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Wandoan Coal Project

<u>Supplementary EIS</u> – Economic Evaluation for Agriculture under Mining Lease

(Sourced: Xtrata EIS)

June 2009

Prepared For

Xstrata Coal Queensland

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Table of Contents

List of Tables

Executive Summary

Large coal mining operations such as the one proposed for the Wandoan district by the Wandoan Joint Venture (WJV) will impede the current grazing operations that are presently operating in the area. As part of a supplementary Environmental Impact Statement (EIS), Brennan Mayne Agribusiness (BM Ag) has been commissioned to analyse and project the specific loss in value of grazing production that will occur, both now and into the future, if the mine is developed.

Grazing production is a resilient and dynamic natural system, which can produce forage for ruminant animals in a range of climates, soil types, topography and management systems. Pasture systems are far less sensitive to a number of variables than other agricultural production systems such as dryland cropping or irrigated cropping.

From a mining perspective it's far easier to rehabilitate mined land back to a similar grazing system than it is for a cropping system. This has been shown by the limited research done to date on assessing the quality of rehabilitated mining sites back to their original grazing systems in Central Queensland. It is this research that provides most of the defining assumptions on which this report is based.

BM Ag has made an assessment of information contained in the current EIS and additional information presented in the Supplementary EIS. BM Ag has then made an analysis of the impact on grazing productivity by mining operations during the life of the mine and after mining operations have been completed.

This analysis has shown that the mining operations will potentially reduce grazing productivity, on an annual basis, by about 40% per annum during the life of the mine and 11% per annum after mining operations have ceased and rehabilitation has been completed. This amounts to (in today's $'s) a loss in gross value of around $2 Million per year during the life of the mine and an annual loss of $515,024 per year over the Mining Lease Application (MLA) areas after mining and rehabilitation is completed.

The main reduction in productivity is due to about 10.6% of the area being unable to be rehabilitated back to its original grazing capacity after mining for various reasons.

A loss in productive capacity has an impact in terms of the contribution that these grazing enterprises make to the surrounding community. These losses have been modeled in a separate supplementary document that has been authored by Parsons Brinckerhoff (PB).

1 Introduction

BM Ag has been commissioned by Xstrata Coal Queensland (XCQ), on behalf of the WJV, to evaluate the grazing production capacity of the area covered by the mining leases in the Wandoan Coal Project. This information is to be included as part of a supplementary report to be included in the EIS.

This evaluation covers three scenarios:

- Scenario 1: Agricultural production without the mine
- Scenario 2: Agricultural production with the mine, without decommissioning
- Scenario 3: Agricultural production with the mine, with decommissioning

Essentially this report is an economic assessment, which means putting a dollar value on the productivity of the resources. As with all economic assessments there is an underlying physical basis to the figures generated. Particularly with agriculture and the many variables that are involved with this production system, a number of assumptions must be made in relation to the key variables that influence physical production. A large section of this report has been devoted to clearly outlining the assumptions made in relation to the physical resources involved. It is important that these assumptions are read and clearly understood before the calculations that underpin this assessment are reviewed.

The parameters of this report have been defined by XCQ and BM Ag. Those parameters are listed below.

- This assessment will be based on the current land use being beef cattle production.
- This assessment will be based on the land being returned to a beef cattle grazing system after mining is completed.
- **No assessment** has been made regarding the potential of dryland cropping on this MLA.
- This report makes **no recommendation** about what is the highest value or best use of this land in relation to agricultural production.
- This report will seek to make an assessment of the total value of beef production from the MLA before, during and after the mining operations of WJV.
- This report will determine the total value of grazing production in gross income terms, i.e. total turnover. A separate report drafted by PB will examine the total economic contribution (operating and capital expenditure) of the grazing entities in the MLA at a regional, state and national level.
- This report does not make any direct comparisons between the value of coal mining production and the value of grazing production for the MLA.

2 Existing Information

The data for this report has been drawn from a wide area. Essential information such as final landforms and mine plans have been drawn from the EIS and information prepared for the Supplementary EIS. Information on the rehabilitation of grazing land has been drawn from papers published by the Centre for Mined Land Rehabilitation (CMLR) at the University of Queensland (UQ). Industry production information and land capacity information has been taken from various Queensland Department of Primary Industries and Fisheries (QDPI&F) publications including the Stocktake (a land management and monitoring package). Soils data and background information has been taken from Commonwealth Scientific & Industrial Research Organization (CSIRO) Land Research Series (Speck et al, 1968) and Department of Natural Resources (DNR) Land Resources Field Manual (Thwaites and Maher, 1993).

Statistical information has been drawn from publications by Meat and Livestock Australia as well as the Australian Bureau of Agricultural and Resource Economics (ABARE). Further information has also been drawn from the Australian Bureau of Statistics (ABS).

BM Ag has drawn on the experience of its Consultants in assessing all the information within this report. These Consultants have many years experience in the financing of rural businesses and assessing the viability of agricultural based operations. BM Ag also has a number of external contractors that the business calls on to supply specialist services in relation to GIS mapping and landscape evaluation.

3 Methodology

As mentioned earlier in the report, this evaluation has three Scenarios:

- without mining
- with mining but without decommissioning
- with mining but with decommissioning

Scenario 1 basically projects forward current grazing production levels on unmined land over a 36 year period. The 36 year period is purely to assist with comparative calculations in the following scenarios.

Scenario 2 requires an assessment of grazing production during the mine activity and presumes that the mine will continue beyond 30 years. In this scenario, the 36 year period (referred to in Scenario 1) is premised on allowing 6 years beyond 30 years, comprising 4 years to rehabilitate areas available for rehabilitation, plus 2 years (years 34 – 36) of static production to assist with comparative calculations.

Scenario 3 presumes that the mine will cease at Year 30, final landform is completed by Year 32 and then rehabilitated areas are completed by Year 36.

The crucial parts to this methodology are being able to ascertain grazing productivity/economic value on unmined land as it is now (Scenario 1), and grazing productivity/economic value on rehabilitated land and non-mined areas (Scenarios 2 and 3).

3.1 Stocktake

The QDPI's Stocktake system was used to assess the land condition, long-term carrying capacity and calculate short term forage budgets. The Stocktake program is a practical means of assessing a landscapes ability to utilise rainfall and convert that moisture into useable dry matter. These assessments can be converted into kilograms of dry matter of available pasture for animal production on a yearly basis. These numbers can then predict the number of stock that can be run on the pasture. Using industry established performance data, this information can then be converted to kilograms of beef produced per hectare and hence, total income per hectare.

This system of evaluation takes into account the current management practices being applied to the land.

3.2 Assessment of Production Levels

Current production has been evaluated under the framework of the QDPI & F Stocktake system across all properties in the MLA areas. This was done by visual assessments in the field to ascertain land type and land condition.

Land **<u>Condition</u>** has four basic rankings A, B, C and D and is assessed as the capacity of land to respond to rain and produce useful pasture and a measure of how well the grazing land ecosystem is working. A brief description of the 'ABCD' framework is given below:

- Land Condition 'A' (Healthy):
  - Good cover of 3P grasses
  - Little bare ground (<30%)
  - Few weeds
  - Good soil condition: no erosion, good surface condition
  - No sign of timber thickening

  'A' condition pasture growth is 100%

- Land Condition 'B' (Not so healthy):
  - Some decline of 3P grasses
  - Increase of less favoured grasses and weeds
  - Bare ground (>30% but <60%)
  - Some decline in soil condition: some signs of previous erosion and/or susceptible to erosion
  - Some thickening in density of woody plants

  'B' condition pasture growth is 75%

- Land Condition 'C' (Sick):
  - General decline of 3P grasses
  - Large amounts of less favoured species
  - Bare ground (>60%)
  - Obvious signs of past erosion and/or highly susceptible
  - General thickening in density of woody plants

  'C' condition pasture growth is 55%

- Land Condition 'D' (Very Sick):
  - General lack of any perennial grasses
  - Severe erosion / scalding / topsoil loss
  - Hostile environment for plant growth
  - Thickets of woody plants

  'D' condition pasture growth is 25% or less

"Land **Type** is a unique parcel of land distinguishable by characteristic landform, soil and vegetation. Different land types, due to their inherent soil fertility, depth, structure and vegetation differences have a different capacity to grow grass. Land condition is assessed at a land type scale..." (Stocktake, Balancing supply and demand)

3.2.1 General Assumptions

Land Class versus Land Condition

The EIS has used the Land Suitability Classification system originally set up by the Department of Mines and Energy. By definition "these rankings apply to the capacity of the land resources to sustain particular forms of land use such as arable farming..." or grazing production (EPA website, Land suitability Assessment Techniques, 1995). Alternatively the Stocktake assessment package describes "grazing land condition is the capacity of grazing land to produce useful forage…a measure of how well the grazing ecosystem is functioning".

Essentially the land suitability classification gives a ranking that is a combination of land type and land condition based on an objective assessment of the characterisation of the resources such as soil (both physical and chemical), topography, micro relief, salinity etc. and whether these resources fit a certain criteria that would be associated with farming or grazing or even forestry.

The Stocktake package separates land type and condition and for each land type and it ranks the land condition which is essentially an assessment of the landscapes ability to produce forage.

The Stocktake package is specifically used for grazing systems where the land suitability classification system is a broader tool that can be applied to any set of agricultural resources. The reason for using a specific grazing package is that it can give a more defined answer in terms of grazing production which can then be related to a financial calculation.

In terms of the end result within specific Land Types, the differences between grazing classes 1 to 4 and Land Condition A to D are negligible and therefore a correlation can be made between the two systems to ensure consistency in the assessment in relation to the EIS.

3.2.2 Current Production Levels

Assessment of the current production levels comprised:

- field visits to assess current land condition
- review of satellite images of the area (J.Chamberlain pers comm, 2008).
- review of soil type data: (CSIRO, Land Research Series No 21; QDPI, Wandoan Soil Conservation District, Land Resource Areas; CSIRO, Dawson-Fitzroy Area: Land Systems, Soil, Vegetation and Pasture Lands).

3.2.3 Land quality

It has been assumed that the current grazing operations are a sustainable land use for this area and there is no foreseeable reason why grazing production will not continue into the future.

Another assumption made is that climate change impact in relation to grazing production will not have any substantial effect as it is extremely difficult to predict long term climate impacts. A conservative pasture utilisation level has been used for the calculations which take into account that at least 20% of years will be dryer than normal.

3.2.4 Produce value

Market trends for red meat are difficult to predict. For the purpose of this report an assumption about the price per kilogram of beef has to be made. An average price has been used based on the average price paid over the last five years for an adult male animal of between 400 to 500 kg (ABARE, 2008). A sensitivity analysis has been done on the final calculations to give a range of possible outcomes in relation to price per kilogram.

3.2.5 Technological advances

It can be argued that in the past, technology changes have increased the productivity in the beef industry and therefore ongoing productivity increases should be accounted for in any projected economic evaluations. ABARE (2008) suggests that in the period from 1977 to 2006 the average annual total factor of productivity growth in the beef industry across the nation has been 1.4%.

However it should be highlighted that most of the improvements in beef production made over the last 20 years has been in relation to breeding efficiency, feedlot production, meat processing and marketing. Over the last five years total annual production of beef in Australia has fluctuated between 2 – 2.2 million tons (Aust. Bureau Statistics, 2008) with the major contributing factor to the variability being drought. Cattle numbers peaked at a record of 29.8 million head in 1975 and have never reached that number since, (Aust. Bureau Statistics, 2005) despite the increased capacity of the feedlot sector.

Carrying capacity and performance of cattle on pasture systems is continually evolving (eg establishment of lucaena and legumes,) but has not changed significantly since the introduction of Hormone Growth Promotants (HGP's) in the early 1980's and the spread of Buffel grass in the mid 1950's to the early 1970's. The current research focus for productivity gains in the beef industry are based on increasing reproductive rates, decreasing mortality rates and reducing the cost of production (MLA, 2006). These factors may not impact significantly on the grazing system at Wandoan as it is mainly a fattening area on already highly developed improved pastures, and this assessment is only based on gross income calculations.

One potential area for an increase in productivity over time is the inclusion of legumes like Leucaena into the current pasture system. There is evidence to suggest (Cook, 2000) that the introduction of Leucaena into the pasture system has the ability to increase carrying capacity by 35-45% and improve weight gain by 15% on a yearly average in relation to a normal Buffel grass system (Lambert, 1996). Leucaena has been around for 20 years or more and does require a certain amount of expertise and expense to develop. Current leucaena development is minimal in the MLA area which would suggest that there are management and/or financial issues preventing further development in the Wandoan area.

Any future pasture/legume development in the area will create production increases however these increases could well be offset by the rundown of buffel grass pastures that tends to occur after a long period of establishment without any legume addition (Cook, 2000). It is for these reasons that productivity improvements based on legume introduction are difficult to predict. In order to put some perspective on this, a sensitivity analysis has been done on current production with price and weight gain used as the key parameters.

The base level weight gain that has been used for the initial calculations is 0.65 kg/head/day. This number is essentially an average based on a range of reported performance data (0.45 to 0.75) from trials within the area (Taylor K, pers comm. March 2009). This is also a good mid range figure from other published data for Central Queensland areas (Cook, 2000) (Hasker, 2000).

3.2.6 Future Production on Unmined land

For the projected calculations, results are stated in today's dollar terms rather than being indexed to inflation. As this report is about the relative value of produce generated by the land under the MLA area, the relative value of the income generated in today's terms will be similar 30 years into the future if prices for beef keep pace with inflation.

Although agriculture has experienced diminishing rates of return in the past, the state of food security around the world is starting to change. With beef being a major protein source in people's diets, it is assumed that the price of beef will keep pace with inflation, thus the real value of production will not diminish.

3.2.7 Future Production on Rehabilitated Grazing Land

An extensive review of grazing trials conducted on rehabilitated land in summer rainfall dominated regions was carried out as detailed in section 6 Potential Impacts, 6.1.1 Background Information. Most of this information came from projects in Central Queensland (CQ) that were funded by the Australian Coal Association Research Program (ACARP) conducted by scientists from UQ, CMLR. The data from these projects came from trials that have similar pasture systems to the Wandoan project.

The information from the ACARP review was used to make some assumptions about pasture production on rehabilitated land in terms of carrying capacity and weight gain performance. This review also gave a frame work for the assessment of the land quality (Land class) after rehabilitation and hence its productive capacity in comparison to the productive capacity of unmined land. These assessments are then related to current production levels on a proportional basis to ascertain a total gross income per hectare in relation to each land classification after rehabilitation has been completed.

3.3 Assessment of the Impacts

3.3.1 Scenario 1 – Agricultural Production without the Mine

The total area within the MDL has been assessed as being available for beef cattle grazing production as a sustainable grazing system. The assessment assumes that there is no dryland or irrigated cropping systems within the MDL for current or future projections.

3.3.2 Scenario 2 - Agricultural Production with the Mine, without decommissioning

After the grazing productivity of mined and unmined land has been ascertained in relation to the relevant land classes then these calculations need to be applied to the various areas of country that fall into each land classification. Over the life of the mine (30 years) these areas will be constantly changing as new pits are opened up and old pits are closed. The mine plan at Year 5, 10, 20 and 30 has been used to calculate the areas and classes of land available for grazing. It has been assumed that the land to be rehabilitated will take four years before it will reach its maximum grazing production as detailed in Implications for the Wandoan Project section 3.4.1. This time lag between full grazing and rehabilitation will be allowed for in the assessment. There is also an additional 2 years of static grazing production added to assist with comparative calculations, ie years 30-34 rehabilitation , years 34-36 static production.

3.3.3 Scenario 3 - Agricultural Production with the Mine, with decommissioning

The mine plans also show the final landforms of the mining lease once mining has been completed. These final landforms will impact on the classification of grazing land and therefore its productivity. The final landforms give a break up of the areas in each land classification after mining. The projected income per ha for each land classification can then be calculated as previously discussed.

3.4 Limitations

The underlying capacity of all grazing operations is defined by its long term stocking rate and average animal performance. These numbers are crucial to the evaluation of agricultural production in terms of putting a total dollar value on the output of this production. It is these parameters that have not been fully investigated in the long term by any rehabilitated trials to date. Thus judgment and comment on long term sustainability and animal performance can only be an assumption.

Current grazing capacity on the land at Wandoan under the MLA has been ascertained by measurements taken during field visits and this grazing capacity will continue on land within the leases which is not directly affected by the physical mining operation. The grazing capacity of these mining leases after the mining operations cease and rehabilitation has been completed, is largely a forecast which is reliant on a number of assumptions being made.

Limitations to the findings of this report are that the majority of the information was sourced from previous studies undertaken by various organisations over periods of time. Eg. the land systems mapping was completed in 1968 and primarily used a landscape methodology to determine soil structure and type at various elevations within the landscape itself. Some ground truthing of this information was carried out which appeared to be accurate, however most of the data used was via a desktop analysis. Future market, production and climatic factors are difficult to predict therefore assumptions have been based on current conditions (unless otherwise stated), eg average price and daily weight gain.

3.4.1 Implications for the Wandoan Project

Based on the researched outcomes of the ACARP Project C9038 presented in this report and the similarities that exist between the Wandoan site and the sites of the grazing evaluations, the following conclusions have been made.

1. In areas that are unaffected by the physical mining operations within the lease boundaries, grazing production will be the same as it is currently (Class 2 grazing/Land Condition B).

2. In areas of rehabilitation where slope can be kept under 10% and quality topsoil can be laid down at a depth of at least 20cm, it would be anticipated that after an establishment phase, the grazing pastures would again have similar production and carrying capacity to the original pasture system (continue as Class 2/Land Condition B).

3. The establishment phase for improved pastures can vary depending on prevailing conditions. Specific data for the establishment phase is difficult to obtain, however common agronomic techniques would suggest the following criteria (Lambert and Graham, 1996).

- Delay first grazing until after first seed set and established secondary root development has established a crown. (8-12months, no grazing). Assuming germination and emergence of seedlings is successful (QDPI website, http://www2.dpi.qld.gov.au/pastures/4140.html#5, 2008).

- Light grazing to remove top growth and stimulate root system, with spelling over wet season creates better seed set (Williams, 2004). (12–24 months, light grazing)

- Increase grazing pressure slowly over next two years until full carrying capacity is reached. Wet season spelling still recommended (24-48 months, medium grazing)

In order to put some production numbers on the above framework for rehabilitated pastures, the following is suggested.

- 0-12 months = zero carrying capacity
- 12-24 months = 25% of district average carrying capacity
- 24-48 months = 50% of district average carrying capacity
- >48 months = 100% of district average carrying capacity

4. In areas of rehabilitation where critical factors such as slope is above 10% or ESP is above 10% in the surface profile of the soil, long term grazing production will be compromised and lower stocking rates will need to be used (Class 3 grazing/Condition B or C). Data from the grazing trials examined would suggest that at least a 25% decrease in grazing pressure would not be unrealistic depending on how severe the restrictions are on the Rainfall Utilisation Efficiency (RUE) of the final landform (Grigg etal, 2006). Therefore it is anticipated that for the purpose of the calculations made in this report, Class 3 grazing country will have a 25% reduced carrying capacity compared to Class 2.
   RUE relates to the ability of the landscape to trap and store moisture for pasture growth. This term is commonly quoted as kilogram of dry matter produced per hectare per mm of rainfall (kg/ha/mm).

5. Data from the ACARP report suggests that average daily gain is not necessarily affected by stocking rate, unless severe pasture rundown has occurred (reduction in 3P or perennial, palatable and productive grasses). If grazing utilisation rates can be kept at 30% in 80% of years then average daily gain of the animals will be the same as is currently being produced. Therefore for the purpose of this report average daily gains will be the same for Class 2 and Class 3 grazing country.

6. It is anticipated that most of the rehabilitated country will fall within class 2 or class 4 grazing; therefore most of the calculations in this report will be based on these two classes of grazing productivity. There will be a small proportion of country that will have limited grazing potential associated with the final voids left at the end of each mining strip.

3.4.2 Reclassification of Rehabilitated Areas

Although 75% of the mined area will be on Land type A (Brigalow Upland Non Cracking Clays), as explained below, we have classed this country, after rehabilitation, back into a Land type B (Brigalow Upland Cracking Clays) for the benefit of our calculations matrix.

The main reason for this is that Land type A has been assessed as our most productive land type with a potential carrying capacity of 2.1 ha/head in a 'B' condition. Land type B has a carrying capacity of 2.8 ha/head in a 'B' condition. The rehabilitated country will have a mixed profile that will not match any of the current soil types; however the majority of the topsoil and subsoil that are understood to be used in the rehabilitation process will have been stripped from Brigalow Upland Non Cracking clays. This will ensure that the rehabilitated areas have a soil profile that will be conducive to high/medium quality pasture growth.

Construction of the rehabilitation areas will be guided by the broad physical and chemical targets, set out in chapter 9 (Table 9-9) of the EIS, for the new soil profile. This will ensure that the quality of the soil will be better than the lower quality soil types currently existing in the MLA area such as soil types C and D (Poplar Box Alluvia Uniform soils and Poplar Box Texture Contrast soils).

Current scientific trial data from other mine rehabilitation sites supports the premise that rehabilitated land can have the same production level as unmined land when all critical elements are met. However we only have data that goes to a maximum level of 2.8 to 3ha/head. Land type 'A' has a grazing production level that is considerably more (2.1ha/head). For this reason BM Ag has decided to err on the side of caution and set the production level for the class 2 rehabilitated country as similar to that of Land type 'B' in a B condition (2.8 ha/head).

4 Existing environment

It was found that in most cases the land condition was a 'B' category. For the purpose of this assessment it has been assumed that land condition in these grazing areas will maintain a land condition of 'B' going forward across all land types (see section 6 – Potential Impacts). This will simplify the calculations as land condition is often a symptom of management and management standards are difficult to predict given changing ownership, generational change and future technology.

Currently all the land within the mining lease for the Wandoan project is categorized as class two grazing country (refer to Xstrata Coal, 2008 EIS Vol 1, Book 5 Technical Reports-Attachment C for Land Classification details).

The MLA areas fall into four main Land types. The approximate areas of each land type are shown below:

Table 1 Land Types in Wandoan Mining Lease Application (MLA) Area

Land Type Classification	Description	Area (Ha)	Proportion of MLA (%)
A	Brigalow upland non-cracking clays	12,691	39
B	Brigalow upland cracking clays	13,007	40
C	Poplar box alluvia uniform soil	4,136	13
D	Poplar box alluvia texture contrast soil	2,348	8
Totals		32,182	100

Each one of these land types has been assessed in relation to its grazing capacity. Appendix F indicates the Wandoan land types within the MDL.

A summary of these assessments has been included into Table 6.

Photo 1. Example of Poplar Box Alluvia Uniform Soil

(Sourced: Xstrat a EIS)

Photo 2. Example of Brigalow Non-Cracking Clay Soils

(Sourced: Xstrata EIS)

Photo 3. Example of Brigalow Cracking Clay Soils

(Sourced: Xtrata EIS)

Photo 4. Example of Poplar Box on Texture Contrast Soils

5 Description of proposed development

5.1 Mining Activities

The Wandoan Coal Project involves the development of a series of coal mine pits over an expected lifespan of 30 years. Mining will occur by strip mining. Overburden will generally be removed by dragline, although some truck and shovel removal may occur. Coal will be removed by truck and shovel.

Mining and development of pits will occur progressively over the life of the mine. Prior to mining each pit, vegetation will be cleared, and topsoil and subsoil will be stripped and stockpiled for use in future rehabilitation and revegetation.

Typically a single final void will remain after completion of mining for each pit, with the exception of Austinvale North, Austinvale, Leichhardt, Woleebee North and Woleebee pits, which are to be used for tailings disposal, and therefore no final voids will remain in the final landform for these pits. The tailings will be disposed of in-pit, and covered with approximately 20 m of overburden.

Final voids will be formed by reducing the outer/boxcut slopes and adjacent overburden stockpiles to up to 1(v):7(h), or 14.2% gradient to infill the void, bringing the pit floor up towards natural topographical surface. Depths of final voids will vary with the volume of material available at each pit for infilling. The upper surface of overburden stockpiles will be levelled out and shaped to provide a gently undulating landform.

Rehabilitation and revegetation of the landform is anticipated to commence within two years following a pit strip being mined. During rehabilitation, soil profiles will be created from the application of subsoil and topsoil, based on soil properties and stripping depth recommendations provided in Table 9-9 of the EIS, with approximately 0.2 m of topsoil and 0.5 m of subsoil, subject to refinement based on trials conducted in early mining operations. Selection of topsoil and subsoil will be based on suitable properties and depth for rehabilitation/long term soil success, and will not be a recreation of the pre-existing soil profiles (eg. a Cheshire soil profile will not be recreated).

5.2 Mine Planning

Mapping of the final landforms provides an indication of the number of hectares that will be affected by slope, topsoiling restrictions and/or topography limitations. These areas will have reduced productivity (carrying capacity) for reasons stated in the previous section.

These landform maps have been drawn up by the WJV and its consultants, and their assumptions of final landforms will be used for this economic assessment. (Refer to Landform and land suitability maps Appendix A-E).

5.2.1 Land Availability around Mining Operations

PB has used a number of criteria to calculate the operational areas during the life of the mine. These calculations have been done at 5, 10, 20 and 30 year stages of the mining operation. The criteria used are as follows.

1. Buffer areas around active mining and infrastructure have been included in the land that is unavailable for mining. A one kilometre buffer around active mining faces, a 100m buffer around haul roads, mine access roads, rail spur, conveyors, levee's, in-pit dumps, creek diversions and other mine infrastructure.

2. Rehabilitated land is only considered to be included into grazing areas once a minimum block of 200 ha is completed. Less than 200 ha are excluded due to the practical and logistical parameters which would exist in providing infrastructure to these areas. Also the capital investment required for such an area may render it uneconomical to develop.

3. Grazing land that is isolated or caught between neighbouring mine infrastructure areas (mining pits) will be considered unavailable for grazing.

5.2.2 Scenario 1 - Agricultural Production without the Mine

There are no mining implications on grazing production calculated throughout this scenario. It projects current land condition and soil type production in a grazing production economic value and projects this over a 36 year period.

5.2.3 Scenario 2 - Agricultural Production with the Mine, without decommissioning

Assesses the agricultural production impacts from the Wandoan Coal Project based on the assumption that mining will continue beyond Year 30. There is the potential for mining to continue beyond the proposed approval period of 30 years, subject to a new, future, environmental impact assessment and government approval. In this scenario pits and infrastructure present in Year 30 will not be rehabilitated or decommissioned, as mining of these pits would continue beyond Year 30 under a new approval. As future mining schedules are not known or approved, and are not subject to this approval, they have not been assessed under Scenario 2. However areas that are available to be rehabilitated in Year 30 will be assessed up to Year 34. An additional 2 years will see this area assessed over a 36 year period for reasons which have been described previously.

5.2.4 Scenario 3 - Agricultural Production with the Mine, with decommissioning

Assesses the agricultural production impacts from the Wandoan Coal Project based on the assumption that mining does not continue beyond Year 30. In this scenario pits present in the landform at Year 30 will be rehabilitated to a stable landform and infrastructure decommissioned and removed after completion of mining in Year 30. A final landform representing how the landscape would be rehabilitated if mining does not continue past Year 30 is presented in Appendix D and can be taken as approximately Year 32. A 4 year rehabilitation program is then assumed which accumulates the calculation period to 36 years.

6 Potential Impacts

6.1 Future production on rehabilitated land

6.1.1 Background information

This information is largely based on the research work funded by ACARP in Central Queensland and carried out by researchers from the Centre for Mined Land Rehabilitation based at the University of Queensland. Under the ACARP Project C9038 a two year grazing evaluation was carried out starting February of 2000 on three rehabilitated mining sites situated at Goonyella Riverside, Norwich Park and Blackwater South. The project was extended a further two years to 2004 to allow for grazing evaluations to be completed over a period of four growing seasons.

Essentially the outcome of this study showed that rehabilitated grazing country could perform as well as unmined grazing production. However a number of critical elements were identified within this projection that have an impact on the successful establishment of long term pasture production.

Critical elements of rehabilitated land identified (Grigg etal, 2007):
1. Sodicity – ESP levels above 10% in the surface soil profile
2. Salinity – EC levels above 0.5 dS/m in the surface profile
3. Slope - gradients above 10%
4. Clay content/Clay type – measured by the ratio between Clay percentage and Cation Exchange Capacity (CEC) or Clay Content Exchange Ratio (CCR). Experimental data would suggest that the relationship between CCR and Rainfall Utilisation Efficiency (RUE) is curve linear. Therefore the best responses were when CCR was below 0.4 or above 0.7.
5. Surface Roughness
6. Maintenance of a basal area above 4% for erosion control (a 4% basal area equates to a 50% ground cover).

It is thought that the above factors in combination or in isolation did not prevent the establishment of improved pastures but reduced the level of dry matter production on an annual basis therefore sustainable stocking rates would need to be lowered to prevent permanent degradation of the resource.

The amount of recorded data available across Queensland on rehabilitated grazing sites is limited and long term data (five years plus) is non-existent. There is some data available from the Hunter Valley in NSW but it is a largely temperate grazing system as opposed to the sub-tropical systems that dominate Central Queensland. However it is worth noting that the Hunter Valley rehabilitation project did produce a grazing capacity that was equal to, if not better than the grazing on unmined land (Grigg, 2000).

Another rehabilitation site worth noting is the Belmore Satellite Deposit Grazing trial at Collinsville. This site has been rehabilitated for three years and is showing very good establishment to improved pastures. Grazing information is still being collated but it is expected to perform very well considering the Landscape Function Analysis (LFA) assessments that have been completed so far are excellent (Landloch, 2008).

The critical values outlined above can mostly be related to one common theme and that is RUE. As discussed previously, this term relates to the ability of the landscape to trap and store moisture for pasture growth.

Across the three sites that were evaluated in Project C9038, two sites were very similar (Blackwater and Norwich Park) in relation to the critical factors outlined previously. The third site at Goonyella Riverside had a number of factors that were considered to be above critical levels. These were slope (10-15%) and sodicity (18% in top 15cm) and clay quality (CEC of 16 with a clay percentage of 48% in the top 15cm - CCR 0.33). These three factors principally effected RUE of the site which in practical terms means dry matter produced after grazing was much lower therefore stocking rates needed to be reduced so that the pasture did not become over utilised. See Tables 2 and 3 below.

Table 2 Averaged Rainfall Utilization Efficiency (RUE) Data across Four Years between Sites

Rehabilitation Site	**RUE (kgDM/ha/mm**
Blackwater	12.4
Goonyella Riverside	8.1
Norwich Park	13.4

(Grigg etal, 2007)

These RUE figures put the Goonyella site 35-40% less efficient in utilising rainfall for pasture production which led to a 25% decrease in sustainable stocking rates.

Table 3 Recommended Stocking Rates (SR) for the Rehabilitated Sites

Rehabilitation Site	**Stocking Rate (ha/head)**	**Comments**
Blackwater	3.2	Estimate based on measured performance from three set stocking rates.
Goonyella Riverside	4.0	Estimate based on measured performance from a number of set stocking rates.
Norwich Park	3.0	The measured performance of this SR would indicate that the long term SR could be higher.

Table 4 Average Performance Data for the Rehabilitated Sites

Rehabilitation Site	Average Daily Gain (kg/head/day)	Comments
Blackwater	0.62	Data collected from February 2000 to August 2003.
Goonyella Riverside	No data	
Norwich Park	0.42	Data collected from May 2000 to April 2004.

The Stocking rates for Norwich Park and Blackwater would indicate that the rehabilitated pastures are producing performance that is comparable to unmined land in the same area as shown in Table 4. (Peck and Chamberlain, 2001)

The Goonyella Riverside site is showing a Stocking Rate that is about one hectare above the average for the area on unmined land (3ha/head) (Peck and Chamberlain, 2001). Stocking rates equivalent to the surrounding area proved to be unsustainable with dry matter production and percentage of cover reducing over time and allowing higher rates of soil erosion. Average daily gain was not significantly different across a range of stocking rates (Grigg etal, 2007). The higher weight gain performance at Blackwater was attributed to a bigger component of legumes established in the pasture.

The sustainability of these grazing sites was assessed by monitoring dry matter production and percentage of vegetative cover. The results strongly correlated with data (QDPI – Stocktake, 2004) previously published that sustainable grazing could be obtained if utilisation rates were kept at 30% or less of total dry matter produced per year and canopy cover was maintained at above 50%. These levels ensured minimal soil movement in the evaluated sites. The dry seasons experienced during this evaluation trial also highlighted that a 30% utilisation rate in 80% of years gave the pastures some reserves to be able to cope with dry periods where utilisations may increase in those 20% of years because of a lack of productive rainfall.

It is worth noting that all three of these sites received on average about two thirds of their annual average rainfall for the last three years of the trial. This has certainly complicated the process of trying to ascertain long term stocking rates.

6.1.2 Application to Wandoan

The data collected from the grazing evaluations in ACARP Project C9038 and the characteristics of those sites give a strong indication of what the grazing potential will be on the Wandoan mining leases after rehabilitation. This is because of a number of reasons:

- Soil characteristics at Wandoan are similar to the soil types where the evaluations took place in relation to clay content and quality, chemical and physical attributes of the top 500mm of the profile (sodicity, salinity, phosphorous and nitrogen), and water holding capacity. Therefore the quality of the replaced topsoil in rehabilated areas should be comparable to those evaluated (Speck etal, 1968).

- Common pasture species at Wandoan are similar to those in the evaluation with Buffel grass being the dominant species. Buffel grass is a 3P pasture species (perennial, palatable, productive) and it has shown in the grazing trials that not only will it maintain its population in a rehabilitated site but it will also increase its share of the population dynamic against other improved pasture species. This has been demonstrated in the trials undertaken despite low rainfall conditions and less than ideal subsoil conditions (Grigg etal, 2006). Critical phosphorous and nitrogen levels; 10mg/kg for P and >0.1% for N (Cook, 2006), are important for Buffel grass pastures and the dominant Wandoan surface soil types meet these levels as long as top soiling requirements can be met.

- Long term total rainfall and rainfall distribution is similar in both areas. As a result peak dry matter production of pasture in an undisturbed state in both areas is similar (5000 – 6000 kg/ha)

- Methods and strategies for rehabilitation on the Wandoan Project stated in the EIS will be similar to those used at the evaluation sites. It is worth noting that the Blackwater site in the trial evaluations was not top soiled in the original rehabilitation work back in 1975. However this site has had a long time to get established and for the spoil to degrade and mineralize which has created a reasonable environment for pasture production.

6.1.3 Reclassification of rehabilitated areas

Based on final land form projections, the data below in Table 5 gives a breakdown of the MLA area in relation to land type and rehabilitation classes.

Table 5 Areas Obtained from Finalized Land Form Plans after Mining Is Completed

Final Land Form	Proportion of Land Type (Ha)				Total
	A	B	C	D	
Unmined Land	4,109	13,400	2,086	1,449	21,044
Rehabilitated Land to Class 2		7,734			7,734
Rehabilitated Land to Class >4		3,404			3,404
				Total	32,182

Rehabilitated land classes have been broken down according to key criteria outlined in the EIS and summarized previously in this report. The main determining criteria in this case have been slope. Class 2 has less than 10% slope and Class 4 and above has 10% and greater slope.

It is worth noting that within the MLA area, over 65% of the area is untouched by mining operations. These areas will have the same grazing productive capacity that has been calculated in Scenario 1 below.

In order to assign productive capacities to the above land forms in relation to the Stocktake model, the following parameters will be used:

Unmined land -	Land type (as stated), Land condition 'B'
Rehab Class 2 -	Land type B, Land condition 'B'
Rehab Class >4 -	Land type B, Land condition 'D' (final voids are included in this category

6.2 Scenario 1 – Agricultural Production without the Mine

Table 6 has added together the results of grazing assessments taken on all four land types existing in the MLA area under four different land conditions (Stocktake assessment). The bottom half of the table has allocated an average daily weight gain and price per kilogram, and calculated a monetary value for the grazing assessment. The results at the bottom of the table show the potential range of gross income that can be produced under different management regimes as land condition is quite often a result of management practices.

When the MLA area was assessed, 90% of the land was in a 'B' condition. As a result of this, the highlighted column under land condition 'B' will be used as the benchmark for current grazing production in the MLA area.

Thus, under current conditions, the MLA area is assessed to be able to produce sustainably 2,765,735 kg of beef per annum (calculated from Table 6 as Number of Head/Area: 11,657 multiplied by Weight Gain per Year: 237 kg per head) multiplied by $1.75/kg or Calculated Gross Income of just over $4.8 Million.

Over the next 36 years the MLA area without mining development, would be expected to produce 99,566,460 kg of beef at a gross value of just over $174 Million.

Table 6 Summary of Grazing Production Values per annum of the MLA Area without Mining

Supply		Totals	Totals	Totals	Totals
Land Type	(A,B,C,D)	A,B,C,D	A,B,C,D	A,B,C,D	A,B,C,D
Land Condition	(A,B,C,D)	A	B	C	D
Yield	(kg)	220,257,656	165,193,242	99,115,945	44,051,531
Wastage	(%)	15%	15%	15%	15%
Wastage	(kg)	33,038,648	24,778,986	14,867,392	6,607,730
Accessible grass	(kg)	187,219,008	140,414,256	84,248,553	37,443,802
Useful species	(%)	100%	100%	100%	100%
Useable grass	(kg)	187,219,008	140,414,256	84,248,553	37,443,802
Utilisation	(%)	30%	30%	30%	30%
Residual grass	(kg)	131,053,305	98,289,979	58,973,987	26,210,661
Available grass	(kg)	56,165,702	42,124,277	25,274,566	11,233,140
Demand					
Weight of Animal	(kg) lwt	450	450	450	450
Intake/AE	(kg/day)	10	10	10	10
Grazing days	(AE days)	**5,673,303**	**4,254,977**	**2,552,986**	**1,134,661**
Productivity					
Carrying Capacity	(ha/hd AE)	2.1	2.8	4.6	10.4
Area Assessed	(ha)	32182	32182	32182	32182
No of Head/Area	(hd)	15543	11657	6994	3109
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237	237
Dollars Per Kilogram	($/kg)	1.75	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 6,453,382**	**$ 4,840,037**	**$ 2,904,022**	**$ 1,290,676**
Profit Per Hectare	($)	**$ 200.53**	**$ 150.40**	**$ 90.24**	**$ 40.11**

***Taken from DPI & F Stocktake Database**

(Highlighted column is the set of data being used for this assessment; however, it is worth noting the total range of productivity from the MLA area).

The two main variables within this evaluation that are difficult to predict is the market price ($/kg) for beef and the weight gain performance (kg/day). The sensitivity analysis in Table 7 accounts for the impact of changing prices and changing production values in relation to gross income from the whole area. Production performance can be influenced by either large changes in weather or advances in pasture productivity that may or may not happen with the introduction of adapted legumes or other new innovations.

Table 7 Sensitivity Analysis for Price and Performance on Gross Income

Price ($/Kg)	Weight Gain (Kg/hd/day) 0.5	0.55	0.6	0.65	0.7	0.75	0.8
1.6	$ 3,403,982	$ 3,744,380	$ 4,084,778	$ 4,425,177	$ 4,765,575	$ 5,105,973	$ 5,446,371
1.65	$ 3,510,356	$ 3,861,392	$ 4,212,428	$ 4,563,463	$ 4,914,499	$ 5,265,535	$ 5,616,570
1.7	$ 3,616,731	$ 3,978,404	$ 4,340,077	$ 4,701,750	$ 5,063,423	$ 5,425,096	$ 5,786,769
1.75	$ 3,723,105	$ 4,095,416	$ 4,467,726	$ 4,840,037	$ 5,212,347	$ 5,584,658	$ 5,956,968
1.8	$ 3,829,480	$ 4,212,428	$ 4,595,376	$ 4,978,324	$ 5,361,272	$ 5,744,220	$ 6,127,168
1.85	$ 3,935,854	$ 4,329,440	$ 4,723,025	$ 5,116,610	$ 5,510,196	$ 5,903,781	$ 6,297,367
1.9	$ 4,042,229	$ 4,446,451	$ 4,850,674	$ 5,254,897	$ 5,659,120	$ 6,063,343	$ 6,467,566

The sensitivity analysis above demonstrates that there can be quite a range of outcomes in terms of gross income from the same carrying capacity, ranging from approximately $3.4 million to $6.5 million per annum. Changes in market price happens readily from year to year, where as changes in performance occurs more gradually over a period of years in relation to exceptional drought circumstances or because of further pasture enhancements. The average value of $4.8 million has been selected to account for varying conditions above and below average.

6.3 Scenario 2 – Agricultural Production with the Mine, without decommissioning

For this scenario the current production benchmark that has been established in the previous section will be used as the starting point in year one and then as the mine develops areas of each land type that are affected by the physical mining will be altered in the evaluation.

Table 8 below illustrates the breakup of the MLA area in relation to the mining operations over the initial 30 year lease period. Mining in this scenario, is proposed to continue beyond Year 30, however, areas that are available to be rehabilitated at Year 30 will be completed over a 4 year period (end Year 34) and grazing production calculations will reflect this. Also to assist with uniformity and comparison of the 3 scenarios, total grazing production has been continued for another 2 years which brings the total assessment period to 36 years.

Table 8 Breakup of Areas within MLA during Mining Operations

Year of Operation	Assessment Category	Area of Land Type (Ha)				Totals
		A	**B**	**C**	**D**	
Year 5	Land Unaffected by mining	6,252	12,915	2,120	1,937	23,224
	Land affected by Mining	8,958				8,958
	Land rehabilitated to Class 2	0				0
	Land rehabilitated to Class 4 and above	0				0
		Totals				32,182
Year 10	Land Unaffected by mining	4,261	12,109	1,839	1,963	20,172
	Land affected by Mining	12,010				12,010
	Land rehabilitated to Class 2	0				0
	Land rehabilitated to Class 4 and above	0				0
		Totals				32,182
Year 20	Land Unaffected by mining	3,757	9,898	1,493	939	16,087
	Land affected by Mining	15,277				15,277
	Land rehabilitated to Class 2	585				585
	Land rehabilitated to Class 4 and above.	233				233
		Totals				32,182
Year 30	Land Unaffected by mining	3,426	9,565	1,545	1,029	15,565
	Land affected by Mining	11,717				11,717
	Land rehabilitated to Class 2	2,503				2,503
	Land rehabilitated to Class 4 and above.	1,579				1,579
	Land rehabilitated to Class 2 after year 20	585				585
	Land rehabilitated to Class 4> after year 20	233				233
		Totals				32,182

As discussed in previous sections, land that has been rehabilitated will require four years before full grazing production can be achieved. Therefore the land under rehabilitation will need to be assessed separately for gross productive capacity until the grazing potential has been fully established. These figures are then added to the total figures for the MLA area.

An indication of areas expected to be undergoing grazing establishment is set out in Table 9 below.

Table 9 Indicative Rehabilitation Program during Mining Operations

Year of operation	(%)of Normal Production	Phase of rehabilitation	Area of Land Condition affected (Ha)				Total Area (Ha)
			A	**B**	**C**	**D**	
Year 20	0	Establishment (yr1)		585		233	818
Year 21	25	Light grazing (yr2)		585		233	818
Year 22	50	Medium Grazing(yr3-4)		585		233	818
Year 23	50	Medium Grazing (yr3-4)		585		233	818
Year 24 – 34	100	Fully stocked (yr4<)		585		233	818
Year 30	0	Establishment (yr1)		2503		1579	4082
Year 31	25	Light grazing (yr2)		2503		1579	4082
Year 32	50	Medium Grazing(yr3-4)		2503		1579	4082
Year 33	50	Medium Grazing (yr3-4)		2503		1579	4082
Year 34	100	Fully stocked (yr4<)		2503		1579	4082

The data in Table 10 below is a summary of the indicative total grazing production of the MLA areas during the 30 year lease period. These calculations are based on the areas already shown in the previous two tables. These calculations also include the amount of production generated from the rehabilitated areas during and after full grazing establishment. It has been assumed that rehabilitated areas only come into the calculations in blocks of 5 years. This however may not be accurate as other areas may begin to be rehabilitated within this period and may overlap the calculations. The method in the table above has been used for simplicity as the effects of these possible overlaps are expected to be minor. All grazing production is based on the land maintaining a ‘B’ land condition and the rehabilitated zones being similar to a ‘B’ land type (Brigalow Upland Cracking Clay).

Table 10 Scenario 2 Summary of Gross Value of Grazing Production for MLA Lease Period

Year of operation	Land Category	Area (Ha)	Carry Capacity (Head)	Annual Beef Production (Kg)	Value per annum @ ($) $1.75/kg	No. of Years	Gross Value ($)
Year 1 to 4	Land Unaffected by mining	23,224	8,181	1,938,897	3,393,070	4	13,572,280
	Land affected by Mining	8,958	0	0	0	0	0
	Sub-Totals	**32,182**	**8,181**	**1,938,897**	**3,393,070**		**$13,572,280**
Year 5 to 9	Land Unaffected by mining	23,224	8,181	1,938,897	3,393,070	5	16,965,350
	Land affected by Mining	8,958	0	0	0	0	0
	Sub-Totals	**32,182**	**8,181**	**1,938,897**	**3,393,070**		**$16,965,350**
Year 10 to 19	Land Unaffected by mining	20,172	6,961	1,649,757	2,887,075	10	28,870,750
	Land affected by Mining	12,010	0	0	0	0	0
	Sub-Totals	**32,182**	**6,961**	**1,649,757**	**2,887,075**		**$28,870,750**
Year 20 to 29	Land Unaffected by mining	16,087	5,690	1,348,530	2,359,928	10	23,599,280
	Land affected by Mining	15,277	0	0	0	0	0
	Land rehabilitated to Class 2	585	210	49,770	87,098	**6	*631,461
	Land rehabilitated to Class 4 and above	233	23	5,451	9,539	**6	*69,158
	Sub–Totals	**32,182**	**5923**	**1,403,751**	**2,456,565**		**$24,299,899**
Year 30 to 34	Land Unaffected by mining	15,565	5,453	1,292,361	2,261,632	5	11,308,160
	Land affected by Mining	11,717	0	0	0	0	0
	Land rehabilitated to Class 2	2,503	898	212,826	372,446	**1	*838,004
	Land rehabilitated to Class 4 and above	1,579	155	36,735	64,286	**1	*144,644
	Land rehabilitated to Class 2 after year 20	585	210	49,770	87,098	5	435,490
	Land rehabilitated to Class 4 and above after year 20	233	23	5,451	9,539	5	47,695
	Sub-Totals	**32,182**	**6739**	**1,597,143**	**2,795,001**		**$12,773,993**
Year 34 to 36	Land Unaffected by mining	15,565	5,453	1,292,361	2,261,632	2	4,523,264
	Land affected by Mining	11,717	0	0	0	0	0
	Land rehabilitated to Class 2	3,088	1,108	262,596	459,543	2	919,086
	Land rehabilitated to Class 4 and above	1,812	178	42,186	73,826	2	147,652
	Sub-Totals	**32,182**	**6739**	**1,597,143**	**2,795,001**		**$5,590,002**
Year 1 to 36	**TOTAL**						**$102,072,274**

* **Note** – These calculations include the production generated from these pastures during the establishment phase of four years.

** **Note** – These calculations represent the number of years at full production for the area stated during this time period.

The above calculations do not allow for gradual overlapping of rehabilitated areas (which may be negligible).

6.4 Scenario 3 - Agricultural Production with the Mine, with decommissioning

Scenario 2 outlines the breakup of the MLA area in relation to the mining operations over the initial 30 year lease period. Scenario 3 proposes mining to cease at Year 30 and a final landform has been prepared to represent how the landscape would be rehabilitated. For the purposes of this assessment the final landform has been assumed to represent Year 32 with rehabilitation taking an additional 4 years, therefore this assessment is based on a 36 year grazing production period.

Again the calculations in Table 11 below, do not allow for the gradual increase of rehabilitated areas that may occur throughout any of the rehabilitated periods during the mines operation. For the benefit of this exercise it will be assumed that all rehabilitation will commence after the final landform has been completed in Year 32.

As outlined in Table 5 the area of Final Landforms assumed to be completed by Year 32 relevant to this scenario 7,734 ha rehabilitated to Class 2. The table below assumes that 585 ha of Class 2 land had been rehabilitated prior to final landform therefore leaving 7,149 ha to commence rehabilitation at Year 32. Also 3,404 ha is the total amount rehabilitated to Class >4 in the final landform. Again 233 ha have been completed prior to Year 32 which leaves 3,171 ha to commence rehabilitation once final landform is completed.

The remaining mined areas (made up of buffers and areas less than 200 ha) which have been excluded in previous calculations, are then added to total unmined hectares at Year 32 or final landform completion.

Table 11 Scenario 3 Summary of Gross Value of Grazing Production for MLA Lease Period

Year of operation	Land Category	Area (Ha)	Carry Capacity (Head)	Annual Beef Production (Kg)	Value per annum @ ($) $1.75/kg	No. of Years	Gross Value ($)
Year 1 to 4	Land Unaffected by mining	23,224	8,181	1,938,897	3,393,070	4	13,572,280
	Land affected by Mining	8,958	0	0	0	0	0
	Sub-Totals	**32,182**	**8,181**	**1,938,897**	**3,393,070**		**$13,572,280**
Year 5 to 9	Land Unaffected by mining	23,224	8,181	1,938,897	3,393,070	5	16,965,350
	Land affected by Mining	8,958	0	0	0	0	0
	Sub-Totals	**32,182**	**8,181**	**1,938,897**	**3,393,070**		**$16,965,350**
Year 10 to 19	Land Unaffected by mining	20,172	6,961	1,649,757	2,887,075	10	28,870,750
	Land affected by Mining	12,010	0	0	0	0	0
	Sub-Totals	**32,182**	**6,961**	**1,649,757**	**2,887,075**		**$28,870,750**
Year 20 to 31	Land Unaffected by mining	16,087	5,690	1,348,530	2,359,928	12	28,319,136
	Land affected by Mining	15,277	0	0	0	0	0
	Land rehabilitated to Class 2	585	210	49,770	87,098	**8	*805,657
	Land rehabilitated to Class 4 and above	233	23	5,451	9,539	**8	*88,236
	Sub–Totals	**32,182**	**5923**	**1,403,751**	**2,456,565**		**$29,213,029**
Year 32 to 36	Land Unaffected by mining	21,044	7,320	1,734,840	3,035,970	5	15,179,850
	Land affected by Mining	0	0	0	0	0	0
	Land rehabilitated to Class 2	7,149	2,565	607,905	1,063,834	**1	*2,393,627
	Land rehabilitated to Class 4 and above	3,171	310	73,470	128,573	**1	*289,289
	Land rehabilitated to Class 2 after year 20	585	210	49,770	87,098	5	435,490
	Land rehabilitated to Class 4 and above after year 20	233	23	5,451	9,539	5	47,695
	Sub-Totals	**32,182**	**10,428**	**2,471,436**	**4,325,014**		**$18,345,951**
Year 1 to 36	**TOTAL**						**$106,967,360**

*** Note** – These calculations include the production generated from these pastures during the establishment phase of four years.

**** Note** – These calculations represent the number of years at full production for the area stated during this time period.

The above calculations do not allow for gradual overlapping of rehabilitated areas (which may be negligible).

Table 12 Total Annual Value of Production from Rehabilitated Land in MLA Area after Mining is Complete

Supply				
Land Type	(A,B,C,D)	B	B	
Land Condition	(A,B,C,D)	B	D	
Yield	(kg/ha)	5102	1387.2	
Wastage	(%)	15%	15%	
Wastage	(kg/ha)	780	208	
Accessible grass	(kg/ha)	4322	1179	
Useful species	(%)	100%	100%	
Useable grass	(kg/ha)	4322	1179	
Utilisation	(%)	30%	30%	
Residual grass	(kg/ha)	3025	825	
Available grass	(kg/ha)	1297	354	
Demand				
Weight of Animal	(kg) lwt	450	450	
Intake/AE	(kg/day)	10	10	
Grazing days	(AE days)	**131**	**36**	
Productivity				**Totals/Avg**
Carrying Capacity	(ha/hd AE)	2.8	10.2	3.6
Area Assessed	(ha)	7734	3404	11,138
No of Head/Area	(hd)	2775	333	3,108
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237
Dollars Per Kilogram	($/kg)	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 1,150,931**	**$ 138,112**	**$ 1,289,043**
Profit Per Hectare	($)	**$ 148.81**	**$ 40.64**	**$ 115.73**

Table 13 Total Annual Value of Production from Unmined Land in MLA Area after Mining is Complete

Supply		**Totals**
Land Type	(A,B,C,D)	A,B,C,D
Land Condition	(A,B,C,D)	B
Yield	(kg/ha)	103,956,104
Wastage	(%)	15%
Wastage	(kg/ha)	15,593,416
Accessible grass	(kg/ha)	88,165,708
Useful species	(%)	100%
Useable grass	(kg/ha)	88,165,708
Utilisation	(%)	30%
Residual grass	(kg/ha)	61,715,996
Available grass	(kg/ha)	26,449,712
Demand		
Weight of Animal	(kg) lwt	450
Intake/AE	(kg/day)	10
Grazing days	(AE days)	**2,671,688**
Carrying Capacity	(ha/hd AE)	2.9
Area Assessed	(ha)	21044
No of Head/Area	(hd)	7320
Weight Gain Per Day	(kg/day)	0.65
Weight Gain Per Year	(kg/year)	237
Dollars Per Kilogram	($/kg)	1.75
Calculated Gross Profit	($)	**$ 3,035,970**
Profit Per Hectare	($)	**$ 144.27**

7 Results Summary and Key Findings

The calculations section of this report has basically highlighted three sets of relevant data. These sets revolve around the core issue of comparing the difference in grazing production between Scenario 1 (without mining), Scenario 2 (with mining, without decommissioning) and Scenario 3 (with mining, with decommissioning).

1. Cumulative comparison for Scenario 1 versus Scenario 2 for the value of grazing production over the 36 years of the mine life.

2. Cumulative comparison for Scenario 1 versus Scenario 3 for the value of grazing production over the 36 years of the mine life.

3. Year-in, year-out comparison for carrying capacity and the value of grazing production after mining operations have presumed ceased and rehabilitation has been completed (Scenario 1 versus Scenario 3).

The three tables below summarise the data for the periods of this project as discussed above.

Table 14 Scenario 1 versus Scenario 2: Comparison of Cumulative Grazing Production from the MLA Area over a 36 Year Period

	Total Kg's Beef Produced	**Gross Income**	**Average/year**
Scenario 1	99,566,460	$174,241,305	$4,840,037
Scenario 2	58,327,014	$102,072,274	$2,835,341
Difference	41,239,446	$72,169,031	$2,004,696
% Difference or decrease in potential output	41%	41%	41%

Table 15 Scenario 1 versus Scenario 3: Comparison of Cumulative Grazing Production from the MLA Area over a 36 Year Period

	Total Kg's Beef Produced	**Gross Income**	**Average/year**
Scenario 1	99,566,460	$174,241,305	$4,840,037
Scenario 3	61,124,206	$106,967,360	$2,971,316
Difference	38,442,254	$67,273,945	$1,868,721
% Difference or decrease in potential output	39%	39%	39%

Table 16 Scenario 1 versus Scenario 3: Comparison of Carrying Capacity and Annual Grazing Production in the MLA Area after full rehabilitation (Year 36 onwards)

	Carrying Capacity / per annum	Total Kg's Produced / annum	Total $ Value / annum
Scenario 1	11,657	2,765,735	$4,840,037
Scenario 3	10,428	2,471,436	$4,325,013
Difference	1,229	294,299	$515,024
%Difference or decrease in potential output	11%	11%	11%

7.1 Key Points

Based on the assumptions provided in this report, direct mining operations on the MLA area will reduce grazing production by 39% to 41% which is a gross loss of around $2Million per year for the life of the mine.

After mining operations have finished and rehabilitation has been completed to full productive capacity, the gross value of grazing production will have been reduced by 11% or $515,024. In cattle terms it means that the MLA area will have an annual carrying capacity that is 1,229 head less than what is predicted for the area in its current state.

These findings are premised on 65.3% of the MLA area remaining untouched by mining, 24.1% of the affected area being rehabilitated to a Class 2 standard (original) and only 10.6% of the affected area being rehabilitated to a lower class of country than original.

As stated at the beginning of this report, this assessment has not included the loss in flow on contributions to the wider community from the reduction of grazing productivity in the MLA area and therefore a loss of expenditure from grazing enterprises. This information has been included in a supplementary report completed by PB based on average operating expenditure information supplied by BM Ag.

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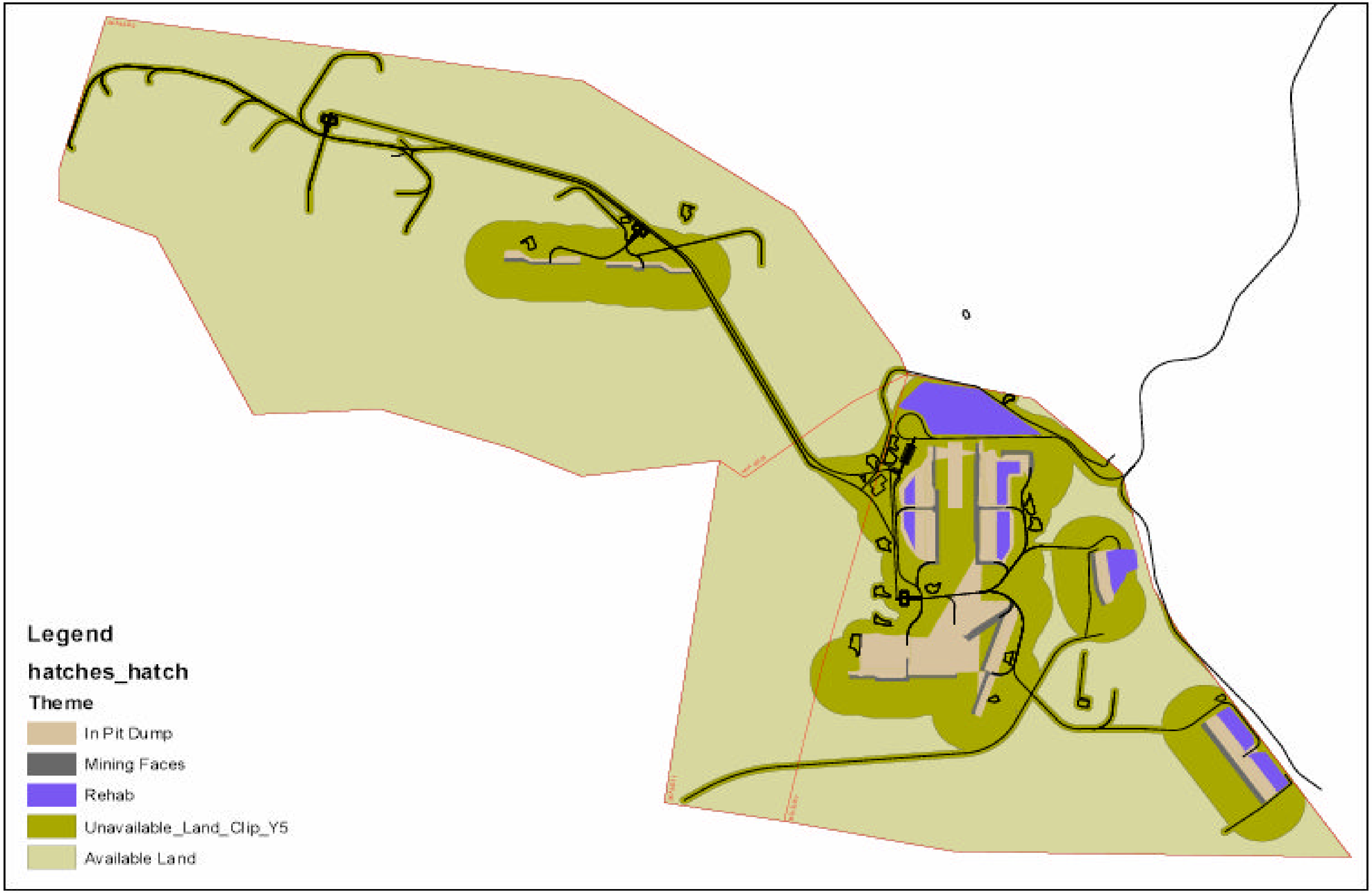
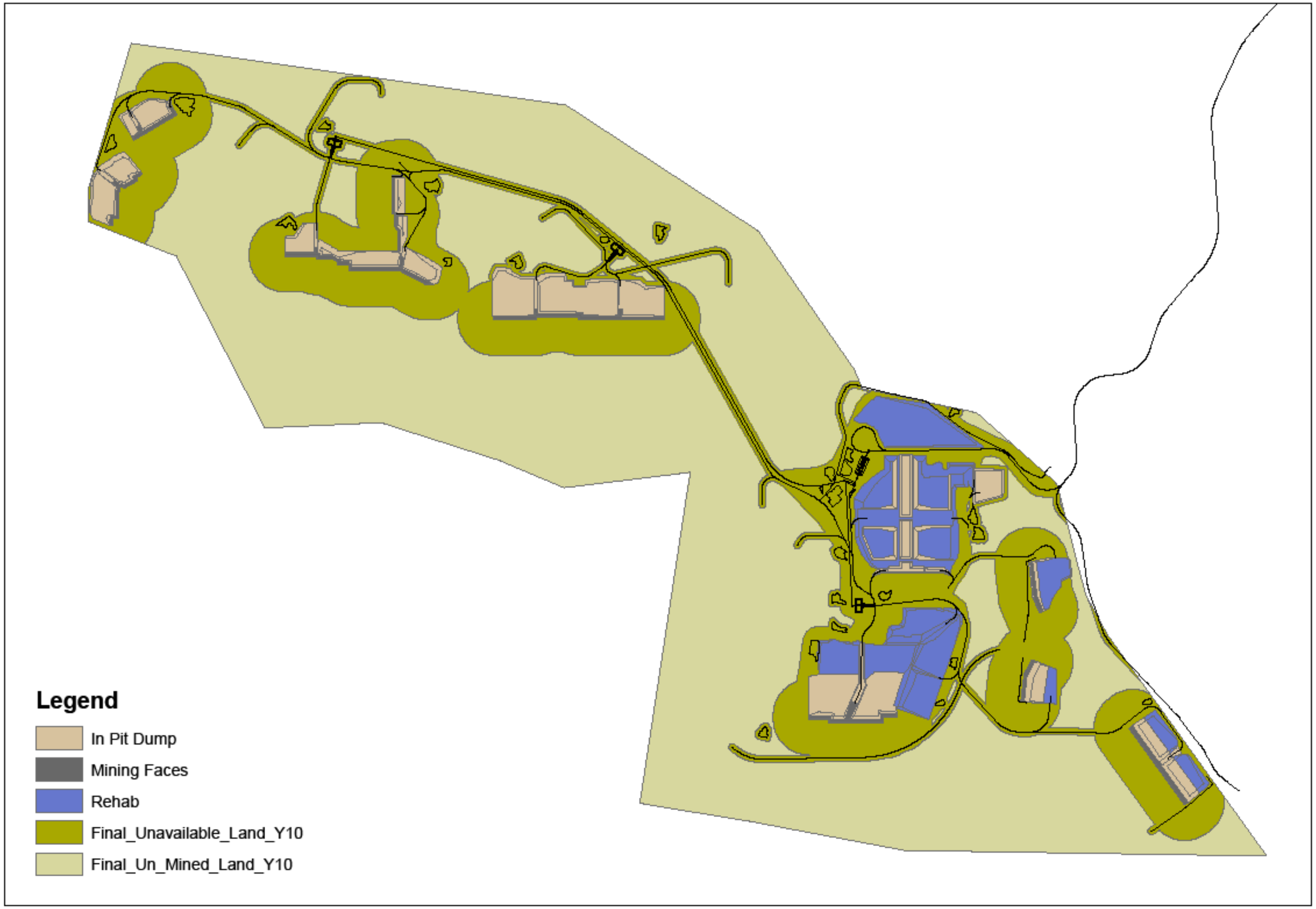
Appendix A Land Form Mapping Year 5



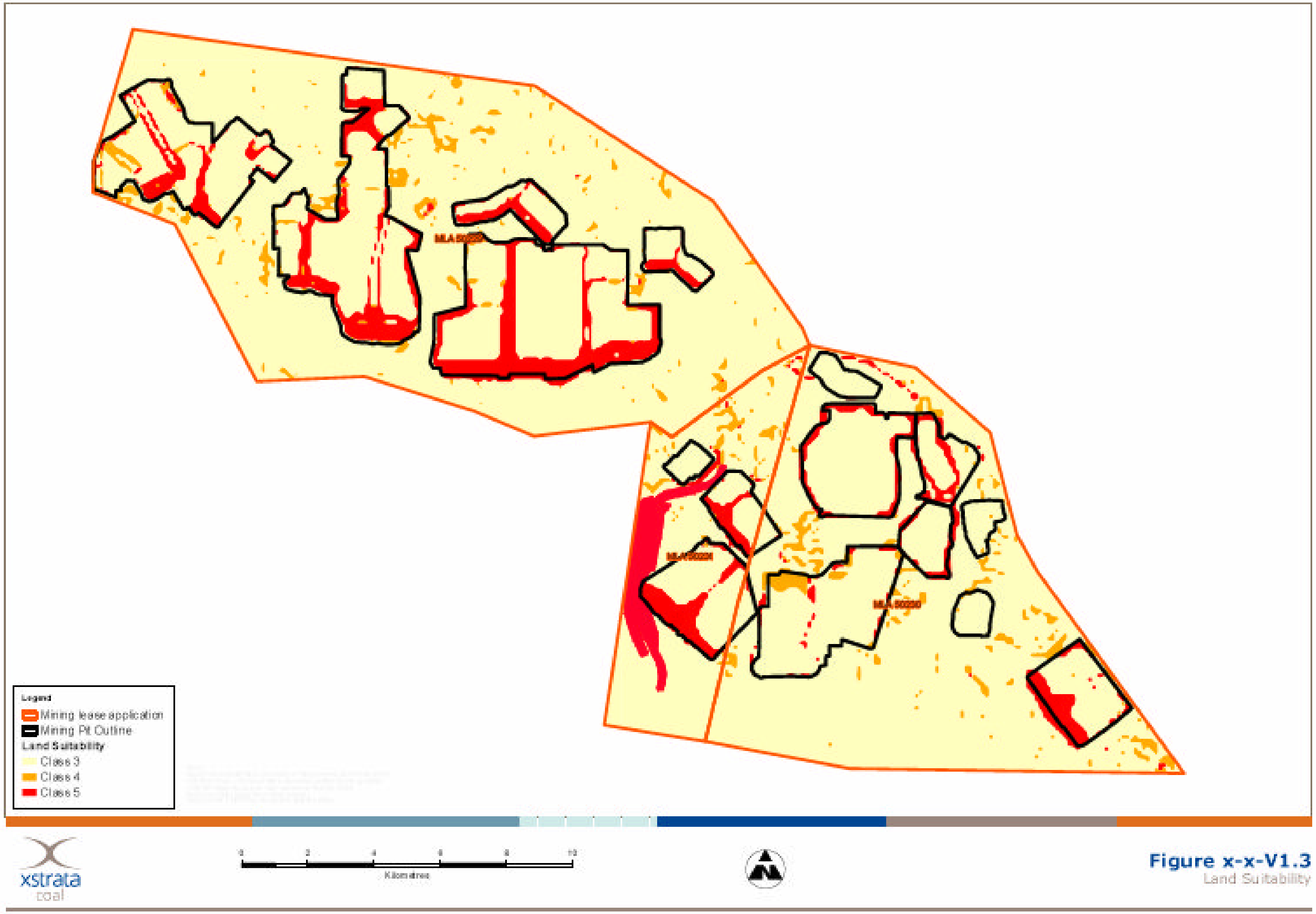
Appendix B Land Form Mapping Year 10



Appendix C Land Form Mapping Year 20

Appendix D Land Form Mapping Year 30

Appendix E Land Suitability



Appendix F Wandoan Land Types

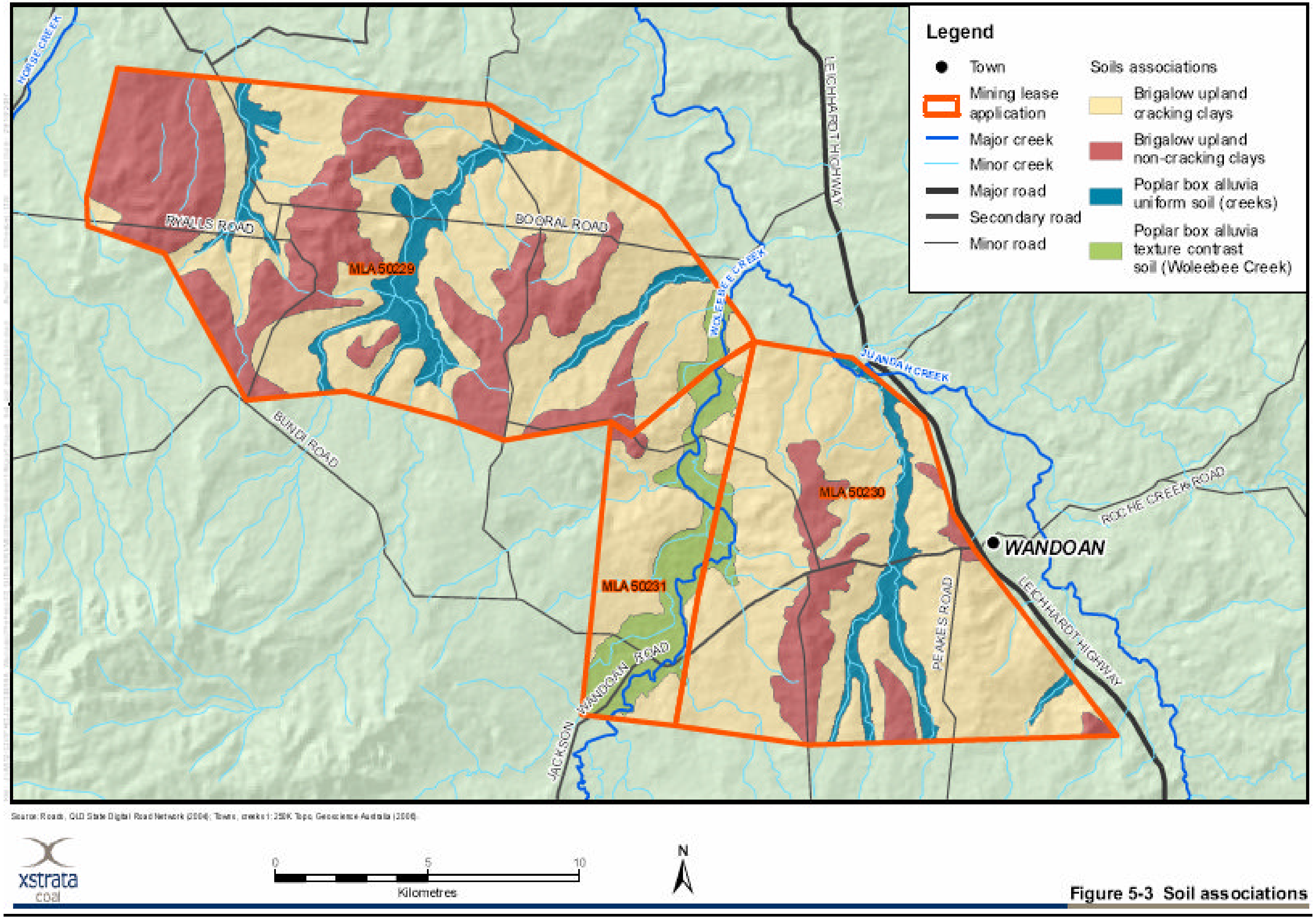


Figure 5-3 Soil associations

Appendix G Grazing Capacity Table for Land Condition A

Brennan Mayne Agribusiness

Land Condition A

Supply						**Totals**
Land Type	(A,B,C,D)	A	B	C	D	A,B,C,D
Land Condition	(A,B,C,D)	A	A	A	A	A
Yield	(kg/ha)	8300	6936	4071	3351	220,257,656
Wastage	(%)	15%	15%	15%	15%	15%
Wastage	(kg/ha)	1245	1040	611	503	33,038,648
Accessible grass	(kg/ha)	7055	5896	3460	2848	187,219,008
Useful species	(%)	100%	100%	100%	100%	100%
Useable grass	(kg/ha)	7055	5896	3460	2848	187,219,008
Utilisation	(%)	30%	30%	30%	30%	30%
Residual grass	(kg/ha)	4939	4127	2422	1994	131,053,305
Available grass	(kg/ha)	2117	1769	1038	855	56,165,702
Demand						
Weight of Animal	(kg) lwt	450	450	450	450	450
Intake/AE	(kg/day)	10	10	10	10	10
Grazing days	(AE days)	**214**	**179**	**105**	**86**	**5,673,303**
Productivity						
Carrying Capacity	(ha/hd AE)	1.7	2.0	3.5	4.2	2.1
Area Assessed	(ha)	12691	13007	4136	2348	32182
No of Head/Area	(hd)	7433	6366	1188	555	15543
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237	237	237
Cents Per Kilogram	($/kg)	1.75	1.75	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 3,086,244**	**$ 2,643,277**	**$ 493,331**	**$ 230,531**	**$ 6,453,382**
Profit Per Hectare	($)	**$ 243.18**	**$ 203.22**	**$ 119.28**	**$ 98.18**	**$ 200.53**

*** Taken from DPI & F Stocktake Database**

Appendix H Grazing Capacity Table for Land Condition B

Brennan Mayne Agribusiness

Land Condition B

Supply						**Totals**
Land Type	(A,B,C,D)	A	B	C	D	A,B,C,D
Land Condition	(A,B,C,D)	B	B	B	B	**B**
Yield	(kg/ha)	6225	5202	3053	2513	165,193,242
Wastage	(%)	15%	15%	15%	15%	15%
Wastage	(kg/ha)	934	780	458	377	24,778,986
Accessible grass	(kg/ha)	5291	4422	2595	2136	140,414,256
Useful species	(%)	100%	100%	100%	100%	100%
Useable grass	(kg/ha)	5291	4422	2595	2136	140,414,256
Utilisation	(%)	30%	30%	30%	30%	30%
Residual grass	(kg/ha)	3704	3095	1817	1495	98,289,979
Available grass	(kg/ha)	1587	1327	779	641	42,124,277
Demand						
Weight of Animal	(kg) lwt	450	450	450	450	450
Intake/AE	(kg/day)	10	10	10	10	10
Grazing days	(AE days)	**160**	**134**	**79**	**65**	**4,254,977**
Productivity						
Carrying Capacity	(ha/hd AE)	2.3	2.7	4.6	5.6	2.8
Area Assessed	(ha)	12691	13007	4136	2348	32182
No of Head/Area	(hd)	5575	4775	891	416	11657
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237	237	237
Cents Per Kilogram	(cts/kg)	1.75	1.75	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 2,314,683**	**$ 1,982,457**	**$ 369,998**	**$ 172,898**	**$ 4,840,037**
Profit Per Hectare	($)	**$ 182.39**	**$ 152.41**	**$ 89.46**	**$ 73.64**	**$ 150.40**

*** Taken from DPI & F Stocktake Database**

Appendix I Grazing Capacity Table for Land Condition C

Brennan Mayne Agribusiness

Land Condition C

Supply						**Totals**
Land Type	(A,B,C,D)	A	B	C	D	A,B,C,D
Land Condition	(A,B,C,D)	C	C	C	C	C
Yield	(kg/ha)	3735	3121	1832	1508	99,115,945
Wastage	(%)	15%	15%	15%	15%	15%
Wastage	(kg/ha)	560	468	275	226	14,867,392
Accessible grass	(kg/ha)	3175	2653	1557	1282	84,248,553
Useful species	(%)	100%	100%	100%	100%	100%
Useable grass	(kg/ha)	3175	2653	1557	1282	84,248,553
Utilisation	(%)	30%	30%	30%	30%	30%
Residual grass	(kg/ha)	2222	1857	1090	897	58,973,987
Available grass	(kg/ha)	952	796	467	385	25,274,566
Demand						
Weight of Animal	(kg) lwt	450	450	450	450	450
Intake/AE	(kg/day)	10	10	10	10	10
Grazing days	(AE days)	**96**	**80**	**47**	**39**	**2,552,986**
Productivity						
Carrying Capacity	(ha/hd AE)	3.8	4.5	7.7	9.4	4.6
Area Assessed	(ha)	12691	13007	4136	2348	32182
No of Head/Area	(hd)	3345	2865	535	250	6994
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237	237	237
Cents Per Kilogram	(cts/kg)	1.75	1.75	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 1,388,810**	**$ 1,189,474**	**$ 221,999**	**$ 103,739**	**$ 2,904,022**
Profit Per Hectare	($)	**$ 109.43**	**$ 91.45**	**$ 53.67**	**$ 44.18**	**$ 90.24**

*** Taken from DPI & F Stocktake Database**

Appendix J Grazing Capacity Table for Land Condition D

Brennan Mayne Agribusiness

Land Condition D

Supply						Totals
Land Type	(A,B,C,D)	A	B	C	D	A,B,C,D
Land Condition	(A,B,C,D)	D	D	D	D	D
Yield	(kg/ha)	1660	1387	814	670	44,051,531
Wastage	(%)	15%	15%	15%	15%	15%
Wastage	(kg/ha)	249	208	122	101	6,607,730
Accessible grass	(kg/ha)	1411	1179	692	570	37,443,802
Useful species	(%)	100%	100%	100%	100%	100%
Useable grass	(kg/ha)	1411	1179	692	570	37,443,802
Utilisation	(%)	30%	30%	30%	30%	30%
Residual grass	(kg/ha)	988	825	484	399	26,210,661
Available grass	(kg/ha)	423	354	208	171	11,233,140
Demand						
Weight of Animal	(kg) lwt	450	450	450	450	450
Intake/AE	(kg/day)	10	10	10	10	10
Grazing days	(AE days)	**43**	**36**	**21**	**17**	**1,134,661**
Productivity						
Carrying Capacity	(ha/hd AE)	8.5	10.2	17.4	21.1	10.4
Area Assessed	(ha)	12691	13007	4136	2348	32182
No of Head/Area	(hd)	1487	1273	238	111	3109
Weight Gain Per Day	(kg/day)	0.65	0.65	0.65	0.65	0.65
Weight Gain Per Year	(kg/year)	237	237	237	237	237
Cents Per Kilogram	(cts/kg)	1.75	1.75	1.75	1.75	1.75
Calculated Gross Profit	($)	**$ 617,249**	**$ 528,655**	**$ 98,666**	**$ 46,106**	**$ 1,290,676**
Profit Per Hectare	($)	**$ 48.64**	**$ 40.64**	**$ 23.86**	**$ 19.64**	**$ 40.11**

*** Taken from DPI & F Stocktake Database**