socio-economic impact of the proposed developments as well as the implications of these impacts for sustainable development. Based on the model outputs and results, the Consultants will then provide the Exxaro with some recommendations. These recommendations should provide the Exxaro with a comprehensive and clear understanding of the potential socio-economic impacts of the two scenarios on the local and broader area as well as the implications from as sustainable development perspective. The following section of the report outlines the approach to an economic impact assessment to give more background to the approach and methodology being undertaken by the Consultants.

3.0 ECONOMIC IMPACT ASSESSMENT

Economic Impact Assessment (EIA) deals with the evaluation of potential impacts of a particular development on the economic environment of a study area (which can be delineated according to impact intensity). It analyses potential changes in production output, Gross Value Added, and employment during construction and operational phases of a particular project. More specifically, EIA assesses the way in which the direct benefits and costs of a proposed project affect the local, regional, or national economy.

- The intervention can be in the form of new investment in infrastructure, new development, adoption of a new policy or services, expansion of current operations, etc.; and
- The types of economic impacts stimulated by the intervention are generally positive and include creation of additional jobs, generation of business sales and value-added, improved quality of life, increase in disposable income, and growth of government revenue.

An intervention into an economy (on any scale) not only creates direct benefits to the investor, but has spill-over effect on the other economic agents. These spill-over effects could be positive or negative. As illustrated in Figure 2 below, three types of economic impacts are generally assessed:

- The **direct** economic effects are generated when the new business creates new jobs and purchases goods and services to operate the new facility. Direct impact results in an increase in job creation, production, business sales, and household income;
- The **indirect** economic effects occur when the suppliers of goods and services to the new businesses experience larger markets and potential to expand. Indirect impacts result in an increase in job creation, Gross Geographic Product (GGP), and household income; and
- The **induced** economic effects represent further shifts in spending on food, clothing, shelter and other consumer goods and services as a consequence of the change in workers and payroll of directly and indirectly affected businesses. This leads to further business growth/decline throughout the local economy.

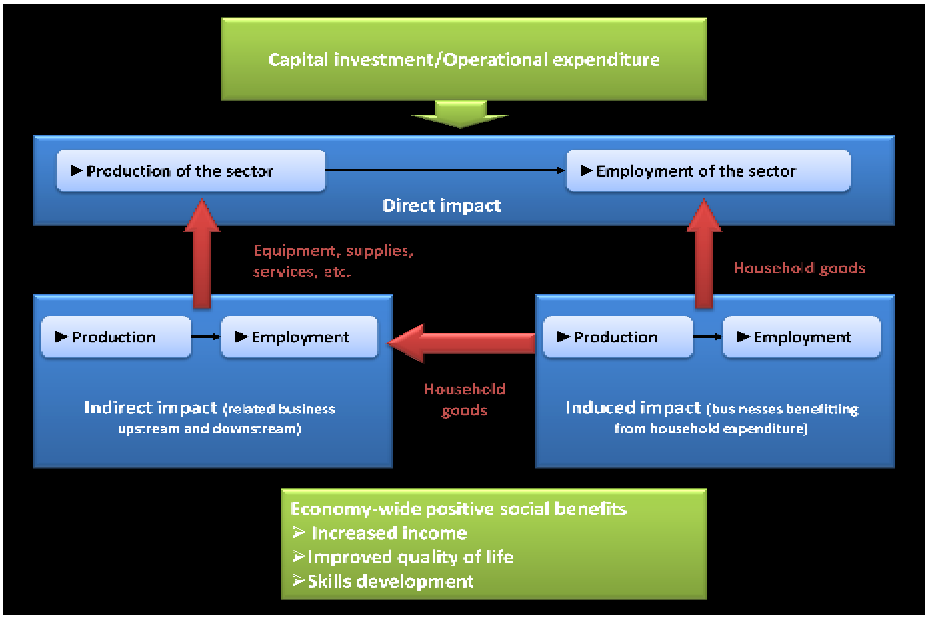

Figure 2: Impact of capital investment/operational expenditure

Economic impacts can also be viewed in terms of their duration, or the stage of the project's lifecycle that is being analysed. Generally two phases are subjected to the economic impact assessment – construction phase and operational phase. The construction phase economic impacts are of a temporary nature, they have, therefore, a temporary effect. On the other hand, the operational phase of the project usually takes place over a long term; hence the impacts during this stage are of a sustainable nature.

4.0 ASSUMPTIONS OF THE SOCIAL ACCOUNTING MATRIX (SAM)

Assessing the economic impact of each scenario was done using an econometric model created on the basis of the national Social Accounting Matrix (SAM) updated to 2009 figures. The SAM is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents in an economy. Assessment of economic impacts requires knowledge of expenditure on the construction of the mine and operating costs borne once mining commences. Conversion of these input data into economic impacts is done by using an econometric model. For the model to be considered valid, all the various assumptions must be adhered to.

The following assumptions were used with respect to the econometric model and modelling exercise for each of the scenarios:

- The capital expenditure (CAPEX) and operational expenditure (OPEX) figures reflect the real situation accurately enough for the purpose of the impact assessment;
- The impact assessment assumes that the proposed development concept is financially viable;
- Production activities in the economy are grouped in homogeneous sectors;
- The mutual interdependence of sectors is expressed in meaningful input factors;
- Each sector's inputs are a function of the specific sector's production, comparative advantage, and location;
- The production by different sectors is equal to the sum of the production of separate sectors'; and
- The technical coefficients of the SAM model remain constant for the period over which forecast projection is made, i.e. **no structural changes in the economy are experienced**.

In order to conduct an accurate macroeconomic impact assessment, it is essential that the data required by the impact model is as precise as possible, since the quality of the model's output is directly related to the quality of the data inserted into the model.

5.0 EVALUATION OF ECONOMIC IMPACTS

The potential or predicted impacts are then evaluated using an approach based on a scoring system. This approach entails assessing economic impacts on the basis of their association to various possible mutually exclusive characteristics of a number of predetermined criteria. A score is pre-assigned to each possible characteristic (per criterion) and the impact's score is determined by a calculation that has been pre-assigned. Criteria include the geographic extent, duration and magnitude of the impact. Once the evaluation exercise has been completed, the implications (both positive and negative) of the potential economic impacts are identified. These implications provide the basis for actions that could improve the positive aspects of the project and reduce the negative aspects.

5.1 Assessment methodology

To determine the implications of the economic impacts, the effect of these impacts on the level of the economic variable in question must be determined. This entails establishing the pre-impact level of activity (baseline) and the change in activity (economic impact) brought about by the 'intervention' in question.

5.2 Evaluation methodology

To evaluate the macroeconomic impacts of each scenario a scoring system is utilised whereby economic impacts are assessed on the basis of its association to various possible mutually exclusive characteristics of a number of predetermined criteria. A score is pre-assigned to each possible factor characteristic and the impact's score is determined by a calculation that has been pre-assigned.

The following criteria are used:

- Direction of impact;
- Geographic extent of impact;
- Duration of impact;
- Magnitude; and
- Probability of occurrence.

Table 1 lists the options associated with each criterion as well as the associated option score. For example, the options associated with the geographical extent criterion are: site, local, regional, national, and international. If the impact under observation has a regional extent, this means that the impact is felt at a provincial level. The impact under consideration would then be assigned a score of 3 for the geographical extent criterion.

Table 1: Criteria Options and Associated Scores

Criterion	Criterion Options	Interpretation	Score
Direction	Positive	Positive impact on level of economic variable	Not applicable
	Negative	Negative impact on level of economic variable	Not applicable
	Neutral	No impact on level of economic	Not

		variable	Applicable
Geographic Extent	Site	Impact extends to primary study area level	1
	Local	Impact extends to local municipality level	2
	Regional	Impact extends to provincial level	3
	National	Impact extends to national level	4
	International	Impact affects global economic relations	5
Duration	Transient	Less than 1 year	1
	Short Term	1 -5 years	2
	Medium Term	5-15 years	3
	Long Term	> 15 years & ceasing with closure	4
	Permanent	> 49 years	5
Magnitude	Negative	See Table 2	0
	None/negligible		2
	Low		4
	Moderate		6
	High		8
	Very High		10
Probability of Occurrence	Improbable	Less than 5% chance	1
	Low Probability	5-40% chance	2
	Medium Probability	40-60% chance	3
	Highly probable	60-90% chance	4
	Certain	Definite	5

Choosing the appropriate geographical extent, duration and probability options are relatively straightforward and do not require any mathematical analysis. Determining the magnitude of an impact is, however, more complex. To evaluate the direct production, GDP, or employment impacts, on the basis of magnitude, the contribution of the production/GDP/employment impact to the change in size of the relevant economic sector's production/GDP/employment during the base period (2007 to 2008) is compared to the production/GDP/employment contribution of the relevant economic sector to the change in the size of the entire economy's production/GDP/employment during the base period (2007 to 2008). The box below summarises the required calculations.

$^{A}/_{B}$ and $^{B}/_{C}$, where

A= Direct Production/GDP/Employment Impact
B= Δ (2007-2008) Sector Production/GDP/Employment
C= Δ (2007-2008) Total Economy Production/GDP/Employment

To determine the magnitude of the indirect and induced production, GDP, or employment impacts, the actual values of the indirect and induced impacts are divided by the actual values of the direct impact. Table 2 presents the various comparative options and their associated scores.

Table 2: Production, GDP, and Employment Magnitude Options

Magnitude Options (Scores)	Direct Impact	Indirect /Induced Impact
Negative (0)	A< 0 B>0	The indirect/induced production/GDP/employment impact is negative
None/negligible (2)	$^{A}/_{B}$ (=0) = $^{B}/_{C}$ (=0)	The size of the indirect/ induced production/GDP/employment impact is less than 25% of the size of the direct production/GDP/employment impact.
Low (4)	$^{A}/_{B}$ (>0) = $^{B}/_{C}$ (>0)	The size of the indirect/induced production/GDP/employment impact is between 25% and 50% of the size of the direct production/GDP/employment impact
Moderate (6)	$^{A}/_{B}$ (>0) < $^{B}/_{C}$ (>0)	The size of the indirect /induced production/GDP/employment impact is between 50% and 100% of the size of the direct production/GDP/employment impact
High (8)	$^{A}/_{B}$ (>0) > $^{B}/_{C}$ (>0)	The size of the indirect/induced production/GDP/employment impact is between 100% and 500% the size of the of the direct production/GDP/employment impact
Very High (10)	A>0 B<0	The size of the indirect/induced production/GDP/employment impact is greater than 500% the size of the direct production/GDP/employment impact.

The following formula is used to calculate the significance of macroeconomic impacts:

Significance Points (SP) = (Magnitude + Duration + Scale)*Probability

Significance scores are classified as follows:

- > 71 High macroeconomic significance;
- 41-70 Moderate macroeconomic significance; and
- < 40 Low macroeconomic significance.

6.0 DELINEATION OF THE STUDY AREA

As a pre-cursor to the first component of the Investigation, data collection and the establishment of a base profile, the various areas of impact needed to be identified and delineated. This was using data provided to the Consultants by Exxaro and through available Global Information System (GIS) data. The site of the proposed Belfast Project is situated some 10 km southwest of the town of Belfast, within the Emakhazeni Local Municipality which forms part of the Nkangala District Municipality in the Mpumalanga Province. Although the direct environmental and groundwater impact areas may vary for the surrounding areas and downstream water users, for the purposes of this Investigation, the impact areas have been delineated as follows:

- **Primary** study area - Emakhazeni Local Municipality (ELM)
- **Secondary** study area - Mpumalanga Province (MP) and Greater Sekhukhune District Municipality (GSDM)

The delineated study area relative to the proposed mining area is shown in Appendix A. A more detailed illustration of the mining area is shown in Appendix B. The rationale for this delineation is due to non-homogenous impact intensity within and between the primary and secondary study areas. It is possible that individuals, households and/or communities that are more closely located to the site of the development will be more significantly affected than those located at a further distance. Similarly, it is possible that the most significant impact may not be felt within the locality in which the development occurs; this is the case when large proportions of labour and/or inputs are imported from outside the study areas. Delineating the study areas into two levels will, therefore, allow for the heterogeneity of impacts to be demonstrated

As illustrated in the map in Appendix A major towns within Emakhazeni include Belfast, Machadodorp, Dullstroom and Waterval Boven. While the Belfast area is generally characterised by its agricultural and mining activities, a major agri-tourism activity is the annual Hadeco Tulip festival held outside the town (Hadeco, 2009). The other major towns, Machadodorp, Dullstroom and Waterval Boven are popular among South African and international tourists and Dullstroom, in particular is recognised as South Africa's premier fly-fishing destination (www.dullstroom.co.za, 2009). The Emakhazeni area experiences moderate summer and cold winters. The area's cold winters coupled with its high altitude (1100 – 2200m) make it suitable for a variety of agricultural activities which include common field crops such as maize, soya beans, wheat, sunflowers and sorghum but also include more niche market horticultural crops such as cherries. According to the National Department of Agriculture (NDA) (2006), cherries require long cold winters and are suitable for a wide range of soil types. Livestock enterprises such as beef, dairy and sheep are also common within the Emakhazeni Local Municipality.

7.0 BASELINE INFORMATION AND GROWTH PROJECTIONS

This section examines key economic and socio-economic characteristics of the primary and secondary study areas. This section is essential to providing both qualitative and quantitative data related to the economies under observation and towards creating a baseline against which the impacts will be assessed. The baseline data presented in this section is based on secondary data collected by the Consultants from various sources.

The following socio-economic and economic indicators are presented and discussed:

- Population size and growth;
- Average household size;
- Income and Expenditure patterns;
- Labour Market dynamics;
- Production; and
- (Regional) Gross Domestic Product.

To provide perspective to the study area data, provincial and national information is also provided.

7.1 Population Size and Growth

The population of any geographical area is vital to its development process, as it affects the economic growth through provision of labour and entrepreneurial skills, and forms the demand for the production output. Examining population dynamics is essential to gaining an accurate perspective of those who are likely to be affected by any proposed development or project. Table 3 below presents the current population of the primary and secondary study areas relative to the Provincial and National population. As Table 3 shows, relative to the population of the Mpumalanga Province, the Emakhazeni LM contributes only 0.82% to the total provincial population.

Table 3: Population size (2009)

Geographic Area	2009
South Africa	48,108,000
Emakhazeni LM	49,088
Greater Sekhukhune DM	1,316,000
Mpumalanga	4,587,000

Source: Quantec (2009)

Over the period 04/05 to 06/07 South Africa's population has been increasing at a decreasing rate. This is shown in Table 4 below which indicates that South Africa's population growth rate declined from 0.68% from 04/05 to 06/07. The Mpumalanga Province and Greater Sekhukhune DM's population growth rate also declined in the period between 2004 and 2006, but improved to 0.98% and 1.65% respectively between 2006 and 2007 – rates higher than the national population growth rate. Emakhazeni experienced negative population growth rates in the 2004 to 2007 period; however growth improved from -2.78% to -2.42% between 2005 and 2007. The negative growth rate could be attributed health impacts due the HIV/AIDS pandemic or migration. Studies undertaken by the Bureau of Market Research (BMR) indicate that HIV/AIDS, fertility rates and migration are the primary factors affecting population growth in South Africa[1]. Future development within Emakhazeni could **potentially** improve its population growth rate and could also induce further development such as housing and industry etc.

Table 4: Historic Population Growth Rates: 2004 - 2007

Geographic Area	04/05	05/06	06/07
South Africa	0.68	0.56	0.46
Emakhazeni LM	-2.40	-2.78	-2.42
Greater Sekhukhune DM	1.55	1.45	1.65
Mpumalanga	1.06	0.92	0.98

Source: Quantec (2009) and Urban-Econ Calculations (2009)

Historic population growth rates, together with the BMR's (2007) national and provincial population projections were used to project the study area's population for the next 10 years. Historic population growth trends were extrapolated using the predicted national and provincial population growth rates for the period in

[1] Bureau of Market Research, Population Estimates for South Africa by Magisterial District and Province 2001 and 2006, 2007.

question, i.e. 2009 to 2019, which, in simple terms, predicts that the national population growth trend will continue to be positive but declining up until 2014 at which point it will become positive and increasing. Table 5 shows the projected population sizes for 2009, 2014 and 2019.

Table 5: Population Size Projections: 2009 - 2019

Geographic Area	2009	2014	2019
South Africa	48,108,000	49,160,000	50,748,000
Emakhazeni LM	49,088	44,915	44,963
Greater Sekhukhune DM	1,316,000	1,345,000	1,388,000
Mpumalanga	4,587,000	4,686,000	4,838,000

Source: BMR (2007), Quantec (2009), and Urban - Econ Calculations (2009)

As shown in Table 5, the population of the Emakhazeni is expected to start increasing from 2014 to approximately 45,000 in 2019. Although the population growth rate is expected to be positive by 2015, the population in 2019 is still not on the same level as in 2009. Mpumalanga Province's population is expected to grow from 4,587,000 in 2009 to approximately 4,838,000, while the Greater Sekhukhune DM population is expected to reach 1,388,000 by the end of 2019.

A projected increase in the size of the population within the Mpumalanga Province and Greater Sekhukhune DM will induce an increase in the demand for employment opportunities but will also increase the demand for food as well as for goods and services. Future developments within these areas, therefore, need to balance the requirements for employment and population growth with food security needs.

7.2 Household size

Economic impact models use labour multipliers to capture the direct, indirect and induced impact on employment generated by any given project. The results, however, do not account for all the affected individuals following a particular project or development. For example, the closure of a mine may result in the loss of 10 direct (on-site) jobs and the newly unemployed workers are the sole breadwinners in their respective households which consist of 4 persons, excluding the newly unemployed worker. An economic impact assessment will indicate that 10 direct jobs have been lost. However, not only 10 individuals are affected by job losses. Household data, therefore, enables a richer interpretation of the results of economic impact analyses. The average household size of 5 may be used to estimate the total number of individuals that are directly affected by the direct employment loss, i.e. 50. Table 6 below shows the current and projected household size for the years 2009, 2014 and 2019.

Table 6: Average Household Size Projections: 2009 - 2019

Geographic Area	2009	2014	2019
South Africa	3.52	3.28	3.05
Emakhazeni LM	4.34	4.26	4.25
Greater Sekhukhune DM	5.93	5.80	5.62
Mpumalanga	4.91	4.69	4.48

Source: Quantec (2009), and Urban - Econ calculations (2009)

Historic household size growth rates, together with the BMR's (2007) national and provincial household projections were used to project the number of households in the study area over the next 10 years. The

population data was then used in conjunction with the household data to calculate estimates of the study area's average household size over the next 10 years.

National average household size is expected to decline over the next 10 years and all sub-national areas under observation are expected to mimic this trend. This could be attributed to HIV/AIDS impacts, urbanisation, household mitoses (where family splits into two households), lower fertility, and a greater preference for single person households. However, the average household size of the primary and secondary study area was higher than national level.

A decline in average household size implies a reduction in the total number of people affected by the employment and income status of household breadwinners. Furthermore, coupled with a growing population, a decline in the average size of households may be indicative of population densification, which is likely to exert pressure on municipal infrastructure and services. Projects that generate government revenue will assist in this regard, through the provision of taxes that can be used to maintain and/or upgrade public infrastructure and services.

7.3 The Labour Market

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs. As such, employment and unemployment rates are important indicators of socio-economic well-being. The sub-sections that follow examine the study area's labour market from a number of angles, including employment rate and sectoral employment patterns.

The composition of the labour force in Primary Study Area, Mpumalanga, and the Greater Sekhukhune DM is detailed in Table 7. According to the official definition, the unemployed are people who:

a) Did not work during the 7 days prior the interview;
b) Want to work and are available to start work within a week of the interview;
c) Have taken active steps to look for work or to start some form of self-employment in the four weeks prior to the interview.

Due to the unavailability of recent Local Municipal level data, it was assumed that the Emakhazeni Local Municipality (ELM) would have the same employed to unemployed ratio as the Nkangala District Municipality. The Nkangala DM's employment and unemployment rates, together with employment data from Quantec (for the LM), where therefore used in the calculation of the LM's employment status.

Table 7: Employment Status: 2008

Geographic area	Employed	Unemployed	Unemp-Rate	Economically Inactive	Working Age Pop	Labour Force Participation Rate
South Africa	12,364,000	6,048,000	32.8%	11,513,000	29,925,000	61.5%
Emakhazeni	14,992	4,924	24.7%	15,643	35,559	56.0%
GSDM	158,246	66,966	29.7%	462,099	687,000	32.8%
MP	1,008,038	280,416	21.8%	1,044,312	2,333,000	55.2%

Source: Quantec (2009), and UE Calculations (2009)
Note: MP – Mpumalanga Province, GSDM - Greater Sekhukhune District Municipality.

As shown in Table 7, the employment rates for the Emakhazeni LM, Mpumalanga Province and Greater Sekhukhune DM are above the national employment rate. Within each of these sub-national geographic areas, in excess of 70% of the economically active populations are employed. The Emakhazeni LM's labour market is characterised by a higher unemployment rate than that of the Province. This could mean that the LM is not generating sufficient employment opportunities to absorb the entire economically active population. It is therefore evident that there is a need to create employment opportunities in the primary and secondary

study area. Table 8 shows the sectoral employment structure of the South African, Emakhazeni LM, Mpumalanga Province and Greater Sekhukhune DM's economies.

Table 8: Sector Employment Contributions: 2008

Economic Sector	SA	ELM	MP	GSDM
Agriculture, forestry and fishing	7.6%	19.4%	12.5%	7.5%
Mining and Quarrying	4.9%	5.4%	9.2%	9.2%
Manufacturing	13.2%	8.6%	10.9%	6.9%
Electricity, gas and water	0.5%	0.4%	1.1%	1.0%
Construction	4.7%	6.9%	4.8%	5.0%
Trade	17.4%	15.8%	18.9%	18.8%
Transport, storage and communication	3.6%	4.6%	2.8%	3.0%
Finance, insurance, real estate and business services	18.2%	12.3%	9.9%	8.9%
Community and Government Services	29.8%	26.7%	29.7%	39.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Quantec (2009), and Urban Econ Calculations (2009)
Note: SA – South Africa, ELM – Emakhazeni Local Municipality, MP – Mpumalanga Province, GSDM - Greater Sekhukhune District Municipality.

The mining sector is responsible for approximately 5% of total employment in the Emakhazeni LM, and only 9% in both the Mpumalanga Province and Greater Sekhukhune DM. Agriculture does, however, play a more substantial role in the Emakhazeni LM, where approximately 19% of all formal jobs are within the agricultural sector. The agricultural sector is the third largest contributor to employment in the LM, after community services (26.7%) and the trade sector (15.8%). This indicates a large dependency of the local labour force on the performance of this sector.

Employment projections for the 2009 to 2019 period are based on historic growth rates and the most recent labour data from Quantec (2009). Employment is expected to decline in 2009 and 2010 after which the employment growth rate is expected to display a positive trend. Table 9 indicates the projected employment figures for 2009, 2014 and 2019.

Table 9: Employment Projections: 2009 - 2019

Geographic Area	2009	2014	2019
South Africa	12,035,186	12,395,587	13,302,022
Emakhazeni LM	14,593	15,229	16,614
Greater Sekhukhune DM	154,038	162,046	178,559
Mpumalanga	981,230	1,014,135	1,093,035

Source: Quantec (2009), and Urban - Econ Calculations (2009)

Emakhazeni has an excess supply of labour, which means that there are members of the working age population who are willing and able to work, but cannot find employment. This does not necessarily imply inadequate employment creation, but may be indicative of structural problems in the labour market that stem from differences in skills demand and skills supply, for example. Activities that generate employment will, therefore, assist in reducing the unemployment rate, *ceteris paribus*, which will exert a positive influence on the socio-economic status of affected individuals.

7.4 Economic Production and GDP-R

Economic growth is a measure of both the performance of an area and the well-being of the citizens of an area. Faster economic growth is taken as an indicator of a healthy economy and an improvement in citizens' well-being. In July 2009, the IMF predicted that global economic growth would be approximately 0.5 percentage points higher than it projected 3 months earlier, in April 2009. According to the IMF (2009), macroeconomic and financial policy support is assisting the world economy to stabilize. Global economic activity is predicted to decline by 1.4% in 2009 and expand by 2.5% in 2010. The IMF foresees growth in emerging and developing countries to pick up during the latter half of 2009. Overall growth in Africa is forecast to increase by 1.8% in 2009 and by 4.1% in 2010. According to the IMF, economic growth in Sub-Saharan Africa will increase by 1.5% in 2009 and 4.1% in 2010.

Figure 3 illustrates production growth rates for the period spanning 2002 to 2008. The figure demonstrates that although growth rates varied amongst the geographic areas under observation, the trend in growth rates has been identical. Between 2002 and 2007, production in the study area grew cyclically: increases in growth in one year were succeeded by declines in growth the following year, as indicated by the parabolic curves of the graphs in Figure 3. Given the trends in production between 2002 and 2007, it would be expected that production growth rates would rise between 2007 and 2008. Figure 3 indicates that this did not happen on national and provincial level, undoubtedly as a result of the global economic crisis. Interestingly the Mpumalanga Province experienced more severe contractions in production than those at national level.

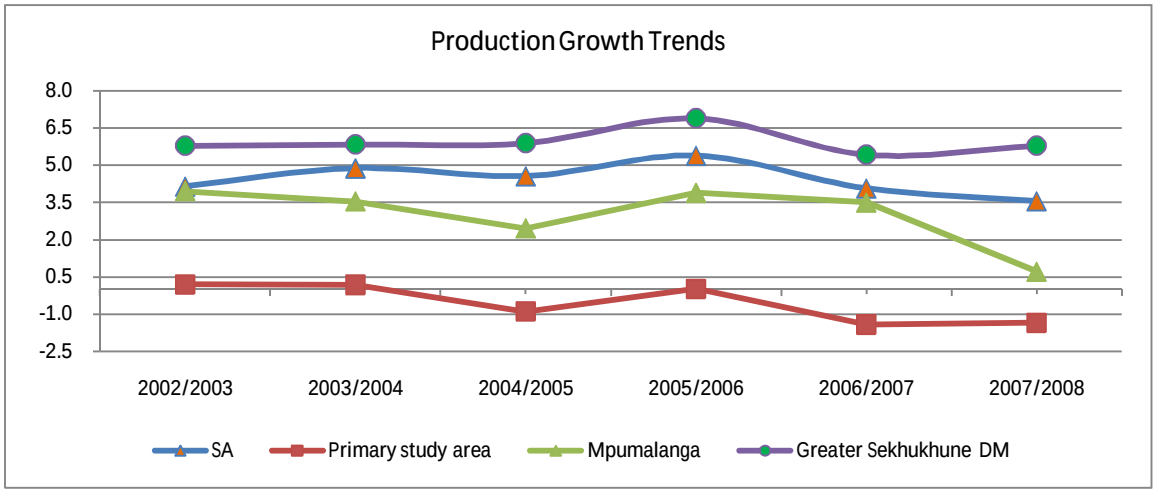

Figure 3: Production Growth Rates: 2002 - 2008

Source: Quantec (2009) and Urban - Econ Calculations (2009)

Figure 4 illustrates the nation's GDP as well as the regional GDP of Mpumalanga, Emakhazeni LM and the Greater Sekhukhune DM for the period spanning 2002 to 2008. Whilst the trend in GDP and GDP-R is similar to that of production, following a cyclical trend, Figure 4 indicates that the changes are less intense (see flatter curves) than changes in production growth rates, but all the areas' GDP declined to below 2002 levels as a result of the global economic crisis.

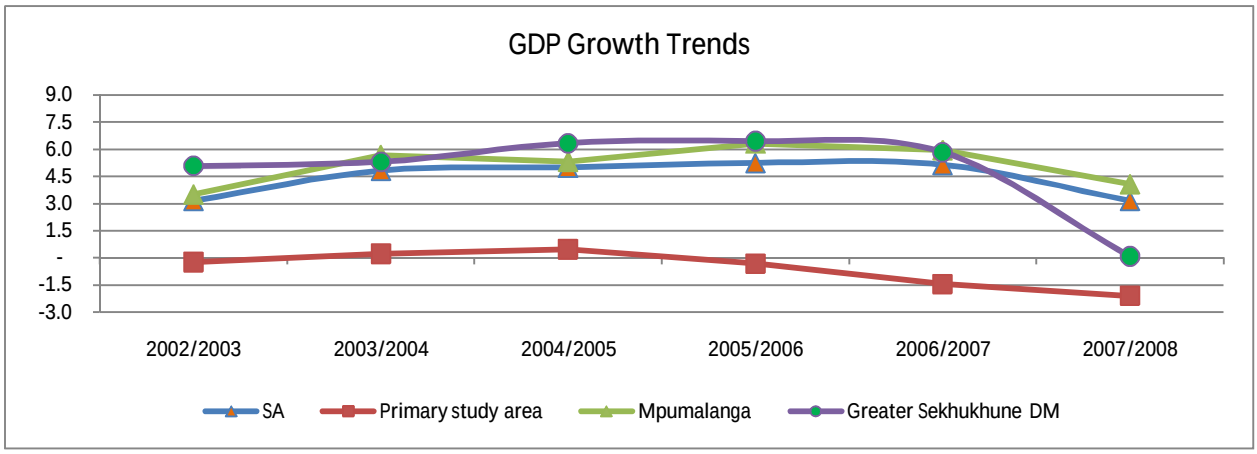

Figure 4: GDP Growth Rates: 2002 - 2008

Source: Quantec (2009) and Urban - Econ Calculations (2009)

Table 10 shows the structure of the study area's economy. The tertiary sector of the economy makes the most notable contributions to national GDP as well as Emakhazeni LM and Mpumalanga Province's GDP-R. The manufacturing sector is also a big role player in the Emakhazeni economy. The Greater Sekhukhune DM's economy is dominated by the manufacturing sector.

Table 10: Sector GDP-R Contributions: 2008

Economic Sector	SA	ELM	MP	GSDM
Agriculture, forestry and fishing	2.9%	0.4%	0.3%	0.8%
Mining and quarrying	5.5%	1.7%	1.0%	9.9%
Manufacturing	17.4%	20.4%	16.7%	19.4%
Electricity, gas and water	2.2%	2.1%	1.9%	1.7%
Construction	4.1%	5.1%	4.9%	6.6%
Trade	15.1%	15.6%	16.7%	14.8%
Transport, storage and communication	11.0%	9.9%	10.0%	9.4%
Finance, insurance, real estate and business services	22.0%	25.2%	32.5%	18.4%
Community and Government Services	19.7%	19.6%	16.0%	19.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Quantec (2009) and Urban - Econ Calculations (2009)
Note: SA – South Africa, ELM – Emakhazeni Local Municipality, MP – Mpumalanga Province, GSDM - Greater Sekhukhune District Municipality.

As shown in Table 10 the mining sector makes a relatively small contribution to the economies of Emakhazeni and Mpumalanga. The agricultural sector makes an insignificant contribution to the GDP in both the primary (ELM) and secondary (MP and GSDM) study areas' economies if one only takes into consideration the contribution of primary agriculture. If the forward and backward linkages in the economy are taken into account, agriculture's contribution should increase. For example, if one includes agriculture's

forward and backward linkages into the economy, agriculture's contribution to national GDP increases from 2.9% to 12% (SA Yearbook, 2009:1).

Historic trends in conjunction with the IMF's (2009) forecasts were used to project production and GDP for 2009 to 2019. Table 11 shows the value of projected production in 2009, 2014 and 2019. As indicated, production in the Mpumalanga Province is expected to grow to R478 billion by 2019, whilst the Greater Sekhukhune DM's production is expected to amount to R72 billion in 2019, whilst production in the Primary Study Area is expected to grow to R4.4 billion in 2019.

Table 11: Production Projections: 2009 - 2019 (R'000 000, 2009 prices)

Geographic Area	2009	2014	2019
South Africa	4,826,675	6,016,334	7,535,697
Emakhazeni LM	4,376	4,401	4,431
Greater Sekhukhune DM	41,400	54,343	72,613
Mpumalanga	337,724	402,948	477,852

Source: IMF (2009), Quantec (2009), and UE Calculations (2009)

GDP-R may be defined as the value of all final goods and services produced within the boundaries of a given region over a given period, usually one year. Table 12 shows the projected GDP-R for the study area for 2009, 2014 and 2019.

Table 12: GDP-R: 2009 - 2019 (R'000 000, 2009 prices)

Geographic Area	2009	2014	2019
South Africa	2,083,740	2,603,521	3,270,730
Emakhazeni LM	1,923	1,936	1,951
Greater Sekhukhune DM	22,160	28,904	38,316
Mpumalanga	140,058	179,568	232,978

Source: IMF (2009), Quantec (2009), and UE Calculations (2009)

The GDP-R of the Primary Study Area is expected to amount to almost R2 billion by 2019. The GDP-R of the Mpumalanga Province is expected to grow to approximately R233 billion by 2019, while the GDP-R of the Greater Sekhukhune DM is expected to amount to R38 billion in 2019. Although GDP growth rates has declined over the last year or so, as the world has been hit by an economic crisis, the IMF (2009) has predicted that the economies of Africa will start recovering towards the end of 2009.

7.5 Income and Expenditure Patterns

Income distribution is one of the most important indicators of social welfare, as income is a primary means by which people are able to satisfy their basic needs such as food, clothing, shelter, health, services, etc. Changes in income inflict changes in the standard of living, more specifically: a positive change in income can assist individuals, households, communities and indeed countries to improve living standards. Table 13 below shows the distribution of monthly disposable income for the study areas.

Table 13: Monthly Income Distribution among Households (2009 prices)

Income category	SA	ELM	MP	GSDM
No income	8.2%	13.9%	10.0%	39.0%
R1 - R628	5.0%	8.0%	24.4%	8.8%
R629 - R1,256	9.0%	25.4%	11.0%	24.7%
R1,257 - R2,512	18.9%	22.7%	20.5%	12.7%
R2,512 - R5,024	19.1%	15.3%	17.3%	7.3%
R5,025 - R10,048	11.4%	7.9%	12.4%	4.7%
R10,049 - R20,096	7.6%	4.2%	6.9%	1.9%
R20,097 - R40,192	5.3%	1.5%	4.3%	0.5%
R40,193 - R80,383	2.8%	0.4%	2.1%	0.1%
R80,384 - R160,766	0.9%	0.1%	0.6%	0.1%
R160,767 - R321,533	0.3%	0.3%	0.2%	0.1%
R321,534 or more	0.2%	0.2%	0.2%	0.0%
Total	**100%**	**100%**	**100%**	**100%**
Weighted Income	**R 7,326**	**R 4,469**	**R 4,007**	**R 2,102**

Source: Quantec (2009), and UE Calculations (2009)
Note: SA – South Africa, ELM – Emakhazeni Local Municipality, MP – Mpumalanga Province, GSDM - Greater Sekhukhune District Municipality.

The largest percentage of households in Emakhazeni LM earned between R 629 and R 5,024. The majority of households in the Greater Sekhukhune DM earned no income, while most households in the Mpumalanga Province earned between R 1 and R 628. The comparison of the percentage of households in the study areas who earned more than R 80,383 per month indicates that the primary study area, as well as the Mpumalanga Province and Greater Sekhukhune DM do not have such a big percentage affluent households as the rest of the country.

The high income inequality in the study areas, and particularly the domination of households with low income earnings, has a direct impact on the weighted average income figures. It was estimated that an average household in the country earned about R 7,326 (2009 prices) per month. This figure was considerably higher than that of all the other mentioned areas. This means that an average household in the study area were worse off than an average household in South Africa, highlighting the urgent need for job creation interventions in the study area and the importance of the currently available positions for sustaining the livelihoods of its households.

Consumer expenditure patterns assist in identifying the sectors of the economy that are likely to be most affected by income that will be sustained and/or created by a prospective development, which is critical since the induced impacts of a project or development are those generated in industries supplying goods and services that consumers spend their incomes on. An examination of household expenditure in 2007 (Table 14) reveals that on average in SA, Emakhazeni, Mpumalanga, and Greater Sekhukhune, the largest proportion of consumers' disposable income, is spent of the purchase of food, beverages and tobacco products.

Table 14: Dominant Expenditure Items: 2007

Good/Service	SA	ELM	MP	GSDM
Personal transport equipment	5.0%	5.1%	5.2%	5.1%
Clothing and footwear	5.7%	10.4%	11.3%	13.2%
Food, beverages and tobacco	26.6%	25.5%	25%	26.6%
Rent	10.4%	7.8%	6.9%	5.2%
Medical services	6.6%	4.6%	4.8%	4.1%
Transport and communications services	9.9%	8.5%	8.6%	7.0%

Source: Quantec (2009)
Note: SA – South Africa, ELM – Emakhazeni Local Municipality, MP – Mpumalanga Province, GSDM - Greater Sekhukhune District Municipality.

7.6 Summary

The population within Emakhazeni is increasing at a decreasing rate. Growth rates are, however, expected to improve in the future. Development within the Emakhazeni is needed to provide employment opportunities and income, thereby mitigating the local municipality's negative population growth rate. The average household size within Emakhazeni is also declining. A possible reason for this could be due to the impact of the HIV/AIDS pandemic. Future development in the area could assist Government through increased tax revenues and by providing (a portion of) funds to maintain and/or upgrade infrastructure and services that come under pressure as a result of demographic trends. While employment, production and GDP-R have declined due to the state of the global economy, the IMF (2009) expects a turnaround in the second half of 2009. Developing countries are expected to recover sooner than developed countries.

8.0 SECTORAL PERSPECTIVE

The objective of this section is to provide a perspective and discussion on agriculture and mining activities and the role they play in the National and local and regional economies of South Africa. The section also presents a discussion of ecosystems goods and services and the role of agriculture in preserving ecosystems goods and services.

8.1 Agriculture perspective

8.1.1 The role of agriculture in the national, regional and local economies of South Africa

Agriculture in South Africa is characterised by scarcity of water and arable land. Approximately 14% of the country's total surface area is considered to be arable and of this, 22% is considered to be high potential arable land. Water availability has been suggested to be the most limiting factor for further expansion of agriculture with South Africa (SA Yearbook, 2008) and the country has a number of stressed river systems. These river systems include the Komati, Crocodile, Olifants, Vaal and Orange. Coupled with the country's scarce resources is its dual-economy; a well developed commercial sector and a small-scale subsistence sector. Since democratisation in 1994, policymakers have been active in attempting to redress this apparent imbalance within the agricultural sector through various land redistribution initiatives with the ultimate objective of transferring approximately 30% of white owned land to black farmers and farming entities (Agri-BEE Steering Committee, 2005). Other major policy shifts since 1994 include (National Department of Agriculture, 2009):

- Deregulation of the marketing of agricultural products in 1996;

- Changes in the fiscal treatment of agriculture, including the abolition of certain tax concessions that favoured the sector;
- A reduction in direct budgetary expenditure on the sector (via subsidies);
- Land reform, consisting of the restitution, redistribution and tenure reform programmes;
- Trade policy reform, which included tariffs on farm commodities liberalisation of agricultural trade including free trade agreements;
- Institutional reform in agriculture; and
- The formalisation of labour legislation to the agricultural sector.

South Africa's areas of high potential arable agricultural land are situated on the eastern side of the country as illustrated in Appendix C. Very few of these areas contain very high potential arable land and the majority of the land is classified as moderate potential arable land. Large tracts of moderate potential arable land are found in the KwaZulu-Natal, Mpumalanga, Gauteng, Free State and Western Cape provinces. Subsistence areas are found predominantly in the former homeland areas of Venda, Lebowa, KwaNgane, Transkei and Ciskei. Despite its relative scarcity of arable land and water South Africa produces a diversity of agricultural produce which include field and horticultural crops, sugar, timber and livestock. The distribution of these crops within South Africa is shown in Appendix D. Common field crops include maize, wheat, cotton, sorghum, soya beans, sunflowers and canola. These field crops are commonly produced under dry-land conditions in provinces such as the Free State, Mpumalanga, Gauteng, Limpopo and KwaZulu-Natal. Horticultural crops such as citrus, stone fruit and apples are commonly produced in the Free State, Mpumalanga, Limpopo and the Western Cape. Livestock products are produced throughout the country.

Since the deregulation of agricultural markets with the promulgation of the Marketing of Agricultural Products Act of 1996 (Act 47 of 1996) the export of agricultural products has increased. According to the SA Yearbook (2009:47) agricultural exports have increased their contribution of total exports from 5% in 1988 to 38% in 2007. Commonly exported commodities include wine, citrus, sugar, grapes, fruit juice, wool and deciduous fruit such as apples and pears. Despite the increase in exports since 1996, imports have also increased; affecting the country's trade balance. In 2007 imports totalled R29.2 billion in value versus R29.7 billion in value for exports. The country's major imports include rice, vegetable and poultry meat. One reason for the increase in the value of South Africa's agricultural imports has been its competitive disadvantage in agro-processing as the country relies on the exports of primary agricultural products which are processed elsewhere and imported back into the country (SA Yearbook, 2009:47).

Although the contribution of agriculture to total GDP has shown a declining trend since 2000, agriculture has an import role to play in the future development of and towards mitigating food insecurity in South Africa. Taking into consideration the forward and backward linkages to other sectors in the economy, primary agriculture provides 1.6 jobs for every one job it creates (nationally) and creates 16% of the workforce in other sectors. Figure 5 illustrates the fluctuating contribution of agriculture to total GDP over the period 2000 to 2009. The SA Yearbook (2009:47) notes that despite the declining contribution of agriculture to total GDP, and that in much broader context agriculture is critical to the South African economy for the following reasons:

- Critical component to the food sector;
- Critical linkages with the broader economy;
- Critical for regional development;
- Major contributor to poverty alleviation, human development and the environment; and
- Major driver of industrial development.

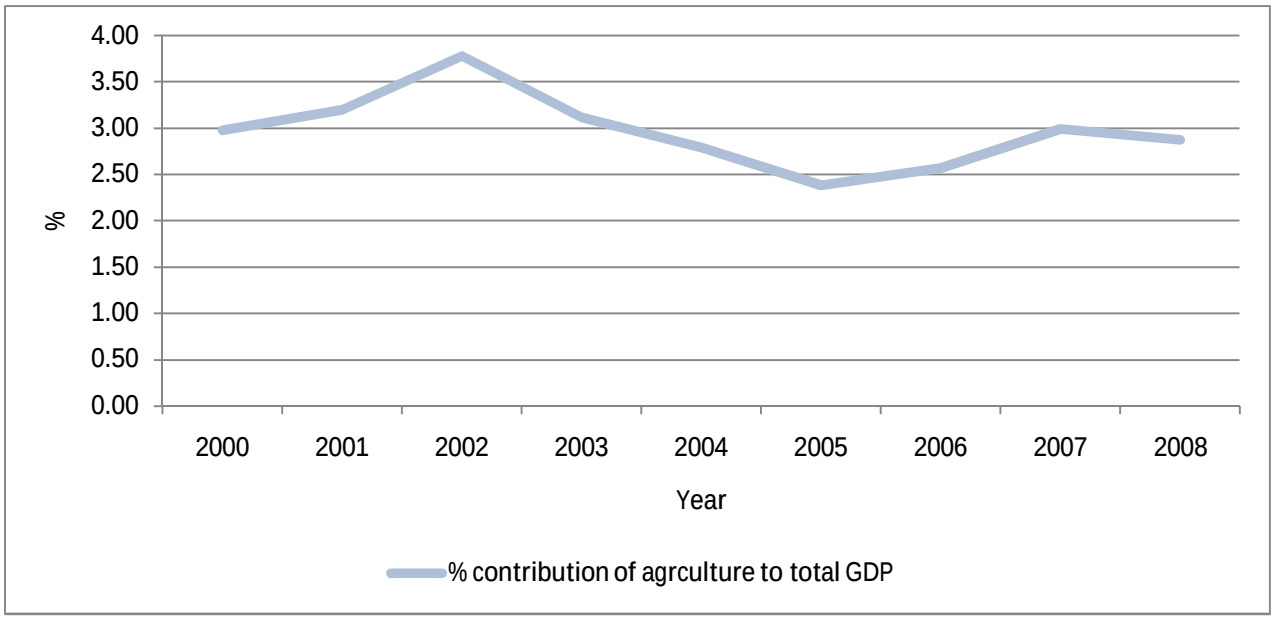

Figure 5: Contribution of Agriculture to total Gross Domestic Product

Source: (Statistics South Africa, 2009)

In 2001 the South African Government adopted the Strategic plan for South Africa agriculture which has the following objectives at its core (National Department of Agriculture, 2009):

- To ensure equitable access and participation for market participants;
- To improve profitability and global competitiveness of South African agriculture; and
- To ensure sustainable resource management.

Considering the Country's dual economy, the South African Government has placed heavy emphasis on the role of agriculture in poverty alleviation and rural development. Industrial and other developments which may come into conflict with the Country's Strategic Plan and agrarian reform, therefore, need to take into account the importance of agriculture from a sustainable production, human development and poverty alleviation perspective.

8.1.2 Agriculture in Mpumalanga

Much of the Mpumalanga Province is situated on a plateau and is divided by an escarpment into Highveld and Lowveld areas. The Highveld area occurs on the eastern portion of the Province and is characterised by summer rainfall (mainly through thundershowers) and cold winters. Snow has been known to fall in the Highveld areas of the Province and frost is also fairly common. The major towns found in the Highveld area of the Province include, Witbank, Middelburg, Belfast and Dullstroom. The Lowveld area of the Province is characterised by sub-tropical conditions and experiences a more even distribution of rainfall throughout the year than the Highveld areas. Major towns in the Lowveld areas include Nelspruit, Malelane and Komatipoort. Three major biomes are found within Mpumalanga. These are the Grassland, Savanna and Forest Biomes. The Grassland biome is the most common within the Province with the Savanna and Forest biomes found mostly on the escarpment and in the Lowveld areas of the Province.

Mpumalanga's diverse climatic conditions make it suitable for the production of a wide variety of agricultural commodities. As shown in Appendix C, the Mpumalanga Province is generally characterised by moderate to high agricultural potential. The figure in Appendix D illustrates the distribution of agricultural production within South Africa according to the types of agricultural In the Highveld areas; commonly produced field crops include maize, wheat, sunflowers, soya beans and dry beans.

Approximately 21% of Mpumalanga is arable (NDA, 2009b:5) and the Province is a major producer of important food crops such as maize, soya beans and sun flowers (GrainSA, 2009). Table 15, below, shows the production and yield data for major food crops (maize, soya beans and sunflowers) in South Africa and Mpumalanga. The relatively high yields for both white and yellow maize (5.5 and 5.6 tons/ha) for Mpumalanga relative to the National average (4.3 and 4.9 tons/ha) indicate that the Province may have a *comparative advantage* for maize production relative to other areas of the country due to the productivity of it agricultural inputs (land, labour and capital). As Table 15 shows, Mpumalanga is responsible for approximately 19.7% and 26.8% of the country's total white yellow maize production, respectively, making the Province an important contributor to food security within the Province and within the country.

Table 15: Production and yield data for major food crops within South Africa and Mpumalanga, 2007/08

	South Africa			Mpumalanga		
	Area ('000ha)	Tons ('000t)	Tons/ha	Area ('000ha)	Tons ('000t)	Tons/ha
White maize	1 737	7 480	4.3	268	1475	5.5
Yellow maize	1 062	5 220	4.9	250	1400	5.6
Soya beans	165	282	1.7	82	128	1.6
Sunflowers	564	872	1.5	17	25.5	1.5

Source: GrainSA (2009)

Livestock enterprises such as dairy, sheep (meat and wool), beef and poultry enterprises are also common in the Highveld areas of the Province. The Lowveld areas are well-known for the production of sub-tropical crops and citrus fruits such as sugarcane, grapefruit, oranges and bananas. Much of the fruit produced in the Lowveld of Mpumalanga is exported to destinations such as the Middle and Far East and the European Union. The Figure shown in Appendix E illustrates the distribution of GDP (on a provincial and area basis) within South Africa. As shown in this Figure, Mpumalanga's agricultural GDP ranges between R301 – R450 per hectare reflecting the Mpumalanga's relatively high agricultural potential.

8.1.3 The role of agriculture in preserving ecosystem goods and services

While farming historically produced food products, the need for farmlands to produce ecosystem services is becoming an increasingly important role in farming. Society is increasingly demanding that farms supply services such as carbon sequestration, water security, food security, biodiversity conservation and flood mitigation due to the growing local, national and global scarcity of these services. Society recognizes that for the economy to continue to grow while maintaining the quality of life in society, it needs to invest in reducing the growing constraints being imposed by diminishing ecological processes, and their associated ecosystem services. Consequently, farm lands with functional ecological assets are increasingly being required to supply public goods and services.

8.1.3.1 What are ecosystem services?

Ecosystem services are the outputs of ecological systems that generate quality of life or well being for people. An ecosystem service is a product that emerges from processes or features within largely natural environments, which enhances human wellbeing and is directly used by people.

8.1.3.2 Why focus on ecosystem services?

In the past economic development only focussed on accessing land, labour and capital to fuel economic activities and to fund social development. However, the economic paradigm has shifted and the quality of ecological assets is being reduced. No longer are capital, skills or labour major constraints to human development - environmental quality is often the limiting factor. Natural capital and associated ecosystem

services are now becoming scarce. 'Business as usual' is creating the reduction in the ecological public goods with costs to society. That is, those people who have being relying on these services will now experience costs in accessing the previously free services, for example - farm wetlands enhance downstream water security at no cost to users. A reduction in water security may result in poor human health, loss of life and declining agricultural productivity. As the Nkomati watershed processes are no longer able to meet the current demand for water security, society will increasingly look at ways to secure these services.

8.1.3.3 Wetlands as ecosystem service suppliers

Services are useful inputs that make our lives better. We are familiar with built services such as electricity, roads and piped water. Wetland ecosystems also supply services that improve the quality of human life.

Importantly, the individual use of wetland ecosystem services usually generates public 'dis-services' – like increased sedimentation of water infrastructure, the reduction in dry season stream flow and the destruction of wildlife refuges. These dis-services are called externalities in economic terms – costs which the individual user, causing the impact, does not have to deal with. These externalities are critical in understanding the trade-off between different individual uses of ecosystem services.

A list of ecosystem services supplied by wetlands is listed in Table 16 below. Grasslands are included in this list as they are also of relevance to the discussion.

Table 16: Wetland and grassland ecosystem services

Wetland and grassland ecosystem services	
Regulatory services	**Services that help to regulate our living environment, and in many cases helping to reduce the impacts one group generates on other groups**
Global climate management	Vegetation capturing carbon or preventing carbon loss into the atmosphere - helping reduce global climate warming
Soil stability	Soil kept on the land by vegetation cover and prevented from moving off - preventing declining land productivity and damage to water storage infrastructure
Soil formation and fertility	Soil ecology or river flooding eroding rocks and maintaining fertile soils
Water distribution	Drainage lines gather and move water from the broader landscape to accessible points or locations, or to deliver to downstream users
Water supply regulation	The capturing of rain water into the soils during the rainy season, and the slow release of the water through-out the year
Waste assimilation	Water plants absorbing waste nitrates and phosphates, and using them for plant growth, taking them out of the water, making it cleaner for downstream users
Groundwater recharge	Vegetation promoting greater water infiltration into the soil
Flood attenuation	Good land cover that reduces water run-off from the land, reducing the degree of flooding
Disease control	Wetland organisms destroying or preying on pathogens in the water, making it safe to use
Pest control	Wetland and grassland processes that prevent plant and animals pests becoming a problem to society
Pollination	Wild grasslands provide a refuge for a wide range of pollinators that

	useful for farmers
Fire damage control	Wetlands curtail dangerous run-away fires by creating fire breaks
Goods	**Goods that are consumed, either for home consumption for sale**
Water supply	Water harvesting for consumption, irrigation and manufacturing
Fibres	Indigenous fibre plants for house building and craft
Biochemical supply	Plants for medicines or other chemicals
Food supply	Wild foods harvested for household use or trade
Fodder supply	Wild plants for animals grazing and browse, particularly wetlands in the dry season
Seed dispersal	Grasslands are a source of seeds which are dispersed widely to surrounding areas, improving grassland productivity
Refugia or nursery for biodiversity	A refuge for wildlife to breed and then repopulate other places
Supporting services	**Services that the landscape provides us with, on which to build enterprises such as farming and tourism**
Tourism	The landscape provides suitable space for general tourism - such as visual amenity, attractive climate, and outdoor activities such as those listed below
Irrigation agriculture - vegetables, fruit crops, maize	A landscape with suitable soils and climate for irrigation agriculture and horticulture
Rain fed crops - maize	A landscape with suitable soils and climate for rain fed agriculture
Stock farming	A landscape with suitable soils, vegetation and climate for stock farming
Birding	A landscape suitable for birding
Hunting	A landscape suitable for hunting
Mountain biking	A landscape suitable for mountain biking
Walking	A landscape suitable for walking and hiking
Cultural and spiritual services	**Services from natural areas which we can't eat or use directly, but which provides us with important social benefits**
Natural heritage	A landscape with indigenous plants and animals, topography and geology that represents the heritage or culture of a people - local, provincial, national or global
Cultural places	A landscape of indigenous plants and animals, and topography that share a relationship with human history and memories at different scales such as a community, a culture, a tribe, or at a national or global community scale
Bench marks in a changing environment	A landscape that is untransformed and represents a relic or example of a unchanged state, while everything around it changes, and allows us to understand how the world around us is changing
Marketing icons	Wild places or plants and animals that help us to compete for visitors of other destinations, such as the special grassland birds

8.2 Mining perspective

8.2.1 The role of mining in the national, regional and local economies of South Africa

South Africa's mineral industry, largely supported by gold, diamond, coal and platinum group metals production, has made an important contribution to the national economy for more than a century. Mining is South Africa's largest industry in the primary economic sector, followed by agriculture.

The mining industry is placing more emphasis on stimulating black economic empowerment (BEE) and this led to the sector becoming a focus of the Reconstruction and Development Programme in terms of entrepreneurial development, black economic empowerment and stimulation of employment and economic growth. In 2007, mining contributed R135.6 billion or 7.7% to the Gross Domestic Product, an increase of R16.2 billion over the previous year. This growth can be attributed to higher commodity prices led by continuing demand from Asia particularly China. During 2007, mining and quarrying contributed 8.9% to Total Fixed Capital Formation. Also there was a rapid growth in fixed investment in the mining sector, which has more than doubled from 2004 to 2007.The mining industry, excluding exploration, research and development structures and head offices staff, employed 2,9% of South Africa's economically active population. The average number of workers employed in the mining industry increased by 8.6% to 495 474 in 2007, as a result of the expansion projects. Coal contributed 12.2% of the total mining industry's labour force (DME, 2008).

The mining industry is an important contributor to Mpumalanga's economy in terms of economic production, export and local sales revenues. The sector contributes over one fifth of Mpumalanga's GGP (Gross Geographic Product). In addition, the sector is a significant source of sustainable employment opportunities in the Province. Extensive coal resources are situated in the western and south-western part of the Province and sustain several large coal-fired power stations situated on the Highveld between Witbank, Standerton, Piet Retief and Carolina, as well as and the petrochemical plants in the area. Known committed investment in mineral related projects in South Africa stood at R63.5 billion by August 2008, 97% of which is for primary minerals and 3% for processed mineral products. Coal projects accounted for 17.5% of the total for primary minerals. Figure 6 below illustrates the current mines, as well as the new mining applications within the Mpumalanga Province. Most of the current mining activities are concentrated around the Witbank,

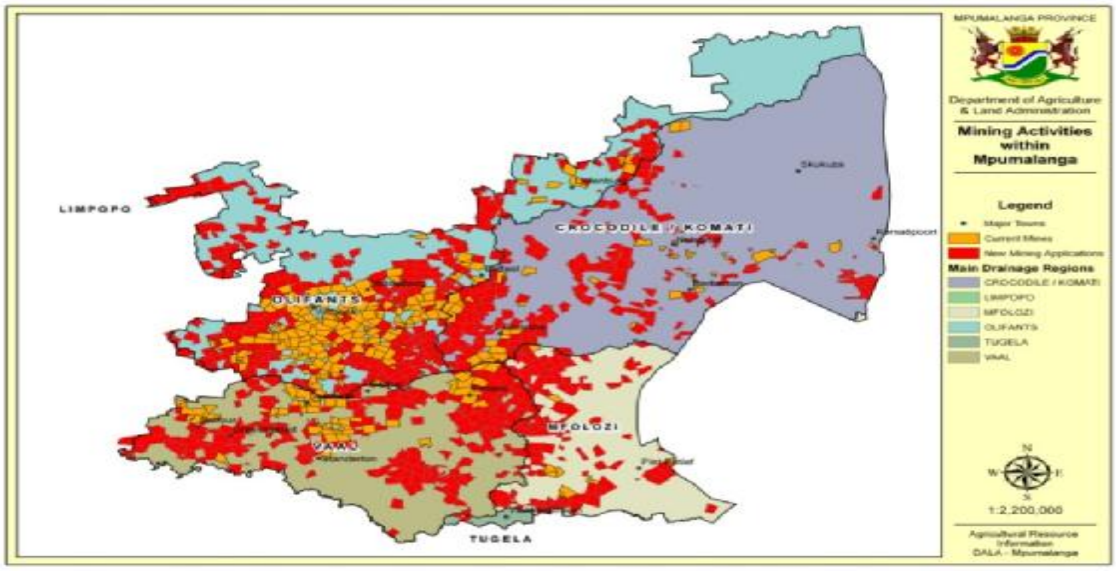

Figure 6: Current and future mining activities in the Mpumalanga Province

Middelburg and Ermelo areas, while new applications were obtained across the Province, mostly in the central and western parts of the Province.

Eskom operates 13 coal-fired power stations in the country – 11 of which are situated in the Province. Mpumalanga accounts for 83% of South African coal production and exports account for 28% of production. The Province is the third largest coal exporter in the world and Witbank is the biggest coal producer in Africa. Although South Africa has 19 official coal fields, 70% of recoverable reserves lie in the Highveld, Waterberg, and Witbank fields. Local coal consumption comprises electricity generation (40%), from the country's coal-firing power stations, petro-chemical production (24%) and metallurgical, industrial and domestic applications.

8.2.2 World coal supply and exports

World coal production grew by 5.3% to 6 488 Mt in 2007, following a four-year period of strong growth averaging 6.5% per annum. China remained the largest producer, accounting for 39% of the total output, followed by the United States (16.2%), India (7.5%), Australia (6.1%) and Russia (4.8%).

In 2007, South Africa produced 247.7 Mt of coal, contributing 3.8% to world coal production, therefore earning the country the 6th position in world rankings. Production increased by 23.6 Mt in the period between 2000 and 2007. Over 80% of the saleable coal production was supplied by mines controlled by the five largest mining groups, namely, Anglo Coal, BHP Billiton, Exxaro, Sasol and Xstrata (DME, 2008).

South Africa contributes 7.5% of total world exports of coal, however the country's annual saleable coal exports declined by 1.6% to 67.7 Mt in 2007. As shown in Figure 7, South African coal was exported to 34 countries, of which 84.5% went to the European Community, where Great Britain, Spain, France, Italy and Germany, were the largest customers. South Africa's coal exports declined in all the other regions and increased only in the Far East where India's imports increased by 403% (DME, 2008).

8.2.3 Demand for coal

Total global consumption increased by 6.2% or 271.7 Mtce in 2007, following a four year trend of annual increases averaging 6.6%. Consumption in South Africa increased by 1.1% (DME, 2008). According to the South African Mining Industry (2008), the electricity sector of South Africa consumed 61% of locally sold coal while the synthetic fuels sector consumed 25%. The industrial sector, including mining, consumed 4.2%, the metallurgical industry used 3% and merchants bought 6 The Belfast Project, if implemented, would supply coal to Eskom's coal-fired power stations as well as the export market.

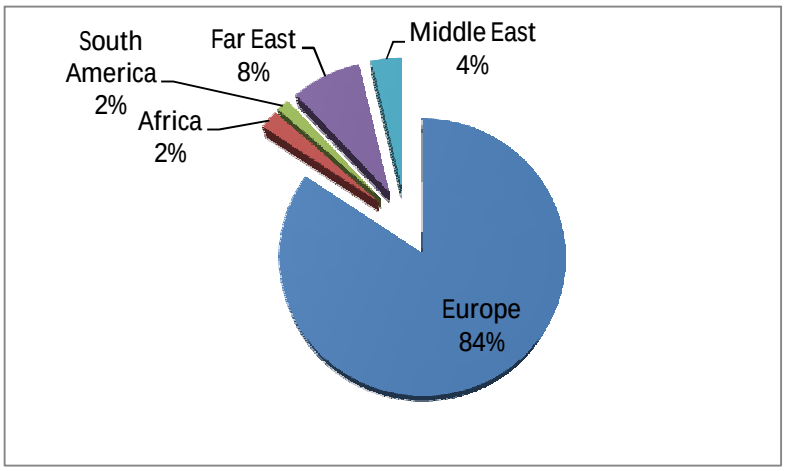

Figure 7: South Africa's coal exports by regional destination, 2007

8.2.4 Summary

Global coal production is expected to grow driven mainly by the robust worldwide demand from electricity generation industry. Demand is expected to decline slightly due to reduced imports from European and Asian countries.In the short and medium term, a steady supply of coal to power stations is vital to ensure a continuous generation of power. The year 2020 is often mentioned as the time when most of the large coal producing mines will cease or reduce production due to reserve exhaustion. New exploration opportunities should be investigated in the short to medium term but greater investment should also go towards finding more sustainable electricity generating solutions given the global acknowledgement of the challenges posed by Climate Change.

9.0 PRIMARY DATA COLLECTION AND ANALYSIS

For each of the scenarios, relevant data was collected from Exxaro and affected farmers in the mining rights application block shown in Appendix B. Data was collected using questionnaires provided to Exxaro and to farmers who were willing to participate and provide details of their production data.

9.1 Data for Scenario 1

The questionnaire completed by Exxaro is attached in Appendix F. The questionnaire covered the three phases of the proposed mine's life cycle; construction, operation and decommissioning, rehabilitation and closure. The data required for Scenario 1 (mining) related to the following:

- Number of persons under full time employment during each phase, employment breakdown and expenditure on salaries;
- Tonnage from proposed mine and production schedule;
- Start of mine construction and lifespan of mine;
- Type, cost and location of additional secondary developments or expansions proposed;
- Infrastructure development: both mine and non-mine;
- Capital expenditure during construction (CAPEX) and operation (OPEX) phases;
- Annual income and expenditure breakdown;
- Procurement policy;
- Breakdown of expenses;
- Expected loans required;
- Total annual operational costs; and
- Total cost of materials required during construction and operation phases.

9.2 Data for Scenario 2

To gather the relevant data for the farming scenario each of the affected farmers found within the mining area was individually contacted and given a questionnaire to complete. The questionnaires were in English and Afrikaans and an example of each can be found in Appendix F. Of the total of 10 active farmers, 6 responded yielding a response rate of about 60%. Two of the total of 10 farmers refused to provide data to the Consultants, another farmer leased his land out to others and one farmer was recently deceased. The relevant data were then extrapolated to complete the dataset. A sample of the surrounding farmers was also collected as many of the directly affected farmers within the mining rights application block felt that these farmers would also be affected by the proposed mining activities. Due to time constraints and the availability

of the relevant farmers, data from only 4 of the farmers surrounding the proposed mining block were collected.

9.2.1 Key characteristics of affected farmers within and adjacent to mining block

Selected data collected from the farmers found within and adjacent to the mining rights application block have been summarized in Tables 17 and 18. As Table 17 shows, maize makes up approximately 73% of the total area of crops planted within the mining block (2672ha maize area/3652ha total crop area). The reported maize yields in the area are also above the Mpumalanga Provincial average of 5.5t/ha and the National average of 4.9t/ha indicating the suitability of maize to this area. The total annual tonnage of maize produced within the mining block equates to 18 704 tons. The domestic value of this harvest is roughly R28.8 million[2]. According to all farmers within the mining block, yields have been increasing over time due to improved farming techniques such as precision farming and improved land fertility due to the cumulative application of fertilisers and macro- and micronutrients. According to a soil report by Viljoen and Associates (2009) on the agricultural potential and land capability of the area within the mining block, approximately 59% of the area within the mining block is arable. Of the soils found within the mining area (Arcadia, Katspruit, Bainsvlei, Hutton and Avalon) Hutton is the most common making up 41% of the total area of soils.

Table 17: Crops produced within mining block

Crop type	Area* (ha)	Yield* (t/ha)
Maize (mainly yellow)	2672	7
Soya Beans	350	2
Wheat	40	6
Dry Beans	60	Na
Oats	70	3
Eragrostis curvula (Lovegrass)	460	0.5
Total	3652	-

Source: Golder Associates Survey Data (2009) *in most recent season

Hutton soils are classified as having high agricultural potential under both dryland and irrigation conditions and combined with the diversity of crops produced within the mining area, the yields of these crops in the most recent season and the potential of the soils within the mining, it can be inferred that the area within the mining block is of medium to high agricultural potential. Table 18 (below) shows the crop types and yields attained by a sample of farmers surrounding the mining block. Although the sample of farms adjacent to the mining block shows less diversification in terms of crop production, one cannot conclude that the areas adjacent to the mining block are less or more productive than the area within the mining block without more detailed information and studies being conducted.

Livestock enterprises are also common within the mining block. Sheep found within the mining block numbered roughly 3 000, dairy cattle numbered 350 and beef cattle numbered roughly 2 890 animals. Livestock enterprises for the sample of adjacent farmers included sheep and dairy and beef cattle. For the sample of adjacent farmers, sheep numbered roughly 1000, dairy cattle 220 and beef cattle 200.

[2] Yellow maize price of R1540/ton as at 30 November 2009 (SAGIS, 2009).

Table 18: Crops produced adjacent to mining block

Crop type	Area* (ha)	Yield* (t/ha)
Maize (mainly yellow)	332	5
Soya Beans	20	3
Cherries	10	4
Total	362	-

Source: Golder Associates Survey Data (2009) *in most recent season

10.0 MODELLING ASSUMPTIONS: SCENARIO 1

Scenario 1 also involves a 100 year period in which agriculture will take place for 4 years prior to the establishment of the mine, followed by the 3 year construction period and 38 years operational life of the mine. After mine rehabilitation, decommissioning and closure, agriculture will be re-established and farming will take place for the remainder of the 100 year horizon. Figure 8 below provides a timeline of the various phases of Scenario 1.

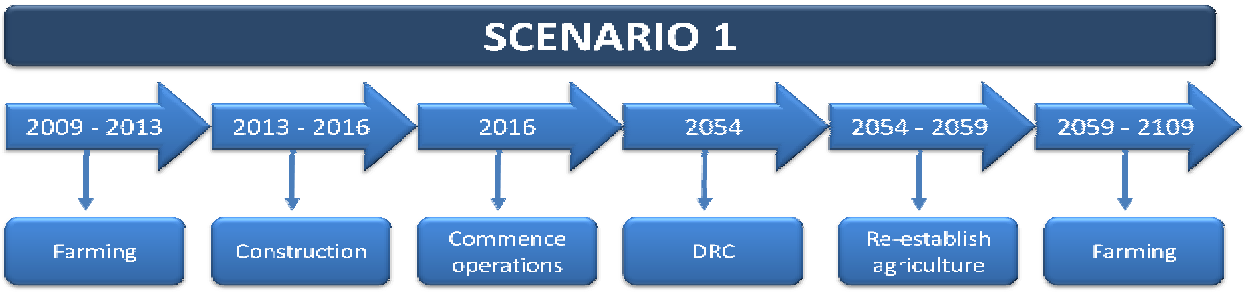

Figure 8: Scenario 1 roll-out

The following assumptions were made for Scenario 1:

- Current agricultural activities will continue for 4 years until construction of the mine commences in 2013.
- During the 38 year operational period of the mine, agricultural activities will take place in the northern portions of the mining area. These agricultural activities are expected to contribute relatively little to the overall impact of Scenario 1 and hence were not included in the model.
- Mine rehabilitation, decommissioning and closure will take 1 year, during which agriculture would be re-established over 5 years.
- Post closure, agricultural activities will resume for the remainder of the 100 year horizon (50 years). **It is assumed that the expenditure on agricultural production pre and post mining will be held constant.**

10.1 Construction Phase Assumptions

The Construction Phase of Scenario 1 is planned to commence in 2013 and last for a period of 3 years. Total investment during this phase of the project is expected to amount to R1 621 000 000[3] and approximately 555 employees will be required. Detailed construction phase assumptions can be found in Appendix G.

3 As at 30 November 2009.

After the mine has been closed down, rehabilitation would be undertaken and agricultural activities would be re-established. Detailed construction phase assumptions for this phase can be found in Appendix H.

10.2 Operational Phase Assumptions

The Operational Phase of Scenario 1 is expected to commence in 2012 and come to an end in 2018. Expenditure during operations is expected to amount to approximately R459 638 678 per annum, whilst around 457 persons will be employed per year. Detailed operational phase assumptions can be found in Appendix I.

10.3 Decommissioning, Rehabilitation and Closure Phase Assumptions

The Decommissioning, Rehabilitation and Closure (DRC) Phase of Scenario 1 is composed of the following direct expenditure elements:

- **Infrastructural aspects** – entails the dismantling of the processing plant and related structures, the rehabilitation of access and haul roads, and the dismantling of fences.
- **Mining aspects** – includes the rehabilitation of the surface water dam and the rehabilitation of processing waste deposits and evaporating ponds with polluting potential.
- **General surface reclamation** – involves reshaping and levelling land and establishing vegetation.
- **Water Management** – comprises re-establishment of drainage lines.
- **Post-closure aspects** – entails mostly monitoring activities.

Detailed decommissioning, rehabilitation and closure phase assumptions can be found in Appendix J.

11.0 MODELLING ASSUMPTIONS: SCENARIO 2

The impact of agricultural production for the next 100 years is presented in the following section. The following assumptions were made:

- The agriculture sector experiences fixed growth trends;
- No structural changes occur in the economy; and
- The impact of technology, innovations and developments in the agricultural sector are not taken into account.

These assumptions are specifically for the SAM modelling process and apply to both scenarios. Farmers are constantly striving to maximize profit under uncertain and changing production conditions and are therefore expected to *adapt* to structural changes in the economy should they occur. Farmers are also likely to adopt appropriate cost-reducing production technologies to improve profitability. Detailed modelling assumptions for Scenario 2 can be found in Appendix K.

12.0 IMPACT ASSESSMENT: SCENARIO 1

12.1 Construction phase impacts of proposed mine

This sub-section examines the macroeconomic impacts associated with the construction phase of Scenario 1. Impact generated by construction works endure for the length of the construction period, in this case, 3 years. Hence, these impacts are often viewed as temporary. One important exception however, pertains to skills developed and experienced accumulated by construction workers. In this respect a construction project engenders an impact that is lasting in nature.

Table 19 summarises the direct, indirect, induced and total production, GDP, and employment impacts that will occur during the construction phase of Scenario 1.

Table 19: Construction Phase Impacts for mine (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impacts During Construction (3 years)				
Economic Indicator	**Direct**	**Indirect**	**Induced**	**Total**
Production	1,621	1,290	434	3,344
GDP-R	563	531	178	1,272
Employment (numbers)	555	531	185	1271

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

Total expenditure during the construction phase of the project will amount to approximately R1 621 billion. The construction industry however, does not operate in isolation, but is party to relationships with other sectors and economic agents. As a consequence, the direct investment in the domestic construction industry will engender increased productivity in other sectors of the economy. Industries supplying inputs to the construction sector will experience an increase in production (i.e. output) of approximately R1 300 billion -*indirect production impact*-, whilst the sectors supplying consumer goods and services will experience a R434 million –*induced production impact*- increase in production. In total, the construction phase of the project will raise the level of production by approximately R3 300 billion.

Raised production levels are accompanied by increased GDP-R. The direct impact on the construction industry is a R563 million increase in its GDP-R. Industries supplying goods and services to the construction industry will experience an increase in GDP-R of approximately R531 million, whilst those supplying consumer goods and services are likely to experience a R178 million increase in GDP-R. Hence, as a result of the construction phase of Scenario 1, the level of GDP-R will increase by a total of approximately R1 300 billion.

The construction phase of Scenario 1 will require the employment of approximately 555 persons for a period of 3 years. Increased production in industries supplying construction inputs and industries supplying consumer goods and services implies the creation of new employment opportunities in these industries. The (indirect) impact on employment in industries supplying construction sector inputs will manifest in the creation of approximately 531 employment opportunities, whilst the impact on industries supplying consumer goods and services (i.e. the induced impact) will be the creation of approximately 185 employment opportunities. In total, the construction phase of Scenario 1 will generate approximately 1271 employment opportunities.

12.2 Operational Phase Impacts of the Proposed Mine

This sub-section examines the macroeconomic impacts associated with the operational phase of the project. The project has a lifespan of 38 years and thus the economic impacts associated with its operation will last for this period. Table 20 indicates the direct, indirect, induced, and total annual production, GDP, and employment impacts associated with Scenario 1.

Table 20: Annual Operational Impacts for mine(R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impacts During Operations (per annum)				
Economic Indicator	**Direct**	**Indirect**	**Induced**	**Total**
Production	1,427	1,306	305	3,038
GDP-R	370	537	126	1,033

Employment (numbers)	105	1849	384	2338

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

12.2.1 Operational Phase Production Impact (Mining)

Direct production per annum during the operational phase of Scenario 1 will amount to approximately R1.4 billion per annum. Higher production in the mining sector will stimulate an increase in the production of approximately R1.3 billion in industries supplying the mining sector with inputs for its operations. In addition, the employment and income generated by higher levels of production in the mining sector and its input-supplying industries will induce an estimated R305 million increase in the production of industries supplying consumer goods and services, as demand for these products rise. The total annual impact of the operation of Scenario 1 is thus a R3 billion increase in the level of production.

In essence, the project entails a direct investment in domestic production of R43 billion for the 38 year operational period, which translates into a R39 billion increase in production in the suppliers of operational inputs to the project, and a R9.2 billion increase in the production of suppliers of household goods and services. The total production impact of 38 years of operation will thus amount to R91 billion.

12.2.2 Operational Phase GDP-R Impact (Mining)

Scenario 1 will contribute roughly R370 million in GDP-R per annum. GDP-R generated in industries supplying the mining sector with inputs will rise by an estimated R537 million per annum, whilst industries that supply consumer goods and services will increase their GDP-R by approximately R126 million per annum. Thus the total annual impact of Scenario 1 on the level of GDP-R is an increase of approximately R1 billion. Scenario 1 will directly generate approximately R11 billion during its operational life. The operational activities of the project will give rise to increased GDP-R of R16 billion by input supply industries, as well as a R3.8 billion increase in the GDP-R of suppliers of consumer goods and services. Thus, in total, the project will stimulate a R31 billion increase in GDP-R during its operational life.

12.2.3 Operational Phase Employment Impact (Mining)

The operation of Scenario 1 will require approximately 105 new employees. Higher production in industries supplying the mining sector with inputs will create an additional 1849 employment opportunities, whilst approximately 384 new employment opportunities will be generated as a result of an increased demand for consumer goods and services which will spark an increase in the production of firms supplying these products. In total, approximately 2338 employment opportunities will be created by the operation of the project.

12.3 Decommissioning, Rehabilitation and Closure Phase Impact Assessment

The sub-sections below describe the annual impacts on production, GDP-R and employment as a result of the Decommissioning, Rehabilitation, and Closure (DRC) phase. The economic impact results are presented in Table 21 below. The results presented in should thus be interpreted in this light, in the event that the DRC period last for more than one year, macroeconomic impacts could change.

Table 21: Annual DRC Impacts for mine (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impacts During DRC (per annum)				
Economic Indicator	**Direct**	**Indirect**	**Induced**	**Total**
Production	289	320	114	723
GDP-R	112	132	47	290
Employment (numbers)	825	577	145	1,547

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

12.3.1 DRC Production Impacts

Total planned investment in production during the DRC Phase amounts to R288 624 946. Industries supplying inputs required during the DRC Phase should experience an increase of around R320 million in production, whilst those industries that supply consumer goods and services should increase production by approximately R114 million. The total production impact of the DRC Phase should therefore amount to approximately R723 million.

12.3.2 DRC GDP-R Impacts

GDP-R amounting to approximately R112 million will be directly stimulated by the DRC Phase of Scenario 1, whilst the indirect GDP-R impact should amount to an estimated R132 million, and the induced GDP-R impact to an estimated R47 million. The total DRC Phase GDP-R impact should thus amount to approximately R290 million.

12.3.3 DRC Employment Impacts

During the DRC phase 825 direct job opportunities will be created. Indirect employment should amount to approximately 577 jobs, whilst the induced employment impact will manifest as approximately 145 employment opportunities. In total, the DRC Phase of Scenario 1 is expected to generate approximately 1,547 employment opportunities.

12.4 Re-establishment of Agriculture

The assessment is based on data obtained from an agricultural survey that was conducted during 2009. Table 22 indicates the direct, indirect, induced, and total annual production, GDP, and employment impacts that will occur during the re-establishment of agriculture in the area.

12.4.1 Construction Phase Production Impact

During the re-establishment of agricultural activities, total expenditure during the construction period will amount to approximately R9.7 million. The construction industry however, does not operate in isolation, but is party to relationships with other sectors and economic agents. As a consequence, the direct investment in the domestic construction industry will engender increased productivity in other sectors of the economy. Industries supplying inputs to the construction sector will experience an increase in production (i.e. output) of approximately R7.6 million, whilst the sectors supplying consumer goods and services will experience a R3.5 million increase in production. In total, the re-establishment of agriculture will raise the level of production by approximately R21 million.

Table 22: Construction Phase Impacts for Agriculture (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impacts During Construction (per annum)				
Economic Indicator	**Direct**	**Indirect**	**Induced**	**Total**
Production	9.7	7.6	3.5	20.8
GDP-R	5.09	3.13	1.45	9.67
Employment (numbers)	202	49	16	268

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

12.4.2 Construction Phase GDP-R Impact

The direct impact on the construction industry is a R5 million increase in its GDP-R. Industries supplying goods and services to the construction industry will experience an increase in GDP-R of approximately R3.1 million, whilst those supplying consumer goods and services are likely to experience a R1.5 million increase in GDP-R. Hence, as a result of the re-establishment of agricultural activities, the level of GDP-R will increase by a total of approximately R9.7 million.

12.4.3 Construction Phase Employment Impact

The construction phase during re-establishment will require the employment of approximately 202 persons. Increased production in industries supplying construction inputs and industries supplying consumer goods and services implies the creation of new employment opportunities in these industries. The (indirect) impact on employment in industries supplying construction sector inputs will manifest in the creation of approximately 49 employment opportunities, whilst the impact on industries supplying consumer goods and services (i.e. the induced impact) will be the creation of approximately 16 employment opportunities. In total, the construction phase during re-establishment of agriculture will generate approximately 268 employment opportunities.

12.5 Total impact for the duration of Scenario 1

Table 23 below presents a summary of the overall economic impact of Scenario 1 on the production, employment and GDP-R for the Primary and Secondary Study areas.

Table 23: Macro-Economic Impact of Scenario 1 over the next 100 years (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impact of Scenario 2: Agriculture – Mining – Rehabilitation – Agriculture						
Economic Indicator	**Total Impact: Agriculture (4years)**	**Total Impact: Construction of mine (3years)**	**Total Impact: Operation of mine (38years)**	**Total Impact: Rehabilitation & Re-establishment (5years)**	**Total Impact: Agriculture (50years)**	**Total Impact (100years)**
Production	144.8	3,344	115,444	806.2	1,810	121,549
GDP-R	58.2	1,272	39,254	328.7	727.5	41,640
Employment (numbers/annum)	268	1271	2338	1815	268	

Source: Urban – Econ Social Accounting Matrix (2009)

13.0 IMPACT ASSESSMENT: SCENARIO 2

This section examines the socio-economic impacts of the current agricultural activities (on the farms which will be affected by the proposed mine) on production, R-GDP and employment.

13.1 Operational Phase Impacts of Agriculture

This sub-section examines the macroeconomic impact associated with the current agricultural activities on the farms that will be lost due to the establishment of the mine. The assessment is based on an agricultural survey that was conducted during 2009 and excludes the activities on the surrounding farm land. Table 24 indicates the direct, indirect, induced, and total annual production, GDP, and employment impacts associated with the current agricultural activities.

Table 24: Annual Operational Impacts for Agriculture (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impacts During Operations (per annum)				
Economic Indicator	**Direct**	**Indirect**	**Induced**	**Total**
Production	15.9	15.4	4.9	36.2
GDP-R	6.2	6.33	3.01	14.55
Employment (numbers)	135	49	16	268

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

13.1.1 Operational Phase Production Impact

Direct production per annum for the current agricultural activities amounts to approximately R16 million per annum. The production in the agricultural sector stimulates an increase in the production of approximately R15 million in industries supplying the agricultural sector with inputs for its operations. In addition, the employment and income generated by production in the agriculture sector and its input-supplying industries induce an estimated R5 million increase in the production of industries supplying consumer goods and services, as demand for these products rise. The total annual impact of the current agricultural activities is thus a R36 million increase in the level of production.

13.1.2 Operational Phase GDP-R Impact

The current agricultural activities generate approximately R6 million in GDP-R per year. GDP-R generated in industries supplying the agricultural sector with inputs will rise by an estimated R6 million per annum, whilst industries that supply consumer goods and services will increase their GDP-R by approximately R3 million per annum. Thus the total annual impact of the current agricultural activities on the level of GDP-R is an increase of approximately R15 million.

13.1.3 Operational Phase Employment Impact

The current agricultural activities on the proposed mining site ensure employment for 135 people. Higher production in industries supplying the agricultural sector with inputs creates an additional 49 employment opportunities, whilst approximately 16 new employment opportunities are be generated as a result of an increased demand for consumer goods and services which sparks an increase in the production of firms supplying these products. In total, approximately 268 employment opportunities are created by the current agricultural activities.

13.2 Total impact for the duration of Scenario 2

The total economic impact for Scenario 2 over the 100 year period is presented in Table 25 below.

Table 25: Macro-Economic Impact of Scenario 2 over the next 100 years (R'000 000, 2009 prices - unless otherwise stated)

Macro-Economic Impact of Scenario 2: Agriculture		
Economic Indicator	**Total (per annum)**	**Total (100years)**
Production	36.2	3,620
GDP-R	14.55	1,455
Employment (numbers)	268	

Source: Urban-Econ Social Accounting Matrix-based Model (2009)

14.0 EVALUATION OF ECONOMIC IMPACTS

14.1 Scenario 1

14.1.1 Implications and Evaluation of Production Phase Impacts

Table 26 below shows that the direct production impact engendered by Scenario 1 is moderately significant to the primary study area. The impacts are site specific in extent, short term in duration and will definitely occur. The magnitude of the impact is high, given that the contribution of the direct production impact to the annual change in the construction sectors production is higher than the contribution of the construction sector to the annual change in the economy's total production. The indirect production impact brought about by the project is moderately significant to the Mpumalanga province. The induced production impact has a low significance due to the combination of a national extent, short term duration, low magnitude (27% of the size of the direct impact) and high probability of occurrence.

Table 26: Significance of Construction Phase Production Impacts

Significance of Production Impact			
Criteria	**Direct Production Impact**	**Indirect Production Impact**	**Induced Production Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	2	2	2
Magnitude	8	6	4
Probability of occurrence	5	4	4
Significance Points	55	44	40
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Low macro-economic significance

14.1.2 Implications and Evaluation of Construction Phase GDP Impacts

Table 27 shows the significance ratings of the direct, indirect and induced construction phase GDP impacts. The ratings are identical to that of the production impacts, which is expected given the positive relationship between production and GDP. The magnitude of the direct GDP impact is rated as high, since the contribution of the project to the annual change in the construction sector's GDP is higher than the construction sector's contribution to the annual change in the entire primary study area economy's GDP. The magnitude of the indirect GDP impact is rated as moderate since it is equal to 94% of the size of the direct GDP impact, whilst the magnitude of the induced GDP impact is rated as low because it is equal to 32% of the size of the direct impact.

Table 27: Significance of Construction Phase GDP Impacts

Significance of GDP Impact			
Criteria	**Direct GDP Impact**	**Indirect GDP Impact**	**Induced GDP Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4

Duration	2	2	2
Magnitude	8	6	4
Probability of occurrence	5	4	4
Significance Points	55	44	40
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Low macro-economic significance

14.1.3 Implications and Evaluation of Construction Phase Employment Impacts

Table 28 shows the significance ratings of the direct, indirect and induced construction phase employment impacts. The contribution of the project to the annual change in the construction sector's employment is higher than the construction sector's contribution to the annual change in the entire primary study area economy's employment, which earns the direct employment impact a 'moderate' rating. The magnitude of the indirect employment impact is estimated to equal 96% the size of the direct employment impact and is thus also rated as moderate. The magnitude of the induced employment impact is rated as low because it is equal to 33% of the size of the direct employment impact.

Table 28: Significance of Construction Phase Employment Impacts (Scenario 2)

Significance of Employment Impact			
Criteria	**Direct Employment Impact**	**Indirect Employment Impact**	**Induced Employment Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	2	2	2
Magnitude	8	6	4
Probability of occurrence	5	4	4
Significance Points	55	44	40
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Low macro-economic significance

14.1.4 Implications and Evaluation of Operational Phase Production Impacts

Table 29 shows the significance ratings of the direct, indirect and induced operational phase production impacts. The magnitude of the direct production impact is high, given that the contribution of the direct production impact to the annual change in the mining sector's production is higher than the contribution of the mining sector to the annual change in the economy's total production. The magnitude of the indirect production impact is rated as moderate since it is equal to 91% of the size of the direct production impact, whilst the magnitude of the induced production impact is negligible because it is equal to 21% of the size of the direct production impact.

Table 29: Significance of Operational Phase Production Impacts

Significance of Production Impact			
Criteria	**Direct Production Impact**	**Indirect Production Impact**	**Induced Production Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	4	4	4
Magnitude	8	6	2
Probability of occurrence	5	4	4
Significance Points	65	52	40
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.1.5 Implications and Evaluation of Operational Phase GDP Impacts (Mining)

Table 30 shows the significance ratings of the direct, indirect and induced operational phase GDP impacts. The ratings are identical to that of the production impacts, which is expected given the positive relationship between production and GDP. The magnitude of the direct GDP impact is high, given that the contribution of the direct GDP to the annual change in the mining sector's production is higher than the contribution of the mining sector to the annual change in the economy's total production. The magnitude of the indirect GDP impact is estimated to equal 145% the size of the direct GDP impact and is thus rated as high. The magnitude of the induced GDP impact is rated as low because it is equal to 34% of the size of the direct GDP impact.

Table 30: Significance of Operational Phase GDP Impacts

Significance of GDP Impact			
Criteria	**Direct GDP Impact**	**Indirect GDP Impact**	**Induced GDP Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	4	4	4
Magnitude	8	8	4
Probability of occurrence	5	4	4
Significance Points	65	60	48
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.1.6 Implications and Evaluation of Operational Phase Employment Impacts (Mining)

Table 31 indicates the significance ratings of the direct, indirect and induced operational phase employment impacts. The magnitude of the direct employment impact is rated as high, since the contribution of the project to the annual change in the mining sector's employment is higher than the mining sector's contribution to the annual change in the entire primary study area economy's employment. The magnitude of the indirect employment impact is rated as very high since it is equal to 1761% of the size of the direct employment impact. Furthermore, the magnitude of the induced employment impact is rated as high because it is equal to 366% of the size of the direct employment impact. Thus, Scenario 1 will not only be beneficial in terms of the number of jobs it creates directly, but will also ensure a large number of indirect and induced employment opportunities.

Table 31: Significance of Operational Phase Employment Impacts

Significance of Employment Impact			
Criteria	**Direct Employment Impact**	**Indirect Employment Impact**	**Induced Employment Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	4	4	4
Magnitude	8	10	8
Probability of occurrence	5	4	4
Significance Points	65	68	64
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.1.7 Implications and Evaluation of Rehabilitation Phase Production, GDP and employment Impacts (Mining)

Table 32 indicates the significance of the production, GDP-R, and employment impacts during the rehabilitation phase. The rehabilitation phase will have a short-term direct impact on the primary study area which will occur with certain probability, and will indirectly affect the Mpumalanga Province with high probability. This phase will also have induced impacts on production, GDP, and employment that could be experienced on national level. In order to determine the magnitude of the impacts, the contribution of the production/GDP/employment during the base period (2054-2055 when rehabilitation phase commences) is compared to the production/GDP/employment contribution of the construction sector to the change in the size of the entire economy's production/GDP/employment during the base period. Due to the fact that projections become inaccurate when data is extrapolated too far into the future, it is impossible to evaluate the magnitude of the impacts accurately. Therefore, the magnitude of the impacts was excluded from the evaluation and the significance points and rating can also not be accurately calculated. The significance rating of this phase is expected to be of low macro-economic significance.

Table 32: Significance of Rehabilitation Phase Production, GDP, and Employment Impacts

Significance of Production, GDP, and Employment Impacts			
Criteria	**Direct Impact**	**Indirect Impact**	**Induced Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	2	2	2
Probability of occurrence	5	4	4

14.1.8 Implications and Evaluation of Production, GDP, and Employment Impacts (Agriculture after mining)

Table 33 indicates the significance of the production, GDP, and employment impacts of agricultural activities after the mine is closed down and rehabilitation took place. The agricultural activities will have a long-term direct impact on the primary study area, and will indirectly affect the Mpumalanga Province with high probability. This phase will also have induced impacts on production, GDP, and employment that could be experienced on national level. The agricultural activities will commence in 2060 after the rehabilitation phase, therefore the magnitude of the impacts have not been included in the evaluation. Therefore, the magnitude of the impacts was excluded from the evaluation and the significance points and rating can also not be accurately calculated. The significance rating of this phase is expected to be of low macro-economic significance.

Table 33: Significance of Production, GDP, and Employment Impacts of Agriculture (after mining)

Significance of Production, GDP, and Employment Impacts			
Criteria	**Direct Impact**	**Indirect Impact**	**Induced Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	5	5	5
Probability of occurrence	5	4	4

14.1.9 Post Closure Agricultural Production

For Scenario 1, it was assumed that expenditure on agricultural production would remain constant for modelling purposes. This is **unlikely** as the land productivity is likely to be affected and, hence, the mix of agricultural enterprises that are viable, post mining will be altered. According to Limpitlaw *et al.* (2005), mines have traditionally had little success in returning prime agricultural land to its former, pre-mining productivity. This, they contend is a result of the following conditions 1) poor understanding of the effect of soil depth on vegetation sustainability, 2) high soil erodability, 3) salt migration through rehabilitated surfaces and 4) soil compaction through poor soil replacement processes (the Red soils commonly found on the Highveld, with less than 28% clay content, are particularly prone to compaction). These factors, in conjunction with disruption of other soil properties such as porosity, water holding capacity and pH result in poor productivity post-mining and have resulted in degraded land. Land degradation has been loosely defined by Eswaran *et al.* (2001) as “a decline in land quality as a result of human activities” and Figure 9 below, illustrates the (hypothetical) relative crop yields per hectare on ‘good’ and ‘degraded’ land given a fixed set of inputs (labour, fertilizer, capital). As Figure 9 illustrates, relative yields increase in proportion to input use to a

greater extent on 'good' land than on 'degraded' land. Relative yields per ha are also well below 100% for degraded land. **Cofie and Penning de Vries (2002) note that the net effect of land degradation is to reduce maximum crop yields, reduce actual yields and the efficiency with which production inputs are used and to increase the risk of crop failure. More inputs will, therefore, be needed to produce the same relative crop yields and costs of production may increase substantially making investment in agriculture less attractive.** Depending on the rehabilitation methods implemented and soil properties, yields on rehabilitated land may, however, be somewhere between that of 'good' and 'degraded' land and the yields of certain crops such as wheat which have a greater salt tolerance than other crops may still have high yields on rehabilitated land (Jovanovic *et al.,* 2002).

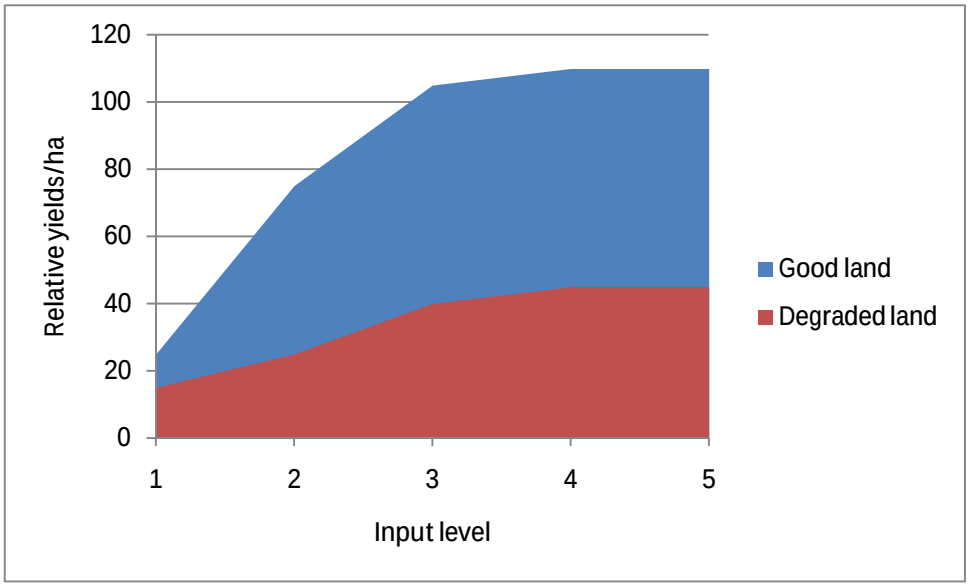

Figure 9: Relative crop yields for good and degraded lands versus input levels

Source: Adapted from Penning de Vries (2001)

The extent to which land will be affected crop production on rehabilitated land post closure will be a function of the soils properties (water holding capacity, salinity, porosity and pH) as well as by the rehabilitation methods used. Nevertheless, to achieve the same productivity per hectare, additional inputs would need to be used on the rehabilitated land area. This will result in increased costs of production and may make investment in agricultural activities on the rehabilitated land less attractive. **This, therefore, reduces the attractiveness of Scenario 1 from a sustainable development perspective.** To improve the attractiveness of Scenario 1, it is anticipated that grassland grown on the rehabilitated area will be able to support livestock enterprises and the area will be able to return to some form of agricultural production. The grazing carrying capacity is, however, likely to be affected as the growth of grasslands are likely to decline without increased input use such as fertilizer. This may further reduce the profitability of livestock enterprises post closure and may mean that livestock production is also not viable on the rehabilitated mine area.

To ensure that the reduction in land productivity post mining is minimised should Scenario 1 be implemented, careful management of topsoil and fertiliser application are crucial (Limpitlaw *et al.,* 2005). As mines have traditionally kept poor records of pre-mining agricultural performance and soil conditions Lampitlaw *et al.* (2005) suggest that at closure, agricultural records should be available and be used to create guidelines for post mining land use.

14.2 Scenario 2

14.2.1 Implication and Evaluation of Production Impacts

As shown in Table 34, the direct production impact engendered by the current agricultural activities is moderately significant to the primary study area. The impacts are site specific in extent, long term in duration

and will definitely occur. The magnitude of the impact is high, given that the contribution of the direct production impact to the annual change in the agricultural sector's production is higher than the contribution of the agricultural sector to the annual change in the economy's total production. The indirect production impact brought about by the agricultural activities is moderately significant to the Mpumalanga province. The magnitude of the indirect production impact is moderate since its size is approximately 97% the size of the direct production impact. The combination of a national extent, long term duration, low magnitude (31% of the size of the direct impact) and high probability of occurrence means that the induced production impact is moderately significant.

Table 34: Significance of Production Impacts

Significance of Production Impact			
Criteria	**Direct Production Impact**	**Indirect Production Impact**	**Induced Production Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	5	5	5
Magnitude	8	6	4
Probability of occurrence	5	4	4
Significance Points	70	56	52
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.2.2 Implication and Evaluation of GDP Impacts

Table 35 shows the significance ratings of the direct, indirect and induced GDP impacts of current agricultural activities. The ratings are identical to that of the production impacts, which is expected given the positive relationship between production and GDP. The magnitude of the direct GDP impact is rated as high, since the contribution of the project to the annual change in the construction sector's GDP is higher than the construction sector's contribution to the annual change in the entire primary study area economy's GDP. The magnitude of the indirect GDP impact is rated as high since it is equal to 102% of the size of the direct GDP impact, whilst the magnitude of the induced GDP impact is rated as low because it is equal to 32% of the size of the direct impact.

Table 35: Significance of GDP Impacts

Significance of GDP Impact			
Criteria	**Direct GDP Impact**	**Indirect GDP Impact**	**Induced GDP Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	5	5	5
Magnitude	8	8	4
Probability of occurrence	5	4	4

Significance Points	70	64	52
Significance Rating	Moderate macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.2.3 Implication and Evaluation of Employment Impacts

Table 36 shows the significance ratings of the direct, indirect and induced employment impacts of Scenario 2. The magnitude of the direct employment impact of agricultural activities is very high, since the project would make a positive contribution to the annual change in the agricultural sector's employment, and the agriculture sector's annual change in employment is negative during the base period. It should be kept in mind that the high macroeconomic significance is because comparisons are only made in the agricultural sector (which is relatively small and sensitive to changes) and should only be compared to other sector using absolute values. The magnitude of the indirect employment impact is estimated to equal 36% the size of the direct employment impact and is thus rated as low. The magnitude of the induced employment impact is negligible because it is equal to 12% of the size of the direct employment impact.

Table 36: Significance of Employment Impacts

Significance of Employment Impact			
Criteria	**Direct Employment Impact**	**Indirect Employment Impact**	**Induced Employment Impact**
Direction	Positive	Positive	Positive
Geographical extent	1	3	4
Duration	5	5	5
Magnitude	10	4	2
Probability of occurrence	5	4	4
Significance Points	80	48	44
Significance Rating	High macro-economic significance	Moderate macro-economic significance	Moderate macro-economic significance

14.2.4 Summary

Both Scenario's 1 and 2 have an overall moderate macroeconomic significance. It should be kept in mind that the magnitude of each impact (and therefore also the significance) is determined by comparisons in the specific sector in which the impact will occur. For example, the direct employment impact of Scenario 2 has a very high magnitude – magnitude is determined by comparing the contribution of the employment impact to the change in size of the agriculture sector's employment during the base period, with the employment contribution of the agriculture sector to the change in size of the entire economy's employment during the base period. Agriculture is a relatively small sector and, therefore, changes in employment as a result of the current agricultural activities will seemingly have a big impact because it is only compared to the employment changes in the agricultural sector itself. If absolute values were compared it will be evident that the employment impact of Scenario 1 are larger than the impact of Scenario 2. It can be concluded that the impact of Scenario 2 will be a moderate long-term impact on the primary study area, but Scenario 1 (if compared in absolute terms) will have a greater impact relative to Scenario 2 because of the boost the economy will experience for the 50 years during which mining related activities will take place. For Scenario 1, it was assumed that expenditure on agricultural production would remain constant for modelling purposes.

This is unlikely as the land productivity is likely to change affecting the mix of agricultural enterprises that are viable, post closure. This is then likely to induce a shift in the types of agricultural enterprises the area can support from predominantly crop to predominantly livestock enterprises. The returns from these livestock enterprises are likely to be lower than pre-mining levels due to a certain degree of land degradation from the disruption of the soil structure during mining and rehabilitation which will affect the carry capacity of the land. The economic effects of Scenario 1 will, therefore, not be sustained in the long-term and future growth in the area, post closure, will need to be fuelled by Municipal District and Local Economic Development initiatives. In contrast, although the economic benefits of Scenario 2 will be less (in absolute terms) than those induced by Scenario 1, the land will retain and even improve in its productivity and, from a sustainable development perspective, Scenario 2 seems a more attractive scenario to pursue.

15.0 ECOSYSTMS SERVICES ANALYSIS

Approximately **378 ha** of wetlands are found within the proposed mining area and provide important services to users on site (farmers) and downstream. **This analysis does not fall into the brief given by Exxaro but should be taken into account, however, as there may be potential future liability for Exxaro as a result of its mining activities.** The proposed mining area falls into the Nkomati catchment and in order to illustrate the potential value of services to the farms onsite and to the offsite or downstream users, a generic table has been created to illustrate;

- The quality of the onsite services supplied (scored between -3 to +3);
- The farmers' dependence on the services (scored 0 to +3);
- The quality of the offsite and downstream services supplied (scored between -3 to +3); and
- The downstream dependence on the services (scored 0 to +3).

This generic Table is presented in Appendix L. The list of services shown in this Table shows that wetlands on farms and within a stressed watershed such as the Nkomati can play a significant social and economic role. Green cells within this table denote high value.

15.1 The potential economic value of Wetlands within the proposed mining area

Whilst there has been no opportunity to value the wetlands, we have selected a number of relevant research papers to highlight the range of values which wetlands can supply. This will serve to illustrate:

- The potential value of benefits enjoyed by broader society;
- Which may have future liability implications for the agents degrading wetlands; and
- Which may have social consequences; with
- Implications for public and shareholder perceptions of corporate social responsibility.

Table 37 below outlines the individual service values for those known. Unknown values are highlighted red.

Table 37: Relevant indicative estimates of value - lower range estimate

Wetlands	Services	R/ha/year	Reference
Direct Benefits	Water Supply	R 20.12	Mander *et al* (2008)
	Harvestable natural resources	R 496.34	Adapted from Sullivan *et al* (2008)
	Food for livestock	R 1 618.59	Adapted from Sullivan *et al* (2008)
	Cultivated foods	R 304.33	Adapted from Sullivan *et al* (2008)
	Cultural significance		
	Tourism & recreation	R 575.03	Palmer *et al* (2002)
Indirect Benefits	Flood attenuation		
	Stream flow regulation		
	Sediment trapping	R 31.58	Mander *et al* (2008)
	Phosphate trapping		
	Waste assimilation	R 5 144.00	Murray *et al* (2009)
	Erosion control		
	Carbon storage	R 46.55	Mander *et al* (2008)
	Wildlife refugia	R 128.00	Murray *et al* (2009)
	Total value in 2008 prices	R 8 364	
	Total wetland hectares	378	
	Total annual value	R 3 161 798.61	

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Mander, M., Blignaut, J. Schulze, R., Horan, M., Dickens, C., van Niekerk, K., Mavundla, K., Mahlangu, I., Wilson, A and McKenzie, M. 2007. Maloti Drakensberg Transfrontier Project Payment for Ecosystem Services: Developing an Ecosystem Services Trading Model for the Mnweni/Cathedral Peak and Eastern Cape Drakensberg Areas. Mander (Ed) INR Report IR281. Development Bank of Southern Africa, Department of Water Affairs and Forestry, Department of Environment Affairs and Tourism, Ezemvelo KZN Wildlife, South Africa.

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The conservative total value of the wetlands (378ha) within the proposed mining area is estimated to be some R3.2 million per year.

An upper range value can be obtained by using know values from international research. See Table 38 below. Missing values are shown in red.

Table 38: Upper range Wetland values

Potential wetland values from Costanza et al 1997 [1]	
Services	**Wetlands values in USD (1996 prices)**
Gas regulation	$265
Climate regulation	$0
Disturbance regulation (including flood management)	$7240
Water regulation	$30
Water supply	$7600
Erosion control	0
Soil formation	0
Nutrient cycling	0
Waste treatment	$1659
Pollination	0
Biological control	0
Refugia	$439
Food production	$47
Raw materials	$49
Genetic resources	0
Recreation	$491
Cultural	$1761
Total value '96 USD prices/ha	$19 581
Total value '96 Rands/ha/yr	R 142 941
Total hectares of affected wetlands (Belfast Mining Block)	378
Total annual value ('96 Price x ha)	R 54 031 811
Total annual value of wetland services in 2009 prices (escalated based on RSA CPI)	**R 123 735 844**

[1] Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. *Nature,* 387, 253-259.

The Costanza figures show a considerably higher magnitude (some one hundred fold increase) of wetland services. This could be considered an upper range value of the affected wetlands. In summary the affected wetlands could supply services to the value of between R3m to R120 million per year to on site as well as downstream users adjacent to the proposed mining area.

15.2 Implications for Scenario 1

As the Nkomati watershed is a stressed system with high demands for water security, any reduction in watershed services which reduce water security could have significant costs for watershed users. By preserving these ecosystems goods and services, the attractiveness of Scenario 2 from a sustainable development perspective is increased. The range and value of wetland services used by society also **warrants further detailed investigations** as the social costs and possible **future liability** could have significant financial and reputation implications for Exxaro.

16.0 DISCUSSION

The Consultants were required to conduct a Sustainable Development Investigation for two development scenarios. The Consultants were commissioned by Exxaro to undertake the Investigation and who are evaluating a potential coal reserve on the farms Zoekop, Blyvooruizicht and Leeuwbank in the Belfast area of Mpumalanga. These scenarios are summarized as follows:

- Scenario 1 - Coal mining for the life of the mine (38 years), rehabilitation and farming for the remainder of the horizon; and
- Scenario 2 - Agricultural production for 100 years (current land use).

The Consultants used a Social Accounting Matrix (SAM) approach to assess the economic impacts of the two scenarios. The results of the modelling found that, in total, Scenario 1 had a total production impact of R121.5 billion and a total GDP-R impact of R41.6 billion over the 100 year horizon. Scenario 1 will also, indirectly, generate 1271 jobs during construction and 2338 jobs per annum during the operational phase of the mine. After rehabilitation and re-establishment of agriculture (which will create another 1815 jobs), the intention is that the land will revert back to some form of agricultural production.

The results of the investigation found that Scenario 2 had a much smaller economic impact relative to Scenario 1. The total production impact of R3.620 billion over the 100 year period ensuring an increase of R1.455 billion in GDP-R. Scenario 2 also provided employment for 268 individuals per annum.

The total economic impact of Scenario 1 far exceeds that of Scenario 2 mainly due the amount of expenditure required to construct, operate and close a large open cast mine. Should Scenario 1 be implemented the level of production, GDP, employment, income and government revenue will all be positively influenced during both its construction and operational phases. Whilst the construction impacts will be short-lived, the annual impacts generated by operations will endure for 38 years after which agriculture will be re-established (which again has positive macroeconomic impacts during construction). The proposed mine will also supply the domestic (Eskom) and the export markets with coal contributing to a more stable energy supply for the country and well as generating important foreign exchange and improving the country's trade balance. This increases the attractiveness of Scenario 1 from an economic development perspective.

South Africa's development and employment targets, however, need to be balanced with the Country's agrarian reform, human development and food insecurity concerns. The South African Government's Strategic Plan stresses the importance of agriculture in meeting these objectives. The Mpumalanga Province is a major source of South Africa's agricultural produce (especially important food crops such as maize and soya beans) and should the future mining applications within the Province proceed, the impact on agriculture and food price inflation will be significant and food imports into the Province may increase. **The land within the proposed mining area is also considered to be highly productive and agricultural enterprises within the proposed mining area are highly diversified.** For Scenario 1, it was assumed that post closure expenditure on agricultural production would remain constant for modelling purposes. This is unlikely as the land productivity is likely to be affected altering the mix of agricultural enterprises that are viable. Expenditure on production inputs such as labour and fertilizer is, therefore, expected to increase. Mines have also, traditionally, had little success in returning prime agricultural land to its former, pre-mining productivity. This is due to reasons such poor understanding of soil properties and poor management during rehabilitation. Future crop production on the rehabilitated land within the proposed mining area is likely to be sub-optimal, yields low and production costs high reducing the viability of post closure crop production on this land. From a sustainable development perspective, the reduced yields and possible increased production costs negatively affects the attractiveness of Scenario 1. Grasslands are to be re-established during rehabilitation and livestock production may be viable despite expected reductions in the carrying capacity of the land post closure.

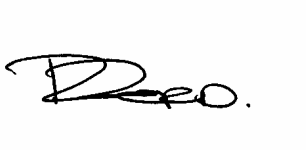
Agriculture also plays a role in preserving important ecosystems goods and services and several wetlands, which deliver these services, are found within the proposed mining area. The preservation of these goods and services in the long-term increases the attractiveness of Scenario 2 from a sustainable development

perspective but further and more detailed investigations are recommended as the impacts on society may have important liability implications for Exxaro.

In conclusion, Scenario 1 has a greater macroeconomic impact than does Scenario 2 and therefore provides greater GDP, production and employment benefits to the Emakhazeni Local Municipality and the surrounding areas in the medium-term. The attractiveness of Scenario 1 is lessened from a sustainable development perspective, however, as the boost to the local and regional economies, although large, will be short-lived (50 years) and there is a strong likelihood of reduced agricultural land productivity post closure. The reduced productivity especially in terms of crop production will induce a change in the mix of agricultural enterprises from predominantly crop enterprises to livestock enterprises. Economic growth will then, primarily, need to be fuelled by Municipal District and Local Economic Development initiatives for the remaining 50 years of Scenario 1. The attractiveness of Scenario 2 is increased from a sustainable development perspective as the land use will not be substantially altered in the long-term and this Scenario also ensures the preservation of important ecosystem goods and services provided by the areas of wetland found within the proposed mining area. Understanding and quantifying the impact of mining activities on these ecosystem goods and services is a key concern from a sustainable development perspective and the social implications need to be more accurately quantified before a definitive conclusion on which Scenario is more desirable can be determined.

The Consultants provide the following recommendations:

- Further and more detailed investigations, from an ecosystems goods and services perspective, are recommended as the impacts on society may have important liability implications for Exxaro. The Consultants also recommend that the ecosystems services be incorporated into the SAM model – this was omitted due to time constraints;
- Should Scenario 1 be implemented, the rehabilitation of the area post-mining should be carefully managed and monitored to ensure that the reduction in land productivity is minimised; and
- Pre-mining records on agricultural performance and current soil conditions should be kept and assessed at the closure of the proposed mine so that the area can be returned as closely to its pre-mining productivity as reasonably possible.



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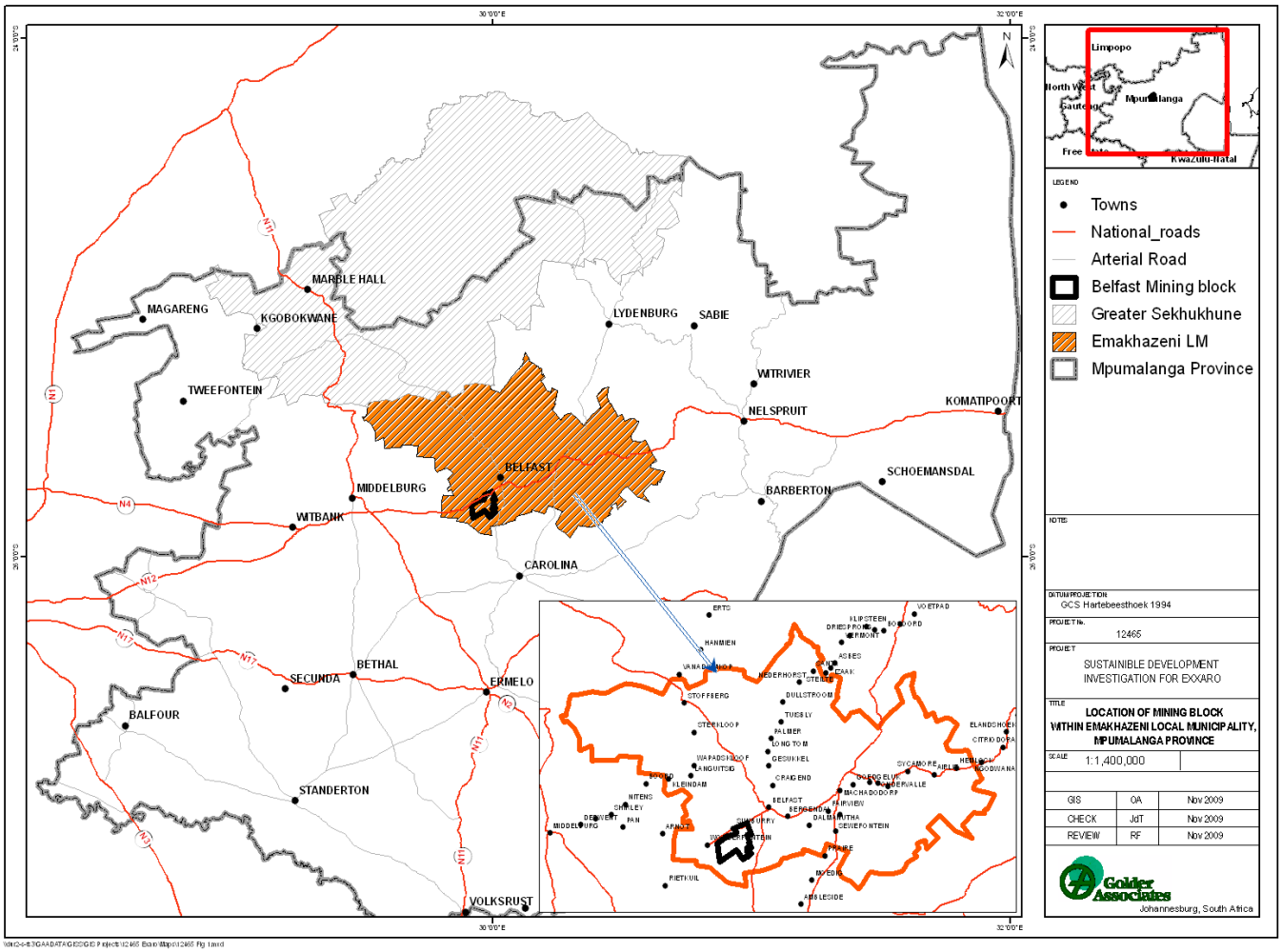
APPENDIX A

Delineation of study area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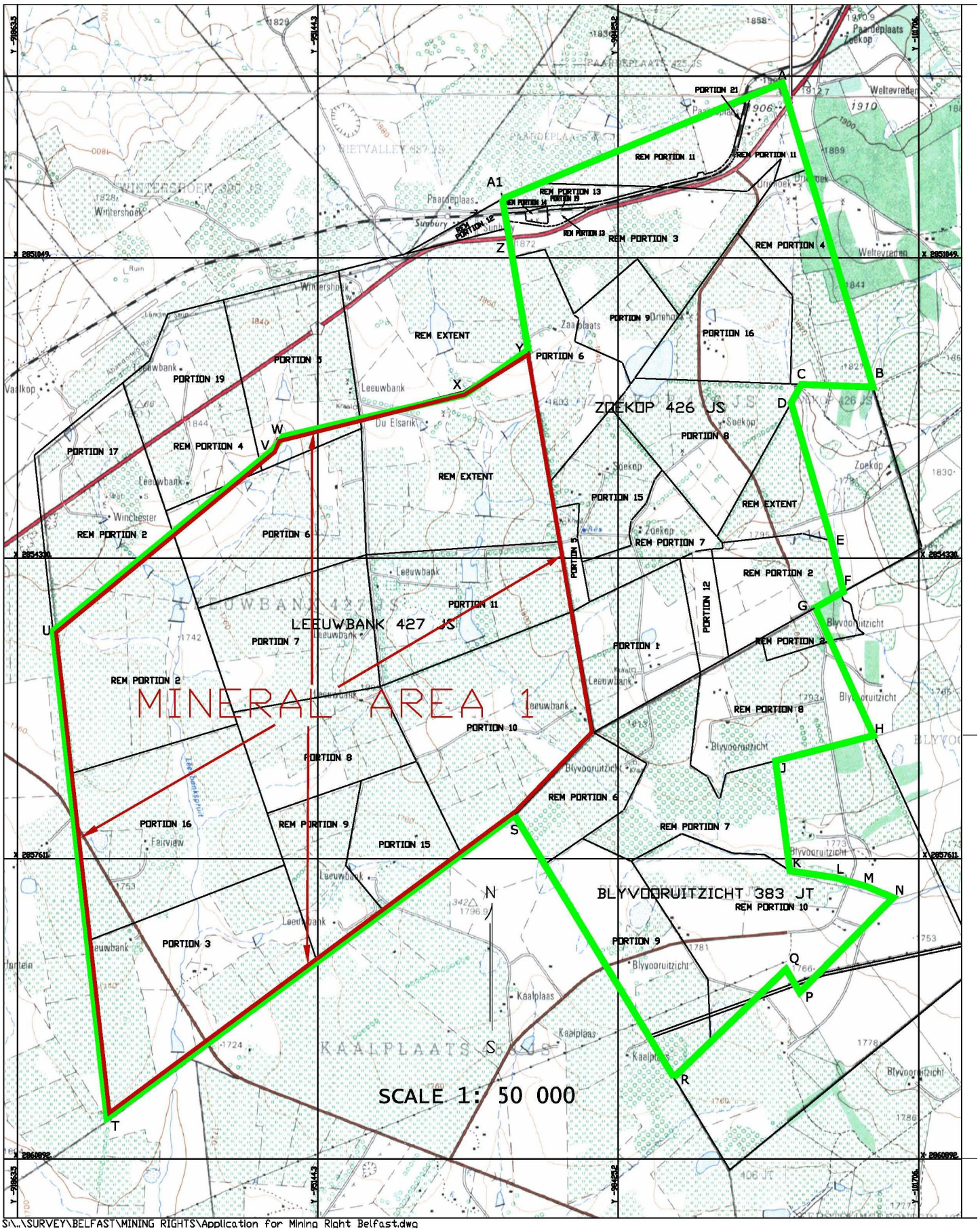
N
MARBLE HALL
MAGARENG
KGOBOKWANE
LYDENBURG
SABIE
WITRIVIER
TWEEFONTEIN
NELSPRUIT
KOMATIPOORT
BELFAST
MIDDELBURG
BARBERTON
SCHOEMANSDAL
WITBANK
CAROLINA
SECUNDA
BETHAL
ERMELO
BALFOUR
STANDERTON
VOLKSRUST
N1
N2
N4
N11
N12
N17
Limpopo
North West
Gauteng
Mpumalanga
Free
Kwazulu-Natal
LEGEND
Towns
National_roads
Arterial Road
Belfast Mining block
Greater Sekhukhune
Emakhazeni LM
Mpumalanga Province
NOTE:
DATUM/PROJECTION
GCS Hartebeesthoek 1994
PROJECT No.
12465
PROJECT
SUSTAINIBLE DEVELOPMENT INVESTIGATION FOR EXXARO
TITLE
LOCATION OF MINING BLOCK WITHIN EMAKHAZENI LOCAL MUNICIPALITY, MPUMALANGA PROVINCE
SCALE
1:1,400,000
GIS OA Nov 2009
CHECK JdT Nov 2009
REVIEW RF Nov 2009
Golder Associates
Johannesburg, South Africa

APPENDIX B

Affected farms within mining area – Belfast, Mpumalanga

December 2009
Report No. 12465-9358-2

Golder Associates



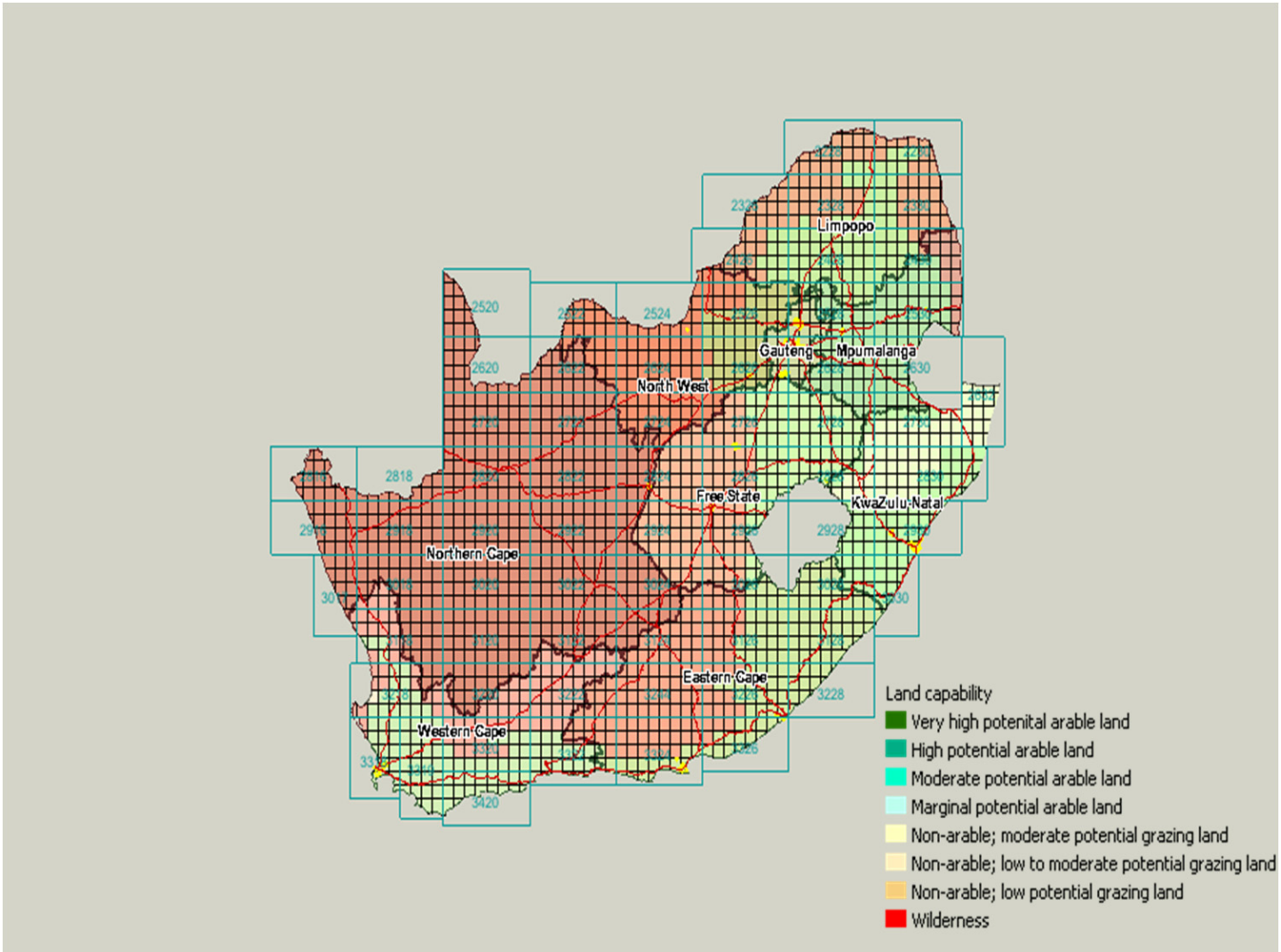
S:\..\SURVEY\BELFAST\MINING RIGHTS\Application for Mining Right Belfast.dwg

APPENDIX C

Agricultural land capability – South Africa

December 2009
Report No. 12465-9358-2

Golder Associates

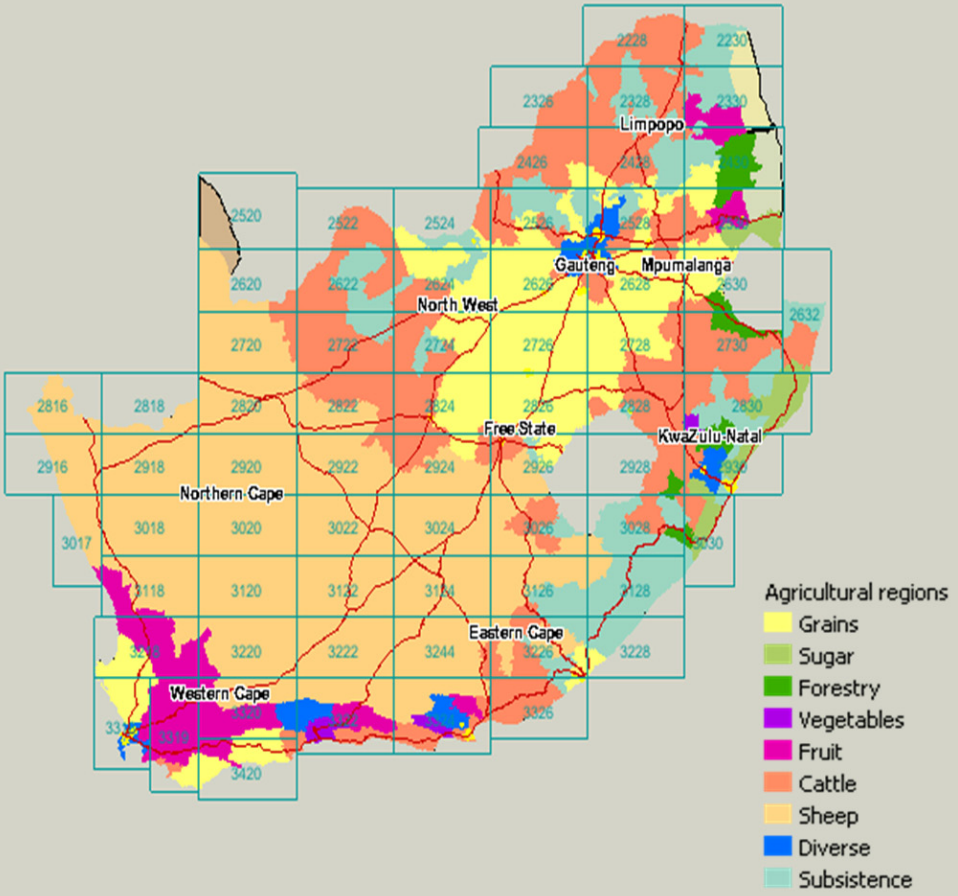

Limpopo
Gauteng
Mpumalanga
North West
Free State
KwaZulu-Natal
Northern Cape
Eastern Cape
Western Cape
Land capability
Very high potenital arable land
High potential arable land
Moderate potential arable land
Marginal potential arable land
Non-arable; moderate potential grazing land
Non-arable; low to moderate potential grazing land
Non-arable; low potential grazing land
Wilderness

APPENDIX D

Distribution of agricultural production according to commodity type – South Africa

December 2009
Report No. 12465-9358-2

Golder Associates

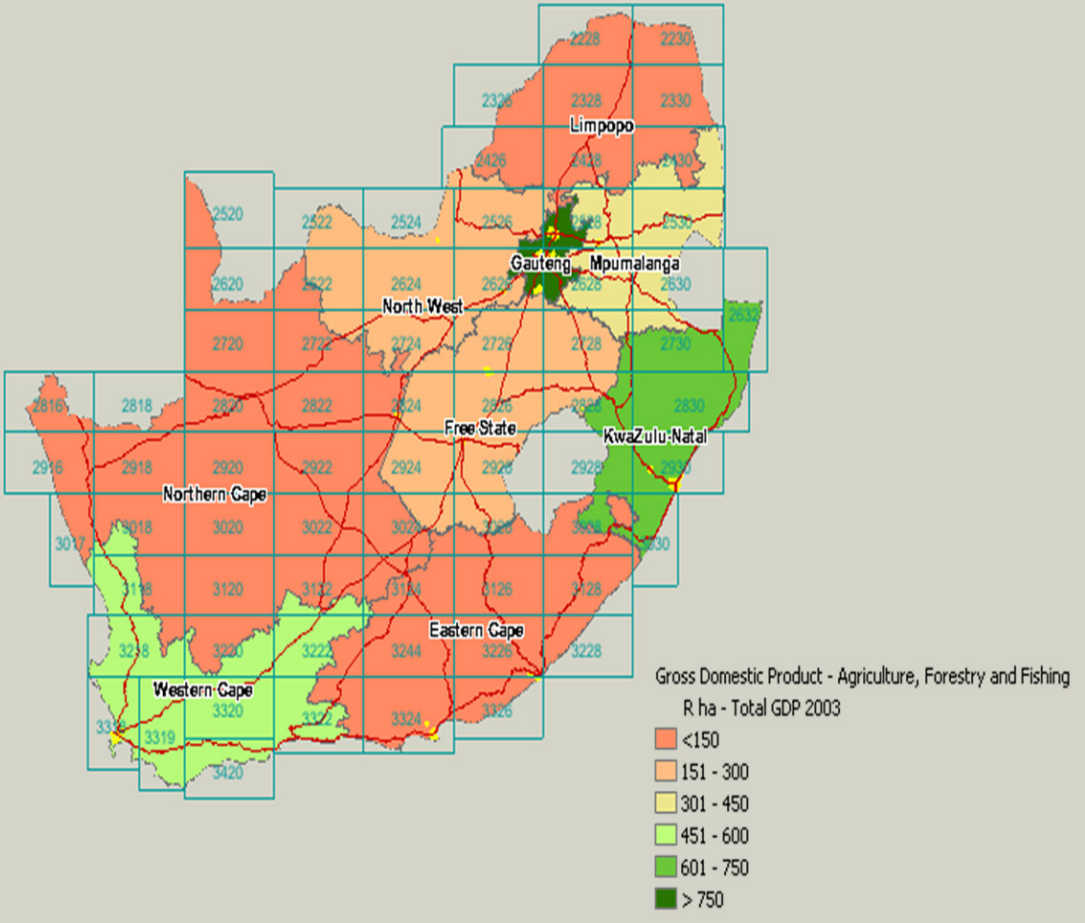

Limpopo
Gauteng
Mpumalanga
North West
Free State
KwaZulu-Natal
Northern Cape
Eastern Cape
Western Cape
Agricultural regions
Grains
Sugar
Forestry
Vegetables
Fruit
Cattle
Sheep
Diverse
Subsistence

APPENDIX E

Gross Domestic Product per hectare - South Africa

December 2009
Report No. 12465-9358-2

Golder Associates


Limpopo
Gauteng
Mpumalanga
North West
Free State
KwaZulu-Natal
Northern Cape
Eastern Cape
Western Cape
Gross Domestic Product - Agriculture, Forestry and Fishing
R ha - Total GDP 2003
<150
151 - 300
301 - 450
451 - 600
601 - 750
> 750

APPENDIX F

Mining data questionnaire completed by farmers within and adjacent to mining area – English and Afrikaans

December 2009
Report No. 12465-9358-2

Golder Associates

Farmer questionnaire

Exxaro Resources Limited is currently evaluating a potential coal reserve on a number of farms in the Belfast area of Mpumalanga. These farms are known as Leeuwbank, Zoekop and Blyvooruitzight and the site is situated roughly 10km south-west of the town of Belfast. Golder Associates Africa, in collaboration with Urban-Econ, has been tasked with conducting the sustainable development investigation into the proposed mining activities.

The sustainable development investigation forms an important component of Exxaro's evaluation process and will take into account the direct as well as broader impact of the proposed mining activities on the local and regional communities. Our approach is to use an input-output model to assess the direct, indirect and induced effects of the proposed activities relative to the status quo (extensive agriculture). A component to the development of an accurate and applicable model is data collection. The objective of this questionnaire is to gather the relevant information pertaining to current and future farming activities from farmers in the affected area. Your participation in this questionnaire is greatly appreciated.

Please answer the questions as accurately as possible. The Consultants are aware of the sensitive nature of the information and all information provided will be treated as strictly confidential.

Name: _____

Portion no: _____

1. What is the area (in hectares) of your property?

   _____

2. How many employees (permanent and casual) do you currently employ?

   _____

3. What monthly remuneration (wage) does each type of employee (permanent and casual) receive?

4. What types of crops do you produce? Please give area estimates for each crop.

5. What yields (per hectare) per crop type were achieved in the most recent season?

6. Please provide information on historical yields for each crop type. Have yields been declining or increasing in the past 5 years?

7. What types of livestock do you own? Please give number of livestock per type.

8. Where do you market your agricultural produce? Who is the market for this produce?

9. Where do you purchase your farm inputs (fertilizer, pestcides, seed, etc.)?

10. Please give an estimate of your annual expenditure on farm inputs, OR

11. Please give an estimate of your annual farm revenue.

12. What other business activities do you have on your farm?

13. Please give an estimate of the amount of capital required to develop your farm business from nothing to its current state.

14. Do you have any intention of developing the farm in the future? For example investing in new buildings and infrastructure, purchasing new equipment, diversifying into more enterprises etc.? Please give as much detail as possible and provide capital estimates for each development.

Thank you for your participation!

Landbou Vraelys

Exxaro Resources Limited evalueer die moontlike steenkool reserwes op 'n aantal plase in die Belfast area van Mpumalanga. Die plase is bekend as Leeuwbank, Zoekop en Blyvooruitzight. Golder Associates Africa, in samewerking met Urban-Econ, is aangestel om 'n handhaafbare ontwikkelings ondersoek te onderneem met betrekking tot die voorgestelde aktiwiteite.

Die handhaafbare ontwikkeling ondersoek vorm 'n belangrike komponent van Exxaro se evaluerings proses en sal die direkte, asook breër impakte, van die voorgestelde aktiwiteite op die plaaslike en streeks gemeenskappe in ag neem. Ons benadering is om 'n toevoer-afvoer model te gebruik om die direkte, indirekte en afgeleide effekte van die voorgestelde aktiwiteite relatief tot die *status quo* (uitgebreide landbou) te skat. 'n Belangrike komponent van die ontwikkeling van 'n akkurate en toepaslike model is data insameling. Die doel van hierdie vraelys is om die toepaslike inligting met betrekking tot die huidige en toekomstige aktiwiteite van boere in die geaffekteerde area te versamel. U deelname en verskaffing van akkurate inligting word hoog op prys gestel.

Die konsultante is bewus van die sensitiewe aard van die vrae en alle inligting wat voorsien word sal as streng vertroulik behandel word.

Naam: _____

Porsie no: _____

1. Wat is die oppervlakte (in hektaar) van u eiendom?

_____

2. Hoe veel werkers (permanent en tydelik) gebruik u ?

_____

3. Wat is die maandelikse vergoeding (loon) aan elke kategorie van werker (permanent en tydelik) ?

_____

4. Watter tipe gewasse plant u? Verskaf asseblief ongeveer hoeveel hektaar per gewas.

_____

5. Watter opbrengs (per hektaar) het u bereik in die mees onlangse seisoen?

6. Voorsien asseblief die historiese opbrengs vir elke gewas. Het opbrengste toegeneem of gedaal in die laaste 5 jaar?

7. Met watte tipe vee boer u (gee assesblief getalle van elke tipe)?

8. Waar word u agronomiese- en veeprodukte bemark?

9. Waar koop u u inset stowwe (misstof, saad, ens.)?

10. Gee asseblief 'n raming van u jaarlikse uitgawe op plaas insette, OF

11. Gee asseblief 'n raming van u jaarlikse plaas inkomste.

12. Watter ander besigheid aktiwiteite het u op u plaas?

13. Gee asseblief 'n raming van die totale kapitaal vereiste nodig om u plaas besigheid te ontwikkel van niks tot sy huidige toestand.

14. Het u enige planne om u plaas in die toekoms te ontwikkel? Byvoorbeeld, belê in nuwe geboue en infrastruktuur, aankoop van nuwe toerusting, ens. ? Gee asseblief soveel as moontlik inligting saam met die kapitale skatting vir die ontwikkeling.

Dankie vir u deelname!

APPENDIX G

Scenario 1 - detailed construction phase assumptions

December 2009
Report No. 12465-9358-2

Golder Associates

Input Data Required	Data available	Data Source/Assumption	Implications of disparities between assumptions and reality	Actual input
Construction Period	☑	Exxaro		3 years
Total Construction Expenditure	☑	Exxaro		R1.621 billion
Total Construction Employment	☑	Exxaro		555 employees
Total expenditure on intermediate inputs	☑	Exxaro	If expenditure on inputs is higher than R1126 million, and expenditure on labour decreases, whilst GOS remains unchanged, then, *ceteris paribus:* • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimates • Direct & induced GDP impacts will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Indirect labour impact will be higher than the model estimates • Induced labour impact will be lower than the model estimates • Direct & induced income impacts will be lower than the model estimates • Indirect income impact will be higher than the model estimates • And vice versa, if expenditure is lower If expenditure on inputs is higher than R1126million, and GOS is lower, whilst expenditure on labour remains unchanged, then: • Direct, indirect and induced production impacts will be higher than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect & induced GDP impacts will be higher than the model estimates • Indirect and induced employment impacts will be higher than the model estimates • Indirect & induced income impacts will be higher than the model estimates • And vice versa if expenditure is lower	R1,126 million
Expenditure on imported intermediate inputs	☒	Industry standard as per Exxaro's instructions	If expenditure on imported intermediate inputs is >0%, then, *ceteris paribus*: • Direct, indirect, & induced production impacts will be lower than the model estimates • Indirect & Induced GDP impacts will be lower than the model estimates • Indirect & induced employment impacts will be lower than the model estimates • Indirect & induced income impacts will be lower than the model estimates	R442million
Total expenditure on labour remuneration	☑	Exxaro	If average annual income per worker <R48 000, then, *ceteris paribus:* • Indirect production impact will be higher than the	R168 million

			model estimates • Induced production impact will be lower than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Induced GDP impact will be lower than the model estimates • Indirect employment impact will be higher than the model estimates • Induced employment impact will be lower than the model estimates • Indirect worker income will be higher than the model estimates • Induced worker income impact will be lower than the model estimates • And vice versa if average annual income per worker >R58000, ceteris paribus	
Gross Operating Surplus	☒	Industry standard GOS (Quantec, 2009)	If GOS is higher than industry standard, and expenditure on intermediate inputs is lower, then, *ceteris paribus*: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect and induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Indirect & induced worker income impacts will be lower than the model estimates • And vice versa if GOS is lower If GOS is higher than industry standard, and expenditure on labour is less, then, *ceteris paribus*: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than model estimates • Direct, indirect & induced income impacts will be lower than the model estimates • And vice versa if GOS is lower	R 327 million
Expenditure per intermediate input	☒	Exxaro approved data split by Urban-Econ (as per SAM)	Indeterminate, depends upon expenditure patterns.	

APPENDIX H

Scenario 1 - detailed construction phase assumptions for the re-establishment of agriculture

December 2009
Report No. 12465-9358-2

Golder Associates

Input Data Required	Data available	Data Source/Assumption	Implications of disparities between assumptions and reality	Actual input
Construction Period	☑	Urban-Econ assumption based on previous experience with similar projects		5 years
Total Construction Expenditure (per year)	☑	Survey data		R9.7 million
Total Construction Employment	☑	Survey data		202
Total expenditure on intermediate inputs	☒	Industry standard based on SAM	If expenditure on inputs is higher than R4.9 million, and expenditure on labour decreases, whilst GOS remains unchanged, then, ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimates • Direct & induced GDP impacts will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Indirect labour impact will be higher than the model estimates • Induced labour impact will be lower than the model estimates • Direct & induced income impacts will be lower than the model estimates • Indirect income impact will be higher than the model estimates • And vice versa, if expenditure is lower If expenditure on inputs is higher than R4.9 million, and GOS is lower, whilst expenditure on labour remains unchanged, then: • Direct, indirect and induced production impacts will be higher than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect & induced GDP impacts will be higher than the model estimates • Indirect and induced employment impacts will be higher than the model estimates • Indirect & induced income impacts will be higher than the model estimates • And vice versa if expenditure is lower	R 4.9 million
Expenditure on imported intermediate inputs	☒	Industry standard	If expenditure on imported intermediate inputs is >0%, then, ceteris paribus: • Direct, indirect, & induced production impacts will be lower than the model estimates • Indirect & Induced GDP impacts will be lower than the model estimates • Indirect & induced employment impacts will be lower than the model estimates • Indirect & induced income impacts will be lower than the model estimates	R382,000
Total expenditure on labour remuneration	☒	Industry standard	If average annual income per worker <R48 000, then,	R2.2 million

			ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Induced GDP impact will be lower than the model estimates • Indirect employment impact will be higher than the model estimates • Induced employment impact will be lower than the model estimates • Indirect worker income will be higher than the model estimates • Induced worker income impact will be lower than the model estimates • And vice versa if average annual income per worker >R58000, ceteris paribus	
Gross Operating Surplus	☒	Industry standard GOS (Quantec, 2009)	If GOS is higher than industry standard, and expenditure on intermediate inputs is lower, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect and induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Indirect & induced worker income impacts will be lower than the model estimates • And vice versa if GOS is lower If GOS is higher than industry standard, and expenditure on labour is less, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than model estimates • Direct, indirect & induced income impacts will be lower than the model estimates • And vice versa if GOS is lower	R 2.5 million
Expenditure per intermediate input	☒	As per SAM	Indeterminate, depends upon expenditure patterns.	

APPENDIX I

Scenario 1 - detailed operational phase assumptions

December 2009
Report No. 12465-9358-2

Golder Associates

Input Data Required	Data available	Data Source/Assumption	Implications of disparities between assumptions and reality	Actual input
Project life span	☑	Exxaro		38 years
Total annual Operational Expenditure	☑	Industry standard GOS added to Exxaro data		R1,427 million
Total annual Operational Employment	☑	Exxaro		105
Total annual expenditure on intermediate inputs	☑	Exxaro	If expenditure on inputs is higher than R1126 million, and expenditure on labour decreases, whilst GOS remains unchanged, then, ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimate • Direct & induced GDP impacts will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Indirect labour impact will be higher than the model estimates • Induced labour estimate will be lower than the model estimates • Direct & induced income impacts will be lower than the model estimates • Indirect income impact will be higher than the model estimates • And vice versa, if expenditure is lower If expenditure on inputs is higher than R1126 million, and GOS is lower, whilst expenditure on labour remains unchanged, then: • Direct, indirect and induced production impacts will be higher than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect & induced GDP impacts will be higher than the model estimates • Indirect and induced employment impacts will be higher than the model estimates • Indirect & induced income impacts will be higher than the model estimates • And vice versa if expenditure is lower	R1,126 million
Expenditure on imported intermediate inputs	☒	Industry standard as per Exxaro's instructions	If expenditure on imported intermediate goods is >0%, then, ceteris paribus: • Direct, indirect, & induced production impacts will be lower than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect & induced employment impacts will be lower than the model estimates • Indirect & induced income impacts will be lower than the model estimates	R 389 million
Total annual expenditure spent on labour remuneration	☑	Exxaro	If average annual income per worker <R139000, then, ceteris paribus:	R16 million

			• Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Induced GDP impact will be lower than the model estimates • Indirect employment will be higher than the model estimates • Induced employment impacts will be lower than the model estimates • Indirect worker income impacts will be higher than the model estimates • Induced worker income impacts will be lower than the model estimates • And vice versa if average annual income per worker >R139000, ceteris paribus	
Annual Gross Operating Surplus	☒	Industry standard GOS (Quantec, 2009)	If GOS is higher than industry standard, and expenditure on intermediate inputs is lower, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect and induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Indirect & induced worker income impacts will be lower than the model estimates • And vice versa if GOS is lower If GOS is higher than industry standard, and expenditure on labour is less, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Direct, indirect & induced income impacts will be lower than the model estimates	R285 million
Annual Expenditure per intermediate input	☒	As per SAM	Indeterminate, depends upon expenditure patterns.	

APPENDIX J

Scenario 1 – detailed decommissioning, rehabilitation and closure assumptions

December 2009
Report No. 12465-9358-2

Golder Associates

Input Data Required	Data available	Data Source/Assumption	Implications of disparities between assumptions and reality	Actual input
Project life span	☑	Golder Associates		1 year
Total annual Operational Expenditure	☑	Golder Associates		R289 million
Total annual Operational Employment	☑	Golder Associates		825
Total annual expenditure on intermediate inputs	☒	Residual (total expenditure less expenditure on labour and GOS)	If expenditure on inputs is higher than R190 million, and expenditure on labour decreases, whilst GOS remains unchanged, then, ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimate • Direct & induced GDP impacts will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Indirect labour impact will be higher than the model estimates • Induced labour estimate will be lower than the model estimates • Direct & induced income impacts will be lower than the model estimates • Indirect income impact will be higher than the model estimates • And vice versa, if expenditure is lower If expenditure on inputs is higher than R190 million, and GOS is lower, whilst expenditure on labour remains unchanged, then: • Direct, indirect and induced production impacts will be higher than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect & induced GDP impacts will be higher than the model estimates • Indirect and induced employment impacts will be higher than the model estimates • Indirect & induced income impacts will be higher than the model estimates • And vice versa if expenditure is lower	R190 million
Expenditure on imported intermediate inputs	☒	0%	If expenditure on imported intermediate goods is >0%, then, ceteris paribus: • Direct, indirect, & induced production impacts will be lower than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect & induced employment impacts will be lower than the model estimates • Indirect & induced income impacts will be lower than the model estimates	0%

Total annual expenditure spent on labour remuneration	☒	Based on Industry standards (Quantec, 2009)	If average annual income per worker <industry standard, then, ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Induced GDP impact will be lower than the model estimates • Indirect employment will be higher than the model estimates • Induced employment impacts will be lower than the model estimates • Indirect worker income impacts will be higher than the model estimates • Induced worker income impacts will be lower than the model estimates • And vice versa if average annual income per worker >Industry standard, ceteris paribus	R59 million
Annual Gross Operating Surplus	☒	Industry standard (Quantec, 2009)	If GOS is > industry standard, and expenditure on intermediate inputs is lower, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect and induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Indirect & induced worker income impacts will be lower than the model estimates • And vice versa if GOS is lower If GOS is > industry standard, and expenditure on labour is less, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Direct, indirect & induced income impacts will be lower than the model estimates	R22 million
Annual Expenditure per intermediate input	☒	As per SAM	Indeterminate, depends upon expenditure patterns.	

APPENDIX K

Scenario 2 – detailed operational phase assumptions

December 2009
Report No. 12465-9358-2

Golder Associates

Input Data Required	Data available	Data Source/Assumption	Implications of disparities between assumptions and reality	Actual input
Total annual Operational Expenditure	☑	Survey data with assumptions regarding GOS		R16 million
Total annual Operational Employment	☑	Survey data		135
Total annual expenditure on intermediate inputs	☑	Survey data	If expenditure on inputs is higher than R10.3 million, and expenditure on labour decreases, whilst GOS remains unchanged, then, ceteris paribus: • Indirect production impact will be higher than the model estimates • Induced production impact will be lower than the model estimate • Direct & induced GDP impacts will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Indirect labour impact will be higher than the model estimates • Induced labour estimate will be lower than the model estimates • Direct & induced income impacts will be lower than the model estimates • Indirect income impact will be higher than the model estimates • And vice versa, if expenditure is lower If expenditure on inputs is higher than R10.3 million, and GOS is lower, whilst expenditure on labour remains unchanged, then: • Direct, indirect and induced production impacts will be higher than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect & induced GDP impacts will be higher than the model estimates • Indirect and induced employment impacts will be higher than the model estimates • Indirect & induced income impacts will be higher than the model estimates • And vice versa if expenditure is lower	R10.3 million
Expenditure on imported intermediate inputs	☒	Industry standard	If expenditure on imported intermediate goods is >0%, then, ceteris paribus: • Direct, indirect, & induced production impacts will be lower than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect & induced employment impacts will be lower than the model estimates • Indirect & induced income impacts will be lower than the model estimates	R1.6 million
Total annual expenditure spent on labour remuneration	☑	Survey data	If average annual income per worker <R139000, then, ceteris paribus: • Indirect production impact will be higher than the model estimates	R2.3 million

			• Induced production impact will be lower than the model estimates • Direct GDP impact will be lower than the model estimates • Indirect GDP impact will be higher than the model estimates • Induced GDP impact will be lower than the model estimates • Indirect employment will be higher than the model estimates • Induced employment impacts will be lower than the model estimates • Indirect worker income impacts will be higher than the model estimates • Induced worker income impacts will be lower than the model estimates • And vice versa if average annual income per worker >R139000, ceteris paribus	
Annual Gross Operating Surplus	☒	Industry standard GOS (Quantec, 2009)	If GOS is higher than industry standard, and expenditure on intermediate inputs is lower, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect and induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Indirect & induced worker income impacts will be lower than the model estimates • And vice versa if GOS is lower If GOS is higher than industry standard, and expenditure on labour is less, then, ceteris paribus: • Direct, indirect & induced production impacts will be lower than the model estimates • Direct GDP impact will be higher than the model estimates • Indirect & induced GDP impacts will be lower than the model estimates • Indirect and induced employment impacts will be lower than the model estimates • Direct, indirect & induced income impacts will be lower than the model estimates	R3.3 million
Annual Expenditure per intermediate input	☒	As per SAM	Indeterminate, depends upon expenditure patterns.	

APPENDIX L

Wetland ecosystem services supplied, their quality and dependence

December 2009
Report No. 12465-9358-2

Golder Associates

SYSTEM SERVICES	ON-SITE FARM SERVICES SUPPLY			OFFSITE / DOWNSTREAM DEMAND FOR SERVICES	
	Quality of service **-3 to +3**	Dependence on service **0 to +3**		Quality of service **-3 to +3**	Dependence on service **0 to +3**
Regulatory services					
Global climate management	3	3		2	1
Soil stability	3	3		3	3
Soil formation and fertility	2	3		2	2
Water supply regulation	3	3		3	3
Water distribution	2	3		3	3
Waste assimilation	3	3		3	3
Groundwater recharge	3	3		3	2
Flood attenuation	3	3		3	3
Disease control	2	3		3	3
Pollination	2	3		3	3
Pest control	2	3		3	2
Fire damage control	2	3		2	1
Goods					
Water supply	2	3		3	3
Fibres	3	2		0	1
Fodder supply	3	3		1	1
Refugia or nursery for biodiversity	3	2		3	2
Seed dispersal	2	3		3	2
Supporting services					
Tourism	2	2		1	1
Irrigation agriculture - vegetables, fruit crops, maize	3	3		2	2
Rainfed crops - maize	3	3		2	2
Stock farming	3	3		1	1
Birding	2	1		1	1
Hunting	2	1		0	0
Mountain biking	2	1		0	0
Walking	2	1		0	0
Cultural and spiritual services					
Natural heritage	2	3		2	3
Cultural places	3	3		2	3
Bench marks in a changing environment	3	1		2	3
Marketing icons	2	1		1	2

At Golder Associates we strive to be the most respected global group of companies specialising in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organisational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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