

Agricultural Impact Assessment



Agricultural Consultants

Report to: Umwelt (Australia) Pty Limited

Northparkes Mines
<u>Step Change</u> Project

Agricultural Impact Assessment (Job Number 2949)

Attention:

Tim Crosdale / Phillip Weir

1 July 2013

Prepared by:

WHK Agricultural Consultants Wellington

Wellington16-18 Maughan StreetWellingtonNSW2820ParkesMugincoble LaneParkesNSW2870SydneyLevel 6 - 200 George StSydneyNSW2000

Tel. 02 6845 1611 Tel. 02 6866 1288 Tel. 02 9247 6766

Email: wellington@whk.com.au



Contents

1	EXE		E SUMMARY	6
	1.1	Introdu	iction	6
	1.2	Assess	sment of Agricultural Resources	6
		1.2.1	Location and General Description	6
		1.2.2	Soils & Topography	7
		1.2.3	Climate	7
		1.2.4	Land and Soil Capability	8
		1.2.5	Agricultural Support Infrastructure	8
	1.3	Strateg	gic Agricultural Land	8
	1.4	Agricul	Itural Enterprises	9
		1.4.1	Crop Types	9
		1.4.2	Productivity	9
	1.5	Agricul	Itural Impact Assessment	9
		1.5.1	Loss of Productivity	9
		1.5.2	Other Impacts	10
		1.5.3	Regional Effects	10
		1.5.4	Mitigation	10
2	INT		TION	11
	2.1	Project	t Overview	11
	2.2	Purpos	se of this Report	13
PA	RT 1	AGR	ICULTURAL RESOURCE ASSESSMENT	14
3	<u>م</u>	SESSME	ENT OF AGRICULTURAL RESOURCES	15
J				
	3.1		on and General Description	
	3.2		Topography	
		3.2.1	General	19
		3.2.2	Soil Mapping	19
		3.2.3	Soil Test Results	22
		3.2.4	Soil Landscapes	23
	3.3		Resources & Water Infrastructure	
	3.4	Climate	e	
		3.4.1	Temperatures	25
		3.4.2	Frost	25
		3.4.3	Evaporation	26



		3.4.4	Rainfall	27
	3.5	Climate	e Change	29
	3.6	Land a	and Soil Capability	29
		3.6.1	Definition and Methodology	29
	3.7	Land S	Suitability	33
	3.8	Agricul	Itural Support Infrastructure	34
		3.8.1	Transport	34
		3.8.2	Major Towns	34
4	STR	ATEGI	C AGRICULTURAL LAND	35
	4.1	Definiti	ion and Methodology	35
		4.1.1	Critical Industry Clusters	35
		4.1.2	Biophysical Strategic Agricultural Land	35
	4.2	Applica	ation to Subject Areas	36
		4.2.1	Critical Industry Clusters	36
		4.2.2	Biophysical Strategic Agricultural Land	37
		4.2.3	Summary	38
5	AGF	RICULT	URAL ENTERPRISES	39
	5.1	Past, C	Current and Potential Enterprises	
	5.2	Produc	ctivity	
		5.2.1	Gross Margin Yields	39
		5.2.2	NSW Grains Report	41
		5.2.3	ABARES Farm Surveys	42
		5.2.4	NPM Data	43
		5.2.5	Assessed Productivity	44
<u> </u>	<u>RT 2</u>	Agr	ICULTURAL IMPACT ASSESSMENT	45
6	IMP	ACTS C	ON AGRICULTURE	46
7	GRO	DSS MA	ARGINS	48
	7.1	Drylan	d Wheat Gross Margin	48
		7.1.1	Expected Income	48
		7.1.2	Expected Costs	49
	7.2	Drylan	d Canola Gross Margin	50
		7.2.1	Expected Income	50
		7.2.2	Expected Costs	51
	7.3	Drylan	d Barley Gross Margin	52
		7.3.1	Expected Income	52
		7.3.2	Expected Costs	53



8	EXF	EXPANSION OF MINE AREA							
	8.1	Area Affected	54						
	8.2	Effect on Agricultural Production	54						
	8.3	Other Potential Impacts	55						
		8.3.1 Agricultural Diversity	55						
		8.3.2 Environmental Impacts on Agricultural Lands	55						
		8.3.3 Changes to Agricultural Land Values	55						
9	REC	BIONAL EFFECTS	56						
	9.1	Study Area	56						
	9.2	Regional Agricultural Production	57						
	9.3	Regional Impact							
10	МІТ	IGATION	59						
11	ABE	BREVIATIONS	60						
12	REF	ERENCES	61						

Figures

Figure 1 - Location Map	. 17
Figure 2 - Project Area Map	. 18
Figure 3 - Topography of Northparkes Mines Land Holdings	. 21
Figure 4 - Paddock Locations and Proposed Mine Extension Areas	. 23
Figure 5 - Temperatures	. 26
Figure 6 - Bureau of Meteorology Recording Stations	. 27
Figure 7 - Land Capability - NPM Land Holdings	. 32
Figure 8 - Winter Crop Yields	. 42
Figure 9 - Land Use	. 47



Tables

Table 1 - Agricultural Trials	.16
Table 2 - Annual Rainfall Statistics	.28
Table 3 - Mean Monthly Rainfall (mm)	.29
Table 4 - Budget Crop Yields	.40
Table 5 - Crop Yields - NSW Grains Report	.41
Table 6 - NPM Crop Yields	.43
Table 7 - Foregone Gross Margin - Mine Expansion	.54
Table 8 - Value of Agricultural Commodities Produced	.57

Attachments

Attachment 1 - Key Features of the Northparkes Mines Step Change Project.	62
Attachment 2 - Climate (Parkes)	64
Attachment 3 - Climate (Peak Hill)	65
Attachment 4 - Rainfall - NPM land holdings	66
Attachment 5 - Soil Tests - NPM land holdings	67
Attachment 6 - Soil Fertility Classes	68
Attachment 7 - Gross Value of Grain Production	69
Attachment 8 - Wheat Receipts	70
Attachment 9 - Crop Expenses	71
Attachment 10 - Canola Receipts	72



1 Executive Summary

1.1 Introduction

Northparkes Mines ("NPM") is a copper-gold mining project located approximately 27 kilometres north of Parkes in central west New South Wales.

The Northparkes Step Change Project ("the Project") encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases and an extended mine life of 7 years until 2032.

The Project will involve physical disturbance to existing agricultural areas and enterprises owned and operated by NPM as a result of the development of mining areas, waste rock dumps, access control, site access road and visitor car park. Project components have been located in proximity to existing and approved mining operations to minimise disturbance of additional areas, including existing agricultural resources, where possible.

The preparation of an Environmental Assessment ("EA") will be required to support the Project Application under Part 3A of the Environmental Planning and Assessment Act 1979 ("EP&A Act").

The purpose of this agricultural impact assessment ("AIA") as a part of the EA is to:

- provide a baseline of the agricultural resources of the project area and surrounding areas upon which the impact of the Project can be assessed, and
- provide a quantitative and qualitative assessment regarding the Project's impact upon the agricultural resources and enterprises both within the project area and within the broader region.

1.2 Assessment of Agricultural Resources

1.2.1 Location and General Description

Northparkes Mines ("NPM") owns approximately 6,217 hectares of land located approximately 27 kilometres north-west of Parkes (Figure 1). The Project area covers approximately 2,644 hectares, which includes existing mining leases and land subject to the Project application. The NPM land holdings in the vicinity of the project area serves as a buffer and are managed by NPM primarily for cropping and a native vegetation conservation area.



1.2.2 Soils & Topography

The topography of the Project area is generally of low relief with gently undulating rises and depressions or drainage lines. The major drainage line is the Bogan River which runs approximately south to north immediately to the west of the Project area. Goonumbla Creek and Tenandra Creek join the Bogan River immediately west of the Project area.

Cunningham (2006) identified 2 soil mapping units within the Project area. Soil mapping unit 1 ("SMU1) is characterised by shallow loam to clay loam soils with gravel and stone in the upper horizons in areas of rock outcrops or shallow bedrock. Soil mapping unit 2 ("SMU 2") is characterised by deeper silty clay to heavy clay soils with little gravel and stone, and occur in lower slope areas, plains and shallow drainage locations. The vast majority of the land used for cropping is classified as SMU2. The SMU 1 areas generally remain as native vegetation, or have been planted to tree lots.

The soils are mostly slightly alkaline to moderately acidic in the surface layers (pH 5.0 to 7.8 - in water) and become more clayey with depth. Some soils have moderately to strongly alkaline subsoils. The topsoils exhibited slight to moderate dispersibility and susceptibility to erosion. However, the subsoils of SMU2 displayed a wide range of dispersibility ranging from slight to very high.

The cultivated land is protected by soil conservation works, conservation tillage practices, stubble retention and an absence of livestock grazing.

Cunningham (2006) identified that most of the SMU2 soil profiles tested have moderate to extreme salinity in their deep subsoil. Recent soil test also indicate moderately high exchangeable sodium in some subsoil samples. Most soils were high in magnesium resulting in low calcium to magnesium ratios in many cases.

1.2.3 <u>Climate</u>

The Parkes district has a temperate climate. Summers are warm to hot with average maximum daily temperatures of 31°C to 33°C in the months of December to February, falling to 14°C to 17°C in the winter months of June to August.

Frost occurrence is heavily influenced by local factors such as topography, however the main recording stations in the area report an average of 19 to 25 frosts per annum.

Rainfall has a slight summer dominance, and generally declines from north to south and from east to west. The Avondale recording site near the Project area has averaged 581 mm of rainfall per annum.

According to the CSIRO, the future climate of the subject areas is likely to be warmer and drier than in the past.



1.2.4 Land and Soil Capability

The Project area comprises mainly class II (46.6 hectares) and class III (191.8 hectares) under the Soil Conservation Service's Rural Land Capability classification. These classes are suitable for regular cultivation, although it is recommended that cropping be undertaken on class III land on a rotational basis. The area surrounding the Bogan River, just outside the Project area, is classified as class IV, land not suitable for regular cropping.

1.2.5 Agricultural Support Infrastructure

The farming operations on NPM land holdings and surrounding areas are located adjacent to the sealed Bogan Road and are located a moderate distance from Parkes. Graincorp operates a number of grain delivery points around the farming properties including primary sites at Parkes and Red Bend.

Parkes provides most support services required by the agricultural industry located in the vicinity of the Project area, including NPM's farms. These services include sale agents, farming supplies, fertiliser sales, plant & machinery sales, employment services and banking.

1.3 Strategic Agricultural Land

It is unlikely that land affected by the Project will be classified as "strategic agricultural land" in the future, based on the current definitions utilised in Strategic Regional Land Use Plans ("SRLUPs") for the New England-North West and the Upper Hunter. Under these SRLUPs, land can be classified as "strategic agricultural land" if it qualifies as either a "critical industry cluster" or "biophysical strategic agricultural land".

It is highly unlikely that any parts of the Project area would be classified as "critical industry cluster" and therefore be considered "strategic agricultural land" under this category as part of a future SRLUP.

Conversely, much of the farming land around the Project area meets the rainfall or water criteria for classification as "biophysical strategic agricultural land". However, the vast majority of this land does not appear to meet both the LSC¹ and soil fertility criteria. Therefore, farming land affected by the Project is unlikely to be classified as "biophysical strategic agricultural land".

¹ LSC - Land & Soil Capability.



1.4 Agricultural Enterprises

1.4.1 Crop Types

Crops grown on the agricultural lands located within the Project area in recent years have included wheat, barley, canola, mustard, chickpeas, field peas and lupins. Wheat, barley and canola have been the largest of these crops.

The choice of crops for the Project area and surrounding NPM land holdings is constrained by climatic factors and a lack of irrigation. It is expected that the cropping enterprises in the Project area and NPM land holdings will continue to be dominated by wheat, barley and canola for the foreseeable future.

1.4.2 <u>Productivity</u>

Information on the productivity of farming properties in the Parkes area is available from various sources including NSW Department of Primary Industries gross margin budgets and NSW Grains Report, ABARES Farm Surveys, NPM's own cropping data.

Past production of cereals by NPM has been higher than district averages. This is advantage is expected to continue.

The expected productivity in the Project area and NPM land holdings is assessed as:

- barley 2.02 tonnes per hectare,
- canola 1.14 tonnes per hectare,
- grain legumes 1.06 tonnes per hectare, and
- wheat 1.93 tonnes per hectare.

1.5 Agricultural Impact Assessment

1.5.1 Loss of Productivity

It is estimated that approximately 117 hectares of arable agricultural land in the Project area will be lost due to mine expansion and development, and through the severance of arable areas. This represents approximately 4.3% of the average crop land within the NPM land holdings in recent years (Table 6). This affected area is currently part of the cropping program operated by NPM and the lost agricultural production is estimated using a gross margin analysis.

The foregone gross income is estimated at \$55,155 per annum, while savings in expenses are estimated at \$38,419 per annum. The foregone gross margin profit is \$16,736 per annum.



1.5.2 <u>Other Impacts</u>

The Project is not likely to have a significant effect on agricultural diversity in the region, or any significant impact of an environmental nature on surrounding agricultural land.

No material changes to agricultural land values are expected due to the effects of the Project.

1.5.3 <u>Regional Effects</u>

The average gross value of agricultural commodities expected to be produced in the Parkes local government area is estimated at approximately \$140 million per annum.

By comparison, the impact of the Project on gross agricultural income is estimated at approximately \$51,855 per annum or only 0.04% of the expected average production in the Parkes local government area.

The very small expected impact on agricultural production should mean that any socio-economic effect within the region arising from reduced agricultural income associated with the loss of a small amount of agricultural land associated with the Project will be negligible.

1.5.4 <u>Mitigation</u>

Given the small size of the economic impact on agriculture at both the local and regional scale, it is envisaged that no mitigation activities are warranted. NPM is committed to the operation of current farming practices on its land holdings for the life of the Project ensuring an ongoing positive contribution to the agricultural industry in the region.

2 Introduction





2.1 **Project Overview**

Northparkes Mines ("NPM") is a copper-gold mine located approximately 27 kilometres north of Parkes in central west New South Wales (Figure 1 page 16).

The NPM land holdings in this area comprise approximately 6,217 hectares which encompass the Project area as well as surrounding agricultural land holdings ("NPM land holdings").

NPM is a joint venture between Rio Tinto (80 per cent), Sumitomo Metal Oceania Pty Ltd. (13.3 per cent) and Sumitomo Corporation (6.7 per cent). Mining operations at NPM commenced in 1993. Since that time, NPM have progressed with the development of open cut (ceased operating in October 2010) and underground mining operations, and associated infrastructure. NPM currently employs over 700 full time equivalent staff.

NPM have undertaken extensive exploration and review of operational scenarios. The review has identified opportunities for the development of a significant resource to provide for extended operations into the future.

The Northparkes Step Change Project ("the Project") encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases and an extended mine life of 7 years until 2032.

The Project area is shown in Figure 2 and consists of existing and proposed mining operations and associated infrastructure. Figure 2 shows the major components of the Project which include:

- Continuation of approved underground block cave mining in the E48 and E26 ore bodies, and associated underground infrastructure;
- Development of underground block caving in the E22 resource beneath the E22 open cut void;
- Campaign open cut mining through development of five open cut resources including;
 - Development of four small open cut pits E31, E31N, E28, E28N; and
 - Proposed E26 open cut which is located in an area of previous underground block cave subsidence (existing vertical extent of subsidence void is approximately 200 metres);
- Amendments to the configuration of tailings storage facilities (TSFs) including



- continuation of tailings disposal to the existing and approved TSFs (TSF 1 and 2, infill between TSF 1 and 2, and Estcourt) to an approved height of 28 metres;
- provision for additional raises on Estcourt TSF to provide for an increased height from the approved 25 metres to up to approximately 28 metres above ground surface; and
- development of a new TSF 3, which will extend to the south and from the southern embankment of TSF 2 to a height of approximately 28 metres above ground surface, which incorporates the approved Rosedale TSF;
- Development of new waste dumps for the management of E28/E28N and E26 open cut waste rock. Waste rock from open cut mining areas will be utilised in the development of TSF 3.
- Continuation of approved ore processing infrastructure up to 8.5 Mtpa capacity, and road haulage of copper concentrate to the existing Goonumbla rail siding;
- Continued use of existing site infrastructure including administration buildings, workshop, internal access roads and service infrastructure;
- Continued use of surface mining infrastructure including ventilation shafts, hoisting shaft and ore conveyors;
- Continuation of existing approved water supply and management processes;
- Development of an amended access road to service all mine related traffic entering the site;
- Establishment of new visitor car parking facilities and access control to support the amended mine site access;
- Continuation of approved mining operations for an extended life of an additional 7 years until the end of 2032; and
- Rehabilitation and closure of the mine site will be carried out after the end of the operational life of the Project in accordance with relevant approvals.

Attachment 1 provides a summary of the key elements of the Project and provides a comparison between the Project and the existing and approved operations.

The Project will involve physical disturbance to existing agricultural areas and enterprises as a result of the development of new mining areas, waste rock dumps, access control, site access road and visitor car park (Figure 2 page 18). These areas occur outside of the existing and approved operational areas as shown on Figure 2, and only include areas of land owned by NPM.



2.2 Purpose of this Report

The purpose of the AIA is to identify and assess the potential impacts of the project on agricultural resources and enterprises resulting from the Project both as a result of physical disturbance through the expansion and development of mining areas and additional infrastructure.

The first part of the AIA (Sections 3, 4 and 5 of this report) provides a baseline of the agricultural resources of the Project area and surrounding areas upon which the impact of the Project can be assessed. This part describes and assesses factors such as topography, climate, soil characteristics & classifications, land capability and infrastructure within areas subject to disturbance.

The baseline information will contribute to an agricultural dataset upon which a quantitative and qualitative assessment can be made regarding the Project's impact upon the agricultural resources and enterprises both onsite and within the broader region.

The following tasks are undertaken in the first part of the AIA:

A detailed resource and land use assessment including:

- assessment of land capability for the Project area;
- description of soil and water resources which are used or are capable of being used for agriculture including soil mapping classifications for the Project area;
- provision of a detailed assessment of existing agricultural productivity for properties subject to disturbance as a result of the Project; and
- identification of any regionally or state significant agricultural resources in the locality that may be impacted by the Project.

The second part of the AIA (Sections 6 to 10) specifically considers the impact of the Project upon agricultural enterprises in areas surrounding the Project area. This part includes a detailed assessment of the potential impacts on soils, land capability, landforms, topography, and land use. It addresses issues such as:

- detailed description of agricultural enterprises which may be impacted by the Project;
- a detailed assessment of the potential impacts of the Project on agricultural enterprises;
- a detailed description of the measures to avoid, reduce, or mitigate impacts on agricultural resources and enterprises; and
- justification for significant long term changes to agricultural resources.



Part 1

Agricultural Resource Assessment



3 Assessment of Agricultural Resources

3.1 Location and General Description

The NPM land holdings are comprised of approximately 6,217 hectares which encompass the Project area as well as surrounding agricultural land holdings and are located approximately 27 kilometres north-west of Parkes (Figure 1 - Location Map).

The Project area covers approximately 2,644 hectares, while the remaining land serves as a buffer between mining operations and the surrounding privately owned agricultural land holdings. Some land within the Project area is currently managed for agricultural land use. The agricultural land within the NPM land holdings is managed by NPM primarily for cropping, with small areas of native vegetation distributed along the margins of the agricultural lands.

Wildlife corridors have been established that link mine lease rehabilitation with remnant vegetation on the agricultural properties. The corridors are established or improved along fence lines, roadsides, creeks and drainage lines. NPM advise that this program has involved the planting of approximately 10,000 trees per annum and more than 150,000 trees have been planted to date across the NPM land holdings. A detailed review of the vegetation within the NPM land holdings and Project area is provided in the main EA report.

Together, the Project area and the surrounding buffer is termed the "NPM land holdings".

The farm strategy for agricultural land in the NPM land holdings has included:

- Increase paddock size and eliminate livestock grazing to improve cropping efficiency.
- Use of crop rotation (mainly winter cereals and canola) to help control weeds and disease.
- Use of zero till techniques and stubble retention to improve soil structure and fertility. Conservation farming was implemented across the land holdings in 1998. At this time, adoption of no-till techniques across central west NSW was relatively low at about 35% of farms (Llewellyn and D'Emden, 2009).
- Adoption of controlled traffic farming to limit soil compaction.

The NSW Department of Primary Industries established a number of agronomy trials across paddocks across NPM land holdings including large scale agronomy trials (including crop variety and type trials, and long term fertiliser and sowing trials). Trials have also been carried out for private companies and for NPM's own benefit. These trials are summarised in Table 1 on page 16.



Table	1 -	Agricultural	Trials
-------	-----	--------------	--------

Stakeholder	Period	Trial	Outcome
NSW DPI	2008 to 2013	Long term phosphorus trial	Five year trial established in 2008
NSW DPI	2008 to 2013	Long term row spacing & seed rate trial	Five year trial established in 2008
NSW DPI	Annual	Agronomy packages for new varieties	Results used by DPI
National Variety Trials	Annual	New varieties of wheat, barley & legumes	Published on the internet
Private Company	2006, 2007 and 2008	Large scale mineral fertiliser demonstration	Results provided via Central West Farming Systems field day and face to face.
Northparkes Mines	Annual	New varieties of cereals, legumes & oilseeds. Large scale demonstration	
Private Company	2006 and 2007	Alternately sourced varieties of wheat & barley	
Northparkes Mines	2006 and 2007	Different planting methods - discs versus tynes	
NSW DPI	2006, 2007 and 2008	Alternate production crop trial	Results used by DPI













Figure 2 - Project Area Map





3.2 Soils & Topography

3.2.1 <u>General</u>

The topography of the Project area is of low relief with gently undulating rises and depressions or drainage lines. There are some small areas of higher relief (5 to 15 metres) south of McClintocks Lane near the existing subsidence zone, and in the south east corner, but these areas are generally not cropped.

A major drainage line runs approximately south to north immediately to the west of the Project area, forming part of the headwaters of the Bogan River catchment. Another water course (Goonumbla Creek) commences in the south east corner of the Project area, and joins the Bogan River immediately west of the Project area. Tenandra Creek also drains a small catchment in the southern part of the Project area, and also joins the Bogan River immediately west of the Project area (Figure 3).

The watercourses are generally ephemeral and only carry surface water after heavy rainfall events. The watercourses do not form deep channels and NPM have implemented appropriate stand off areas that are not cropped.

3.2.2 Soil Mapping

Cunningham (2006) identified 2 soil mapping units within the Project area.

Soil mapping unit 1 ("SMU1) was restricted to the areas where rock outcrops or occurs at relatively shallow depths. Soil mapping unit 2 ("SMU 2") occurs in midslope, lower slope, level plains and shallow drainage depression locations.

Cunningham undertook a survey on a limited part of the NPM land holdings to the south east of the main mining operations. However, the study area was adjacent to the farming areas affected by the Project, and our experience with the property, soil test results (see below) and recent observations indicate that soils across the remainder of the farming operation are similar to those described by Cunningham, apart from some alluvial soils along the Bogan River and associated watercourses. However, these alluvial soils are not utilised for grazing or cropping, and are not within the Project area.

The main differences between SMU1 and SMU2, is the depth of soil and amount of gravel and stone in the upper horizons (see below). Consequently, the vast majority of the land used for cropping is the deeper, less stony SMU2. The SMU 1 areas generally remain as native vegetation, have been planted to tree lots, or remain otherwise uncropped.

SMU1 Description:

Cunningham (2006) describes SMU1 as up to 88cm deep with firm to hardsetting surfaces, and some to much surface gravel.

The topsoil ranges widely from loam to clay loam, with a pH of 5.0 to 7.0 in water, and usually hydrophobic.



Texture generally becomes more clayey with depth and the subsoil has a pH of 5.5 to 7.5. Some to much angular gravel to 4cm is present and the subsoil usually not hydrophobic.

SMU2 Description

The SMU2 soils are deeper to 280 cm deep with variable surface condition including firm, self-mulching, loose, soft or hardsetting and little surface stone or gravel.

The topsoil ranges from silty clay, to medium to heavy clays which are sometimes hydrophobic. The pH is usually in the range of 5.0 to 6.5.

Subsoils have clay texture throughout with horizons sometimes becoming gritty near bedrock.

<u>Erodibility</u>

Cunningham (2006) carried out 3 laboratory tests (particle size analysis, dispersion percentage, and the Emerson aggregate test) to assess the erodibility of the soil units.

These tests generally showed that the topsoils had slight to moderate dispersibility and susceptibility to erosion. The subsoils of SMU1 also showed negligible to slight dispersibility, but the subsoils of SMU2 displayed a wide range of dispersibility ranging from slight to very high.

The cultivated land is protected by soil conservation works, conservation tillage practices, stubble retention and an absence of livestock grazing. Cunningham (2006) noted that these factors contributed significantly to the absence of visible signs of erosion.

Salinity

Cunningham (2006) identified that most of the SMU2 soil profiles tested had moderate to extreme salinity in their deep subsoil. These saline layers were generally deeper than 60cm deep and would have little direct effect on crop growth. However, they may indicate a propensity for the some soils to develop dryland salinity problems under favourable conditions.

These saline subsoils were found 5 out of 6 profiles tested across most areas of SMU2 in the area studied by Cunningham.





Figure 3 - Topography of Northparkes Mines Land Holdings



3.2.3 Soil Test Results

Extensive soil testing is undertaken by NPM on a semi-regular basis across the NPM land holdings utilised for agriculture. In February 2012, soils tests were carried out in various paddocks (Attachment 5), including paddocks 14, 16 and 20 which were adjacent to farming areas that will be affected by the Project (see Figure 4). The results of this soil testing were reviewed to provide an indication of the relevant soil fertility characteristics of the land utilised for agriculture.

No soil testing was done at this time on the paddocks directly affected by the Project.

All soils were clay loams or clays, and most were slightly alkaline to moderately acidic in the surface layers (pH 6.1 to 7.8). The soil test are broadly consistent with the SMU2 soils surveyed by Cunningham (2006). The pH levels should not be a significant constraint to commonly grown crops.

Some soils had moderately to strongly alkaline subsoils. Subsoil alkalinity can indicate sodicity, reduce the availability of trace elements, and lead to toxic concentrations of some ions (such as boron, aluminium and bicarbonate). However, in this case there appears to be no boron or aluminium toxicity and no sodicity. Low available zinc levels in the subsoil tests (0.19 to 0.55 mg/kg) may be influenced by the alkalinity.

In general, there were adequate levels of nitrate nitrogen, phosphorus and potassium in the top soils, but nitrate nitrogen was low to very low in subsoils. Sulfate sulphur was generally low (3.0 to 8.4 mg/kg) with few test recording higher levels.

Cation exchange capacity was generally in the range of 9 to 25 meq/100g indicative of reasonably fertile soils. Exchangeable sodium percentages were low (generally 2% to 4%), however the 2 tests in paddock 28 gave sodic results greater than 6%. High exchangeable sodium can cause soil structural problems. However, the zero till, stubble retention and controlled traffic techniques adopted by NPM should minimise the effect on cropping.

Salinity (electrical conductivity less than 0.4 dS/m) and chloride (less than 66 mg/kg) were relatively low in all tests. The depth of sampling in these tests was not as great as some horizons of moderate to high salinity found by Cunningham (2006).

Most soils were high in magnesium resulting in low calcium to magnesium ratios in many cases (between 1.1 and 2.0). Low calcium to magnesium ratios can lead to structural problems in some soils and may be a primary cause of problems such as crusting sometimes observed in the subject soils. These problems have largely been alleviated by management techniques such as stubble retention and zero tillage.







3.2.4 Soil Landscapes

The soil landscapes of the Forbes area have been described in detail by King (1998). This study area did not extend as far north as the NPM land holdings, ending less than 2 km from the southern most point of the NPM property. However, two soil landscapes described by King (1998) and extensively found nearby, appear to be relevant to soils in the NPM land holdings based on the survey of Cunningham (2006), the soil test results, our observations and proximity.

Goonumbla Soil Landscape

The landform consists of crests, ridges and undulating slopes north west of Parkes with slope gradients of up to 15%.

Soils are varied reflecting the differing topography of the area. Shallow, welldrained soils including Lithosols and Red Podzolic Soils occur on crests. Shallow Red Earths, Euchrozems and Red Podzolic Soils are commonly found on upper and mid slope areas. Deeper, moderately drained Non-calcic Brown Soils occur lower slopes.

Generally, soil fertility is low to moderate. Low levels of phosphorus and nitrogen, shallow soils and stony areas limit plant production. Topsoil pH is neutral ranging to moderately alkaline in the subsoil.



Cation exchange capacity in the topsoil is moderate, with moderate levels of exchangeable calcium. Exchangeable magnesium and potassium levels are high, but sodium is low. Generally, exchangeable calcium and magnesium are high in the subsoil, while sodium and potassium levels are moderate.

Soils are non-sodic and non-saline. Observed soil structural problems include hardsetting surfaces, plough pans and sheet erosion. Erodibilility of the soils is moderate to high, and erosion hazard is moderate.

Cooks Myalls Soil Landscape

The landform consists of gently inclined slopes generally with slope gradients 3% to 8%. Local relief is less than 20 metres.

Moderately deep (> 50 cm) and moderately well-drained Red Podzolic Soils occur on slopes. Deeper, poorly drained Red Solodic Soils occur along drainage lines and lower slopes. Shallow to moderately deep (< 80cm) well drained Terra Rossa Soils, Red Podzolic Soils and Red Earths are found in areas of limestone and other sedimentary bedrocks. Small area of gilgai soils (Vertosols) also occur.

Generally, soil fertility is moderate, but Red Solodic Soils have low fertility and are often both saline and sodic. Soils have low to very low available phosphorus and moderately high to high phosphorus sorption capacity. Topsoil pH is moderately acid to neutral, increasing to moderate to high alkaline in the subsoil.

Cation exchange capacity is low to moderate, with moderate to high levels of exchangeable calcium, magnesium and potassium. Exchangeable sodium ranges from moderate for Red Podzolic Soils to very high in the subsoil of Red Solodic Soils.

Observed soil structural problems include hardsetting surfaces and sheet erosion. Erodibility of the soils is moderate to very high, and erosion hazard is high.

3.3 Water Resources & Water Infrastructure

There are more than 50 stock water dams on the NPM land holdings, plus the natural watercourses of the Bogan River, Goonumbla Creek and Tenandra Creek. As noted above the natural watercourses within and surrounding NPM land holdings are ephemeral and do not provide a reliable source for agricultural land uses.

No irrigation has been undertaken on the NPM land holdings and no irrigation infrastructure is present.



3.4 Climate

The closest Bureau of Meteorology recording stations to the Project area that measure temperature and other meteorological data are:

- Parkes Macarthur Street (Station number 065026),
- Peak Hill Post Office (050031),
- Parkes Airport AWS (065068).

The most important long term data from the Parkes (Macarthur Street) and Peak Hill stations are summarised in Attachment 2 and respectively.

There are also "rainfall only" recording stations supervised by the Bureau of Meteorology. These are discussed below in Section 3.4.4.

The locations of these rainfall recording stations are shown in Figure 6.

3.4.1 <u>Temperatures</u>

The Parkes district has a temperate climate with relatively little variation across the subject areas (Figure 5). Differences in topography and aspect produce variations in micro climate on a small scale, but in broader terms the climate is relatively homogenous.

Summers are warm to hot with average maximum daily temperatures of 31°C to 33°C in the months of December to February. Average maximum summer temperatures are generally 0.5°C to 1.0°C cooler in Parkes than Peak Hill, presumably because of its slightly higher elevation.

Minimum temperatures in summer generally average from 16°C to 19°C.

Winters are cool, and average maximum daily temperatures of 14°C to 17°C are recorded across the subject area in the months of June to August. Average minimum daily temperatures in winter are generally between 4°C and 6°C.

3.4.2 <u>Frost</u>

Temperatures frequently fall below 2°C in winter (the air temperature at which a frost may be expected).

A significant number of days with overnight temperatures of below 2°C can be expected between May and September, although this aspect is heavily influenced by local factors such as topography (Attachment 2 and Attachment 3). Parkes and Peak Hill average 25 days and 19 days per annum, respectively.







3.4.3 Evaporation

The Macarthur Street site in Parkes is the only nearby Bureau of Meteorology site that has measured evaporation and then only for a 12 year period between 1970 and 1982 (Attachment 2). Longer term evaporation data from the Wellington Research Station (Station number 065035 - 1965 to 2005) suggests that the Parkes data may underestimate historical evaporation rates.

Mean evaporation averaged 1.8 mm per day between May and August, rising above 7 mm per day in December and January. Mean annual evaporation was about 1,550 mm, with more than 42% of this occurring in the summer months. By comparison, the mean annual evaporation at the Wellington Research Station was about 1,800 mm.

Based on mean temperatures and relative humidities at Peak Hill (Attachment 3), evaporation rates at the Project area are likely to be 5% to 10% higher than at Parkes.



3.4.4 <u>Rainfall</u>

In addition to the recording stations referred to in Section 3.4, the Bureau of Meteorology maintains rainfall recording stations at a number of additional places around Parkes (Figure 6). Two of these are located in close vicinity of the Project area , namely:

- Goonumbla (Avondale) station number 050002
- Goonumbla (Coradgery) station number 050016.

Avonda Goonu ibla (C radger Source: Google Earth(2010) and NPM (2012) Note: Service Corridor assumed width 40m Northparkes Land Holdings Bureau of Meteorology Rainfall Stations

Figure 6 - Bureau of Meteorology Recording Stations



The Goonumbla (Coradgery) station has much missing data in recent years, and the Goonumbla (Avondale) data appears to be more reliable, although recorded over fewer years.

The Avondale site has averaged 582 mm of rainfall per annum over the past 70 years (Table 2).

Station:	Goonumbla (Avondale)	Goonumbla (Coradgery)			
Number:	050002	050016			
Opened:	1942	1882			
Status:	Open	Open			
Latitude:	32.92° S	32.97° S			
Longitude:	148.09° E	148.06° E			
Elevation:	274 m	290 m			
Mean	581.8	526.8			
Lowest	158.2	182.0			
5th Percentile	294.9	293.2			
10th Percentile	352.3	333.3			
Median	571.4	514.3			
90th Percentile	809.7	739.9			
95th Percentile	937.1	830.3			
Highest	1295.9	1191.9			

Table 2 - Annual Rainfall Statistics

Mean monthly rainfall statistics are presented in Table 3 (page 29).

Each of the stations exhibit a small summer dominance of rainfall, with no clear trend across the subject area. Mean long term rainfall in the 6 months from October to March is 10% to 20% higher than the mean rainfall from April to September.



<u>All Years</u>													
Station	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Goonumbla (Avondale)	56.0	59.5	47.3	42.7	50.8	39.1	44.4	45.6	40.7	53.2	55.4	47.5	581.8
Goonumbla (Coradgery)	52.0	47.9	39.1	40.9	43.0	44.0	41.3	42.7	37.1	44.5	45.6	46.7	526.8

<u>1961 to 1990</u>													
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Goonumbla (Avondale)	69.1	47.4	42.8	50.4	54.8	31.6	40.7	48.9	33.1	48.3	47.9	51.5	566.4
Goonumbla (Coradgery)	64.3	48.2	47.9	53.4	57.3	32.2	43.7	48.8	36.3	52.9	50.5	49.7	585.3

3.5 Climate Change

According to the CSIRO (2007a, 2007b) the Central West and Lachlan catchments have experienced warming of around 0.8°C since 1950, and this is likely to be partly due to human activities. They also report that the catchments have also experienced significant change in annual rainfall, with a trend toward decreasing rainfall of approximately 25 mm per decade in the south of the Central West Catchment and in the Lachlan Catchment. However, the contribution of human activities to this rainfall decline is hard to distinguish from natural variability.

The CSIRO (2007a, 2007b) conclude that the future climate of the subject areas is likely to be warmer and drier than in the past. There are likely to be differing effects on agricultural production, with higher carbon dioxide levels, warmer winter temperatures and less frosts favouring plant growth. Conversely, hotter summer temperatures, higher evaporation rates and lower rainfall will place greater constraints on production.

Studies of stream flows in the Murray-Darling Basin indicate that climate change is likely to reduce flows in the future and irrigated industries are likely to be affected by reduced water availability. This could lead to lower allocations and higher water prices in the long term (CSIRO 2007a, 2007b).

3.6 Land and Soil Capability

3.6.1 Definition and Methodology

As part of a basic inventory of the rural lands of NSW, rural land capability maps of the Eastern and Central Divisions were prepared by the then Soil Conservation Service in the late 1980s.

The aim of the Soil Conservation Service's Rural Land Capability classification is to delineate the various classes of rural land on the basis of the capability of



the land to remain stable under particular land uses (Cunningham et al, 1986).

The standard eight-class classification is based on an assessment of the biophysical characteristics of the land (such as climate, slope gradient, landform types, adverse soil conditions, rock outcrop, drainage and inundation), the extent to which these will limit a particular type of land use, and the technology available for land management. The classification has a hierarchical sequence, ranging from land with the greatest potential for agricultural or pastoral use, to that which is entirely unsuitable for either.

Class	Land use	Description
Ι	Mainly cropping	Suitable for a wide variety of uses. No special soil conservation works or practices necessary.
Π	Mainly cropping	Usually gently sloping land suitable for a wide variety of uses. Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation are necessary.
Ш	Mainly cropping	Sloping land suitable for cropping on a rotational basis. Structural soil conservation works such as graded banks and waterways are necessary, together with soil conservation practices as in Class II
IV	Mainly grazing	Land not suitable for regular cropping due to limitations such as slope, erosion, soil depth or climate. Occasional cultivation, better grazing land. Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture, maintenance of good ground cover.
V	Mainly grazing	Land not suitable for regular cropping due to considerable limitations such as slope, erosion, soil depth or climate. Similar to Class IV but not as productive, structural soil conservation works such as diversion banks and contour ripping, together with the practices in Class IV.
VI	Grazing	Not capable of cultivation, less productive grazing areas.
VII	Tree cover	Generally comprises of steep slopes, shallow soils and/or rock outcrops. Land best protected by trees and other vegetation.
VIII	Unsuitable for agriculture	Cliffs, lakes or swamps or other lands where it is impractical to grow agricultural produce or timber.

The classes (from Emery, undated) are as follows:



A revised rural land and soil capability classification system (Land and Soil Capability ("LSC") Mapping for NSW) has been developed by the NSW Department of Environment and Climate Change (now the Office of Environment and Heritage ("OEH")). It builds on the Rural Land Capability system and retains the eight class structure.

The LSC system has been used in the formulation of strategic regional landuse plans for the Upper Hunter and the New England-North West areas. In particular, it is part of the criteria for defining biophysical strategic agricultural land. However, it is understood that the data is not currently available in digital form to the public.

Figure 7 presents a rural land capability map for the Project area, including the areas of additional disturbance associated with the Project land holdings based on mapping undertaken by the Department of Land and Water Conservation (1989).

The mapping has been reviewed during property inspections of the Project area by the authors, and by reference to topographic and soils maps, and satellite images. No broad material inaccuracies have been identified in the original maps.

The land capability mapping was done at a broad scale, and there are some small areas of land within the class II and III which would be classified as class IV or V by more detailed survey. These areas are not cropped or grazed by NPM.

The Project area comprises mainly classes II and III (Figure 7). These classes are suitable for regular cultivation, although it is recommended that cropping be undertaken on class III land on a rotational basis.

Much of the class II and III lands is continuously cropped by NPM. The land capability system was devised in the 1980s before the common adoption of conservation farming techniques such as zero-tillage and stubble retention. Although it is recommended that cropping be rotated with pasture on class III land, the continuous cropping adopted by NPM does not include regular cultivation, and provides sufficient protection to sustain and improve the class III soils.

The area surrounding the Bogan River is classified as class IV, land not suitable for regular cropping. This land is not cropped or grazed by NPM, and is just outside the Project area.

Some small areas of class VI land (including Goonumbla Hill) are located to the south east of the Project area toward Goonumbla siding.

The areas affected by the Project are predominantly mapped as class III (191.8 hectares) with a smaller area of class II (46.6 hectares). These classifications relate to pre-mining capability. However, based on satellite images and observations made at the site, there are some areas affected by the Project that would be classified as class IV or V under larger scale mapping.





Figure 7 - Land Capability - NPM Land Holdings

32



3.7 Land Suitability

NSW Agriculture (now the Department of Primary Industries) produced agricultural land classification maps in the 1980s ranking land on its suitability for agricultural production. The maps are produced by evaluating biophysical, social and economic factors that that may constrain the use of land for agriculture. In general terms, the fewer the constraints on the land, the greater its value for agriculture (Hulme, et al, 2002).

The system has five classes of suitability for general agricultural use and was developed specifically to meet the objectives of the Environmental Planning and Assessment Act 1979. These classes range from:

Class 1 - Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.

to

Class 5 - Land unsuitable for agriculture or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which preclude land improvement.

The agricultural suitability of the areas impacted by the project have not been reviewed in depth. This is due to:

- A lack of digitised mapping of agricultural suitability,
- The availability of the land capability classifications as an alternative measure of agricultural suitability,
- The availability of topographical and soil measures, and historical land use, as an indicator of agricultural suitability, and
- The time elapsed since the preparation of the maps.

Hulme et al (2002) acknowledge that an inherent feature of agricultural land classification maps is that they have a limited life. The life span of the maps depends on changes to the biophysical, social and economic factors.

For example, most of the arable land across the Project area would be classified as class 2. This class consists of "arable land suitable for regular cultivation for crops but not suited to continuous cultivation". However, the development of conservation farming techniques such as minimum tillage and stubble retention since the 1960s mean that these areas can now be continuously cropped (but not continuously cultivated) without soil degradation.



3.8 Agricultural Support Infrastructure

3.8.1 <u>Transport</u>

The Project area is adjacent to a sealed road to Parkes, and is otherwise serviced by all-weather gravel roads. The property is also situated close to major road links including the Newell Highway (which is the main north-south inland highway in NSW), the Parkes-Condobolin Road, the Parkes-Orange Road and the Renshaw McGirr Way (Parkes to Wellington).

Rail links in the area include the Sydney Adelaide rail corridor, the Parkes-Narromine railway, and the Parkes-Stockinbingal line.

The area is well served by major transport links, and a 24 hour, 7 days per week multi-modal transport facility near Parkes has been established to capitalise on these links.

Graincorp operates a number of grain delivery points near the Project area including primary sites at Parkes and Red Bend, and major sites at Mickibri, Gunningbland, Peak Hill, and Bogan Gate. Goonumbla silo is located close the Project area, and was previously operated by Graincorp and Grenfell Commodities.

A commercial air service to Sydney (which is approximately 50 minutes by air) is operated out of Parkes Airport with 3 daily return flights.

3.8.2 <u>Major Towns</u>

The Parkes township has population of approximately 11,800 with a further 4,200 residents in the surrounding villages and rural lands.

Parkes provide most support services required by the agricultural industry including sale agents, farming supplies, fertiliser sales, plant & machinery sales, employment services and banking. Other nearby larger centres include Forbes (50 km), (Dubbo (about 110 km) and Orange (about 120 km).

The Central West Livestock Exchange is located approximately 10 km north of Forbes. These modern saleyards hold cattle sales every Monday, prime lamb and sheep sales every Tuesday, and pig sales every second Friday.

Sheep abattoirs are located in Dubbo.



4 Strategic Agricultural Land

The Strategic Regional Land Use Plans ("SRLUPs") for the New England-North West and the Upper Hunter classified parts of these regions as "strategic agricultural land" under the criteria set out in the following subsections.

The New England-North West and the Upper Hunter do not cover areas relevant to the Project. The Project area is within the Central West Strategic Land Use Area. A draft Strategic Regional Land Use Plans Central West Strategic Land Use Area has not yet been released.

Despite this, this section assesses land affected by the Project against the "strategic agricultural land" criteria as defined in SRLUPs for the New England-North West and the Upper Hunter.

4.1 Definition and Methodology

4.1.1 <u>Critical Industry Clusters</u>

Under the Strategic Regional Land Use Plans for the New England-North West and the Upper Hunter, a critical industry cluster is an industry cluster that meets the following criteria:

- 1. there is a concentration of enterprises that provides clear development and marketing advantages and is based on an agricultural product;
- 2. the productive industries are interrelated;
- 3. it consists of a unique combination of factors such as location, infrastructure, heritage and natural resources;
- 4. it is of state, national and/or international importance;
- 5. it is an iconic industry that contributes to the region's identity; and
- 6. it is potentially substantially impacted by coal seam gas or mining proposals.

4.1.2 <u>Biophysical Strategic Agricultural Land</u>

Under the Strategic Regional Land Use Plans for the New England North West and the Upper Hunter, biophysical strategic agricultural land must meet the following criteria:

- 1. Is land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), and
- 2. Is land capability classes 2 or 3 under the Land and Soil Capability Mapping of NSW (OEH), and


- 3. Has reliable water of suitable quality, characterised by land having rainfall of greater than 350mm per annum (9 out of 10 years) or properties within 150m of:
 - a regulated river, or
 - unregulated rivers where there are flows for at least 95% of the time (ie the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers, or
 - groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids of less than 1,500mg/L.

- 4. Land that falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH), and
- 5. Land capability classes 1 or 2 under the Land and Soil Capability Mapping of NSW (OEH), and
- 6. Meets the same criteria listed under item 3, above.

4.2 Application to Subject Areas

4.2.1 Critical Industry Clusters

It is highly unlikely that any parts of the Project area would be classified a "critical industry cluster".

Existing agricultural industries are limited to relatively common livestock, and dryland cropping enterprises, and do not appear to meet the specified criteria for a critical industry cluster.

In particular, no existing industries appear to have the level of interrelationship, unique characteristics, degree of state importance, and contribution to the region's identity to warrant classification as a "critical industry cluster".

Areas in the New England North West and the Upper Hunter regions similar in nature to the mixed farming and dryland cropping areas of Parkes have not been classified as a "critical industry cluster" in the relevant Strategic Regional Land Use Plans.



4.2.2 Biophysical Strategic Agricultural Land

Much of the land in the Project area potentially meets some of the criteria for classification as "biophysical strategic agricultural land" as outlined below.

Rainfall and Water

All land in the Parkes and Forbes regions would meet the criteria of having an annual rainfall of greater than 350mm per annum in 9 out of 10 years.

Land and Soil Capability

Biophysical strategic agricultural land must also be land capability classes 2 or 3 under the Land and Soil Capability Mapping of NSW ("LSC"). These classes are defined as follows:

<u>Class 2</u> - Slight but significant limitations - Land capable of sustaining high impact land uses which can be managed by readily available, easily implemented management practices

<u>Class 3</u> - Moderate limitations - Land capable of sustaining high impact land uses which can be managed by more intensive, readily available and accepted management practices

These classes correspond relatively closely with classes II and III of the older land capability system (Section 3.6.1).

Most of the Project area are mapped as classes II and III under the land capability system, and are likely to be classified as classes 2 or 3 under the LSC.

Soil Fertility

Under the New England North West and Upper Hunter SRLUPs "biophysical strategic agricultural land" must be either:

- land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), or
- land of 'moderate' soil fertility and class 1 or 2 under the LSC.

A draft "pre publication" map of the Central West Strategic Land Use Area, which includes the Project area, has been provided by Richard Hicks (OEH - Dubbo). However, the large scale (1:1,170,000) and the low quality of the maps makes analysis of the soil fertility classifications in relevant areas difficult and potentially inaccurate.

However, the metadata for the dataset² indicates that fertility levels are derived from a lookup table system linking a fertility class to a particular soil type (Great Soil Group). The metadata also includes a copy of this lookup table (Attachment 6).

² http://www.environment.nsw.gov.au/resources/soils/SRLUP_1_5_Fertility_v1_4_Metadata_120411.pdf



The soils which are common in the Project area, such as Red Podzolic Soils, Red Earths, Non-calcic Brown Soils, Red Clays and Brown Clays are all classified as moderately low fertility or moderate fertility.

It is noted that Cunningham (2006) describes soils according to "The Australian Soil Classification - An Interactive Key" (Jacquier et al, 2001), rather than Great Soil Groups. His classification of Red Dermosols and Red Chromosols in SMU1 indicate soils similar to Red Podzolic Soils, Red Earths, and Non-calcic Brown Soils found in the Goonumbla soil landscape. The vertosols of SMU2 are similar to the Grey, Brown and Red Clays of the Great Soil Group classification.

4.2.3 <u>Summary</u>

While most of the Project area would meet the rainfall and land capability criteria for "biophysical strategic agricultural land" based on published definitions, soil fertility is not high enough to meet this criteria. Therefore, the vast majority of these areas are unlikely to be classified as "biophysical strategic agricultural land".

There may be small parts of the Project area that technically qualify as "biophysical strategic agricultural land" because they have moderate fertility and are class 2 under the LSC. However, at the scale of mapping that is expected, it is unlikely that such small areas of marginal fertility (that is a mixture of moderately low fertility and moderate fertility soils) would be included.

No part of the Project area is likely to meet the criteria for a "critical industry cluster".



5 Agricultural Enterprises

5.1 Past, Current and Potential Enterprises

Crops grown on the NPM land holdings in recent years have included wheat, barley, canola, mustard, chickpeas, field peas and lupins. Wheat, barley and canola have been the largest of these crops (see Table 6). This crop mix is similar to other farms in the surrounding district.

The choice of crops for the NPM land holdings is constrained by climatic factors and a lack of irrigation. Relatively low summer rainfall and high evaporation rates restrict the potential of summer crops. Some dryland summer crops could be grown on an opportunistic basis when soil moisture levels and the rainfall outlook are favourable. However, it is unlikely that summer cropping will become a major enterprise on the NPM land holdings unless there is a substantial change in climate.

Winter crop selection is also restricted somewhat by market, economic and rotational limitations. While some other winter crops such as oats, safflower, triticale, linseed, faba beans and rye could be grown on the NPM land holdings, restricted markets, low returns, unreliable yields or difficulties of inclusion into the cropping rotation are likely restrict their adoption.

It is expected that the cropping enterprises in the NPM land holdings will continue to be dominated by wheat, barley and canola for the foreseeable future. There may be some changes in the relative proportions of each crop, and perhaps greater grain legume crop areas will be planted. However, wheat, barley and canola are well suited to the soils, infrastructure and management, and are expected to remain the major crops.

5.2 **Productivity**

The various regional statistics and measures of crop yields are discussed below.

5.2.1 Gross Margin Yields

The NSW Department of Primary Industries publish gross margin budgets for various zones of NSW each year. The budgets include an estimate of typical yields, plus crop prices and expenses.

The Parkes area is near the boundary between the Central East and Central West zones used by the NSW Department of Primary Industries for dryland winter crops. Therefore, the yields set out in the 2012 budgets of the most common crops grown in the area are set out for both zones below.

Dryland yields in the Central West zone are substantially lower than that in the Central East zone, generally by 30% to 50%. This is mainly due to lower



average rainfall and higher temperatures in the western areas. Under good management and good seasons in the Parkes district, yields should be more similar to those budgeted for the Central East zone, than for the Central West zone. However, the budgeted Central East yields do not fully allow for the chance of droughts and other causes of crop failures or greatly reduced yields that are more prevalent in the Parkes district than in higher rainfall areas to the east.

Table 4 - Budget Crop Yields					
<u>Gr</u>	oss Margi	<u>n Budget Crop Y</u>	ïelds		
NSW De	partment o	of Primary Indust	<u>ries - 2012</u>		
	<u>Short</u>	<u>Fallow (No Till)</u>			
		Budge	t Yields		
		(tonnes p	er hectare)		
		Dryland	Dryland		
Central East Central West					
Winter Crops					
Barley	Malt	4.2	1.9		
Canola		2.5	1.6		
Chickpeas 2.2 1.6					
Field Peas2.51.8					
Lupins	Albus	Albus 2.3 1.2			
Oats	Grain	3.4	2.2		
Wheat 3.8 1.8					



5.2.2 NSW Grains Report

The NSW Department of Primary Industries also publish the NSW Grains Report around seven times per year. The NSW Grains Report provides forecasts and estimates made by the Broadacre Cropping Unit concerning crop area, production and yield for New South Wales by crop type and region. Forecasts are made during the growing season and final estimates of production and yield are made after harvest.

The data in the NSW Grains Report is set out for the Parkes region and is available for the 19-year period from 1993 to 2011 (Table 5).

NSW Grains Report - 1993 to 2011					
		Parkes			
	Average	Average Average Annual Yi			
	Area	Yield	Range		
	(hectares)	(tonnes per ha)	(tonnes per ha)		
Winter Crops					
Wheat	72,632	1.72	0.4 to 3.0		
Barley	21,816	1.75	0.4 to 3.0		
Oats	10,029	1.34	0.2 to 2.5		
Chickpea	756	1.03	0.3 to 1.5		
Field Pea	1,147	1.18	0.3 to 1.9		
Lupins	3,279	1.07	0.2 to 2.1		
Canola	6,616	1.14	0.3 to 2.1		
Other	1,684				

 Table 5 - Crop Yields - NSW Grains Report

 Average Crop Yields

 NSW Crains Report

 1002 to 2011

The average crop yields set out in Table 5 are lower than the budgeted yields in Table 4. This is because the yields in the NSW Grains Report are averaged across all seasons, including about 6 substantially drought-affected crops in the last 19 years. The NSW Grains Report also take into account all standards of crop management, while the budgets assume a good standard of management.

Few summer crops are grown in the Parkes region and these are not included in the summary.

Yields have fluctuated widely over the 19-year review period. However, there has been no apparent strong trend to higher yields over this period (Figure 8, page 42).



Figure 8 - Winter Crop Yields



5.2.3 ABARES Farm Surveys

ABARES undertakes annual farm surveys across Australia. Results are disaggregated into regions, with Region 122 being relevant to the Parkes area. Region 122 (central western NSW) includes the shires of Bland, Cabonne, Coolah, Coonabarabran, Cowra, Dubbo, Forbes, Gilgandra, Lachlan, Mudgee, Narromine, Weddin and Wellington, in addition to Parkes.

Average wheat yields from ABARES farm surveys are published, with data available from 1991 to 2011. These are summarised as follows:

Average	1.84 tonnes per hectare
High	3.21 tonnes per hectare
Low	0.33 tonnes per hectare

These overall results are similar to the yields set out in the NSW Grains Report for the period from 1993 to 2011.

Similar to the NSW Grains Report data, yields have fluctuated widely over the 21-year review period. However, there has been no apparent strong trend to higher yields over this period.



5.2.4 NPM Data

NPM has operated the farming property in the NPM land holdings for an extended period, and has extensive records of crop productivity by paddock, crop type and seasons.

Summaries of the crops grown by NPM in the NPM land holdings are given below in Table 6.

Table 6 - NPM Crop Yields

Average Crop Yields					
NPM Land holdings					
	2008	2009	2010	2011	Average
Barley					
Area (hectares)	1,132	1,014	1,229	862	1,059
Production (tonnes)	3,523	1,745	2,392	1,829	2,372
Yield (tonnes per hectare)	3.11	1.72	1.95	2.12	2.24
<u>Canola & Mustard</u>					
Area (hectares)	49	587	161	749	386
Production (tonnes)	18	315	52	703	272
Yield (tonnes per hectare)	0.37	0.54	0.32	0.94	0.70
<u>Wheat</u>					
Area (hectares)	1,238	1,089	1,353	961	1,160
Production (tonnes)	2,679	1,190	3,493	2,569	2,483
Yield (tonnes per hectare)	2.16	1.09	2.58	2.67	2.14
<u>Grain Legumes</u>					
Area (hectares)	91	288	60		147
Production (tonnes)	102	328	90		173
Yield (tonnes per hectare)	1.11	1.14	1.51		1.18
<u> Total - All Crops</u>					
Area (hectares)	2,510	2,978	2,803	2,572	2,716
Production (tonnes)	6,321	3,579	6,027	5,101	5,257
Yield (tonnes per hectare)	2.52	1.20	2.15	1.98	1.94

Crop Vield .

There have been 3 reasonably good growing seasons in the last 4 years. Therefore, the yields achieved by NPM are generally much higher than the average district over the last 19 years (Table 5).

On a year by year comparison, the cereal yields over the last 4 years have been relative good. NPM wheat yields between 2008 and 2011 have averaged 12% more than the Parkes average over the same period from the NSW Grains Report. Similarly, NPM barley yields have been 23% higher. Conversely, yields achieved by the NPM canola crops have been variable, being 34% higher



than the Parkes average in 2009, but 41% lower in 2011.

Various grain legume crops have been grown by NPM between 2008 and 2011. The amounts in Table 6 include chickpea, field pea and lupin crops.

5.2.5 <u>Assessed Productivity</u>

Past production of cereals in the NPM land holdings has been higher than district averages. This advantage is expected to continue. Therefore, the assessed productivity of the area is based on past actual yields.

The past average yields of various crops grown by NPM between 2008 and 2011 are set out in Table 6 above. However, seasonal conditions in this period have probably been somewhat better than may be expected as a long term average, and certainly better than experienced in the last 19 years, on average. Therefore, the expected productivity is assessed at 90% of the actual past average yields.

Expected productivity of the canola crops is assessed at the 19-year average for the Parkes region as set out in Table 5 (1.14 tonnes per hectare).

Expected productivity of the grain legume crops is assessed at 90% of the actual average past yield set out in Table 6.

On this basis, the following expected productivity (tonnes per hectare) in the NPM land holdings is assessed:

Dryland Winter Crops			
Barley	2.02		
Canola	1.14		
Grain Legumes	1.07		
Wheat 1.93			



Part 2

Agricultural Impact Assessment



6 Impacts on Agriculture

.....

The impact of the Project on agricultural enterprises will be limited to the loss of some agricultural land currently owned by NPM to mine developments in the Project area, due to the development of new mining areas, waste rock dumps, access control, site access road and visitor car park.

Some agricultural land in the NPM land holdings will be lost due to mine expansion and development (Figure 2 - Project Area Map). The total disturbance area is estimated at 238.4 hectares, however not all of this area is utilised for agriculture. It is estimated that arable agricultural land totalling approximately <u>110 hectares</u> will eventually be occupied by mining areas and infrastructure associated with the Project. Figure 9 (page 47) shows the areas of the site currently used for agricultural activities that will be directly affected by the proposed mine expansion areas.

The agricultural land directly affected by the proposed mine expansion is mostly arable cropping areas but also includes some small revegetation areas and non arable areas not currently used for any agricultural enterprises. The additional disturbance will therefore affect the cropping enterprises operated by NPM, including wheat, barley and canola growing. The effect will be limited to most or all of paddock 13 and parts of paddocks 11, 15 and 17 (Figure 4).

In addition to agricultural land directly affected by expanded mining areas and infrastructure associated with the Project, some additional arable areas will probably be taken out of production. This will occur when small arable areas become severed from other arable areas because of the mine expansion. These areas will probably be uneconomic to continue cropping because of their small size. Areas affected include the northern part of paddock 17, the north western part of paddock 15, and the eastern part of paddock 11.

As noted above, the arable agricultural land area directly occupied by mining and infrastructure associated with the Project is estimated at approximately 110 hectares. However, the total area of arable land lost as a result of the Project (including land directly occupied and severed land) is estimated at approximately <u>117 hectares</u>.

The total area directly occupied by the Project consists of approximately 46.6 hectares of land capability class II and 191.8 hectares of class III (Figure 7). The area of arable land lost as a result of the Project (approximately 117 hectares) is relatively evenly split between land capability class III (approximately 65 hectares) and class II (approximately 52 hectares). These areas represent the pre mining classification of the subject land.

The impacts associated with the loss of this area of agricultural land are discussed and assessed in the following sections.



Figure 9 - Land Use





7 Gross Margins

Most of the expected impacts on agriculture are related to changes in enterprises. The usual method of analysing enterprise change is through gross margin analysis of the expected enterprise income and expenses.

A gross margin of an enterprise is the gross income of the enterprise less the variable expenses incurred in generating the enterprise income. Therefore, a gross margin analysis only considers gross income and variable costs, it does not address fixed (or overhead) expenses. The effect of the project on overhead expenses is expected to be relatively small compared to the impact on income and variable costs. This impact will be assessed separately.

The relevant gross margins of the major agricultural enterprises in the NPM land holdings are discussed in the following sections.

7.1 Dryland Wheat Gross Margin

Dryland wheat has been a major component of the past cropping at the NPM land holdings and throughout the Parkes district. It is likely to continue to be an important crop in these areas irrespective of the Project. However, the Project is expected to reduce somewhat the amount of dryland cropping (including wheat) undertaken due to the expansion of mining and associated activities onto agricultural land owned by NPM.

7.1.1 Expected Income

The expected yield is assessed in Section 5.2.5. This assessment considered the yield data contained in NSW Department of Primary Industries gross margin budgets, the NSW Grains Report, ABARES Farm Surveys results and NPM's own yield records in assessing the expected average dryland wheat yield at 1.93 tonnes per hectare.

The expected average price is assessed at \$254 per tonne (delivered silo), which is the average of the gross value of production over the last 10 years, as published by ABARES in various issues of Agricultural Commodities (Attachment 7). This assessment is also made in light of the following:

- 1. The NSW Department of Primary Industries 2012 gross margin budget for wheat - central west zone (DPI Budget 1, page 76) is based on a higher price of \$275 per tonne (on farm). However, this is based on high quality prime hard wheat which would not be achieved in all years, and in all circumstances.
- 2. The average of the gross value of production over the last 5 years has been similar at \$255 per tonne (Attachment 7).
- 3. There has been no strong trend in prices over the last 12 years (Attachment 7).



4. According to ABARES Farm Surveys data³, wheat receipts have averaged approximately \$240 per tonne and \$250 per tonne of wheat sold respectively over the 5 and 10 years to 2010/11 (Attachment 8).

7.1.2 Expected Costs

The assessment of expected costs for the dryland wheat enterprise is mostly based on the 2012 NSW Department of Primary Industries gross margin budget - central west zone (DPI Budget 1, page 76).

Machinery operation, seed, fertiliser, herbicide, fungicide, harvest levy and insurance costs are all derived from the DPI budget. Cartage costs are estimated by WHK lvey.

The assessed dryland wheat gross margin is detailed in Budget 1 (page 73), and summarised below:

	\$ per hectare
Income	\$490.33
<u>Less</u>	
Machinery Operations	\$36.94
Seed	\$32.20
Fertiliser	\$117.80
Chemicals	\$50.63
Harvest & Cartage	\$81.78
Other	\$9.71
Total Variable Costs	\$329.05
Total Gross Margin	\$161.28

The wheat enterprise costs set out in the DPI budget have been reviewed against average crop costs set out in the ABARES Farm Surveys data for the NSW cropping industry (Attachment 9).

Average contract costs over the last 5 years (\$36.19 per hectare) surveyed by ABARES have been substantially lower than budgeted (\$81.78 per hectare). This reflects the historical reliance of NPM on contractors for harvesting and cartage, while many other crop producers carry out these functions themselves. It is assumed that NPM's reliance on contractors will continue into the future.

The estimated average surveyed chemical cost (\$63.58 per hectare) is similar to the budgeted amount of \$50.63 per hectare. The inclusion of some pasture chemicals in the surveyed amount, and the higher level of chemicals generally used on some crops such as canola probably accounts for some of the difference in the amounts.

Budgeted fertiliser costs (\$117.80 per hectare) are significantly higher than the

³ http://abares.win.hostaway.net.au/ame/agsurf/agsurf.asp



average surveyed costs (\$56.76 per hectare). The higher cost is justified by relatively low fertility of the soils on the NPM land holdings, and the higher assessed average yields. These factors are expected to increase fertiliser costs above the average surveyed amounts.

Budgeted seeds costs are also higher than the average surveyed amount. It is assumed that all seed will be purchased by NPM, while the average surveyed cost is lower because substantial amounts of seed is retained by some growers from previous crops. The seed costs are relatively small.

The above analysis indicates that the budgeted amounts are relatively consistent ABARES Farm Surveys data on crop costs.

7.2 Dryland Canola Gross Margin

Dryland canola has also been a major component of the past cropping at the NPM land holdings and throughout the Parkes district. Canola has been the fourth largest crop in the Parkes district between 1993 and 2011, behind wheat, barley and oats.

7.2.1 Expected Income

The expected yield is assessed as set out in Section 5.2.5. This assessment considers yield data contained in NSW Department of Primary Industries gross margin budgets, the NSW Grains Report, ABARES Farm Surveys results and NPM's own yield records, in assessing the expected average dryland canola yield at 1.14 tonnes per hectare.

The expected average price is assessed at \$494 per tonne (delivered silo), which is the average of the gross value of production over the last 5 years, as published by ABARES in various issues of Agricultural Commodities (Attachment 7). This assessment is also made in light of the following:

- 1. The NSW Department of Primary Industries 2012 gross margin budget for canola - central west zone (DPI Budget 2, page 78) is based on a slightly lower price of \$460 per tonne (on farm), equivalent to nearly \$480 per tonne at a local silo.
- 2. The average of the gross value of production over the longer period of 10 years has been lower at \$442 per tonne (Attachment 7). However, greater weight is given to more recent prices in this analysis. There has been a relatively strong trend to higher prices over the last 12 years.
- 3. According to ABARES Farm Surveys data⁴, canola receipts have averaged \$476 per tonne and \$458 per tonne respectively over the 5 and 10 years to 2010/11 (Attachment 10).

⁴ http://abares.win.hostaway.net.au/ame/agsurf/agsurf.asp



7.2.2 Expected Costs

The assessment of expected costs for dryland canola enterprises is mostly based on the 2012 NSW Department of Primary Industries gross margin budget - central west zone (DPI Budget 2, page 78).

Machinery operation, seed, herbicide, windrow costs, harvest levy and insurance costs are all derived from the DPI budget. Cartage costs are estimated by WHK lvey.

Fertiliser, harvest, aerial spray and pesticide costs are based on the DPI budget, but lower amounts have been used due to the lower yield assessed in this budget⁵, and therefore a lower expected level of inputs. The two late seasons insecticide sprays are applied to half of the crop area, on average, in this analysis, compared to 100% of the crop area for both sprays in the DPI budget. Nitrosul fertiliser application is halved compared to the DPI budget.

The assessed dryland canola gross margin is detailed in Budget 2 (page 74), and summarised below:

	\$ per hectare
Income	\$563.28
Less	
Machinery Operations	\$40.37
Seed	\$43.50
Fertiliser	\$141.50
Chemicals	\$64.83
Harvest & Cartage	\$139.95
Other	\$17.05
Total Variable Costs	\$447.20
Total Gross Margin	\$116.08

The canola enterprise costs set out the DPI budget have been reviewed against average crop costs set out in the ABARES Farm Surveys data for the NSW cropping industry (Attachment 9).

Average contract costs over the last 5 years (\$36.19 per hectare) surveyed by ABARES have been substantially lower than budgeted (\$139.95 per hectare). This reflects the historical reliance of NPM on contractors for harvesting and cartage and the higher requirement of canola crops for contract activities than most other dryland crops. It is assumed that NPM's reliance on contractors will continue into the future.

The estimated average surveyed chemical cost (\$63.58 per hectare) is similar to the budgeted amount of \$64.83 per hectare.

⁵ By comparison, the DPI budget is based on an expected yield of 1.6 tonnes per hectare.



Budgeted fertiliser costs (\$141.50 per hectare) are significantly higher than the average surveyed costs (\$56.76 per hectare). The higher cost is justified by relatively low fertility of the soils on the subject properties, and the higher fertiliser requirement of canola crops than most other dryland crops. These factors are expected to increase fertiliser costs above the average surveyed amounts. Average crop yields across the ABARES Farm Surveys data were also lower than budgeted in this analysis.

Budgeted seeds costs are also higher than the average surveyed amount. It is assumed that all seed will be purchased by NPM, while the average surveyed cost is lower because substantial amounts of seed is retained by some growers from previous crops. The seed costs are relatively small.

The above analysis indicates that the budgeted amounts are relatively consistent with ABARES Farm Surveys data on crop costs.

7.3 Dryland Barley Gross Margin

Dryland barley has been the second largest component of the past cropping at the NPM land holdings, only slightly behind dryland wheat. Across the Parkes district it is also the second largest crop, but the average area between 1993 and 2011 has been less than one-third of the average wheat crop. However, on average, the barley crop has been over 3 times the area of the canola crop over the same period (Table 5).

7.3.1 Expected Income

The expected yield is assessed as set out in Section 5.2.5. This assessment considers yield data contained in NSW Department of Primary Industries gross margin budgets, the NSW Grains Report, ABARES Farm Surveys results and NPM's own yield records in assessing the expected average dryland wheat yield at 2.02 tonnes per hectare.

The expected average price is assessed at \$206 per tonne (delivered silo), which is the average of the gross value of production over the last 10 years, as published by ABARES in various issues of Agricultural Commodities (Attachment 7). This assessment is also made in light of the following:

- 1. The NSW Department of Primary Industries 2012 gross margin budget for barley - central west zone (DPI Budget 3, page 81) is alternatively based on a similar price of \$180 per tonne (on farm) for malting barley⁶ and a much lower price of \$140 per tonne for feed barley. Feed barley prices fluctuate considerably, and the DPI budget reflects the relatively low prices prevailing at the time the budget was prepared.
- 2. The average of the gross value of production over the shorter period of the last 5 years has been similar at \$194 per tonne (Attachment 7).
- 3. There has been no strong trend in prices over the last 12 years (Attachment 7).

⁶ Equivalent to almost \$200 per tonne at silo.



7.3.2 Expected Costs

The assessment of expected costs for the dryland barley enterprise is mostly based on the 2012 NSW Department of Primary Industries gross margin budget - central west zone (DPI Budget 3, page 81).

Machinery operation, seed, fertiliser, herbicide, fungicide, harvest levy and insurance costs are all derived from the DPI budget. Cartage costs are estimated by WHK lvey.

The assessed dryland barley gross margin is detailed in Budget 3 (page 75), and summarised below:

	\$ per hectare
Income	\$415.77
Less	
Machinery Operations	\$19.72
Seed	\$37.45
Fertiliser	\$61.80
Chemicals	\$72.56
Harvest & Cartage	\$83.35
Other	\$8.16
Total Variable Costs	\$283.04
Total Gross Margin	\$132.73

The barley enterprise costs set out the DPI budget have not been specifically reviewed against average crop costs set out in the ABARES Farm Surveys data, as was done for wheat. The results of a comparison are expected to be similar to the wheat cost review (Section 7.1.2).



8 Expansion of Mine Area

8.1 Area Affected

Some agricultural land in the NPM land holdings will be lost due to mine expansion and development (Figure 2 - Project Area Map). It is estimated that agricultural land totalling approximately <u>110 hectares</u> will eventually be occupied by mining areas and infrastructure associated with the Project. Figure 4 shows the areas of the site currently used for agricultural activities that will be affected by the proposed additional disturbance areas.

In addition some additional arable areas will be taken out of production due to severance (Section 6). Therefore, the total arable area lost as a result of the Project is estimated at approximately <u>117 hectares</u>.

8.2 Effect on Agricultural Production

The arable agricultural area expected to be taken out of production is currently part of the cropping program operated by NPM.

The lost agricultural production is analysed using a gross margin analysis. The effect on the gross income and enterprise expenses of each dryland enterprise are calculated using the gross margins calculated in Sections 7.1 to 7.3.

The arable agricultural area taken out of production is assumed to be planted to wheat, canola and barley in the same proportions as grown by NPM over the period from 2008 to 2011. This has been approximately 45% wheat, 40% barley and 15% canola (see Section 5.2.4).

The effect of the mine expansion on the gross income and expenses of each dryland crop enterprise is estimated in Table 7 (below) using the gross margins calculated in Sections 7.1 to 7.3.

		Reduced	Reduced	
	Area	Gross	Enterprise	Foregone
Туре	(ha)	Income	Expenditure	Profit
Wheat	53	\$25,816	\$17,325	\$8,491
Canola	18	\$9,881	\$7,848	\$2,033
Barley	47	\$19,458	\$13,246	\$6,212
Total	117	\$55,155	\$38,419	\$16,736

The foregone gross income is estimated at <u>\$55,155</u> per annum, while savings in expenses are estimated at <u>\$38,419</u> per annum. The foregone gross margin profit is <u>\$16,736</u> per annum.



8.3 Other Potential Impacts

8.3.1 <u>Agricultural Diversity</u>

The Project is not likely to have a significant effect on agricultural diversity in the region. Diversity could be reduced if unusual or uncommon enterprises are particularly affected by the Project.

The physical expansion of the NPM's mine site will affect dryland cropping areas owned and managed by NPM. Nearly 97% of NPM's cropping between 2008 and 2011 has consisted of common crops such as wheat, barley, canola, field peas and lupins (see ARA report). Approximately 3% of the crop area has consisted of less common crops such as mustard and edible beans.

In addition, the area of dryland cropping taken out of production by the mine expansion is very small relative to the total dryland cropping in the region. For example, the NSW Grains report (December 2012) indicates that the total winter crop harvested in the Parkes region in 2012 was 177,500 hectares. The expected loss of arable area due to the Project (approximately 117 hectares) represents only 0.06% of the total winter crop area in the Parkes region.

8.3.2 <u>Environmental Impacts on Agricultural Lands</u>

The Project is not expected to have any significant impact of an environmental nature on surrounding agricultural land such as off site impacts or pest & weed management.

The Project has been designed to minimise emissions into the surrounding environment consistent with existing approved operations and relevant impact assessment criteria, and therefore no dust or noise issues are expected on surrounding agricultural lands.

The existing agricultural operations are undertaken by NPM according to best practices. Therefore, no pest or weed management issues are expected, due to the standard of those practices and the small size of the agricultural impact.

8.3.3 Changes to Agricultural Land Values

No material changes to agricultural land values are expected due to the effects of the Project.

The removal of some agricultural land as a result of the planned physical mine expansion should not have any effect on the value of surrounding farm land. No expansion of mining activities outside land currently owned by NPM is planned and no further purchase of agricultural land will be undertaken as part of the Project.



9 Regional Effects

A small economic impact to agriculture totalling \$16,736 per annum has been identified and quantified in Section 8 of this report.

Foregone Profit	\$16,736
Reduced Enterprise Expenditure	\$38,419
Reduced Gross Income	\$55,155

These impacts are contrasted to the size of the regional agriculture sector in the following subsections.

9.1 Study Area

The effect of the Project on agriculture will be largely manifested in the areas surrounding the township of Parkes. Parkes is the major population centres close to the mine, and is the major source of agricultural inputs such as fuel, fertiliser, chemicals and machinery. Parkes is also a transport and buying hub for agricultural produce.

Consequently, the area surrounding Parkes is the most relevant region against which to gauge the agricultural economic impacts of the Project.

Organisations such as the ABS report statistics over various statistical areas. A common statistical area is the "local government area". In this case, the relevant local government area is the Parkes Shire.

This local government area is the appropriate district for gauging the regional impacts as it encompasses the township of Parkes, and much of its economic zone of influence. The project area is also located in the Parkes Shire.



9.2 Regional Agricultural Production

The past values of agricultural commodities produced in the Parkes local government area and the broader Central West statistical division are set out below in Table 8.

Value of Agricultural Commodities Produced				
	Central West	Parkes		
	Gross Value	Gross Value		
	\$m	\$m		
2010-2011	1,513.3	173.1		
2009-2010	759.4			
2008-2009	874.8			
2007-2008	860.5			
2006-2007	741.6			
2005-2006	983.8	93.9		

 Table 8 - Value of Agricultural Commodities Produced

ABS Source:

75030DO011 Value of Agricultural Commodities Produced,

Australia, 2005-06 to 2010-11

Statistics for Parkes are not available for the period from 2006-06 to 2009-10, therefore the values for the Central West statistical division are included for reference. The Central West statistical division includes the Parkes local government area and 12 other local government areas ranging from Rylstone, Lithgow and Oberon in the east, to Lachlan and Bland Shire Councils in the west.

The total gross value of agricultural commodities produced in the Parkes local government area totalled just under \$94 million in 2005-2006. The value of agricultural production in the broader Central West statistical division was then relatively consistent between 2005-2006 and 2009-2010, averaging \$844 million per annum. It appears likely that the value of agricultural production in Parkes remained at similar levels to 2005-2006 in these years.

The total gross value of agricultural commodities produced in the Parkes local government area, and in the Central West statistical division increased markedly in the most recent year for which data is available (2010-11). The total value of agricultural production in Parkes in 2010-11 was approximately \$173 million, more than 84% higher than in 2005-2006.

The increase in 2010-11 was mainly fuelled by higher crop values due in part to substantially higher yields, but also to higher wheat, barley and canola prices. There were also large increases in sheep and wool prices, and a more modest



increase in cattle prices.

The period from 2005-06 to 2009-10 were characterised by dry seasonal conditions and lower than average crop yields (Section 5.2.2). Therefore, the gross value of agricultural commodities produced during this period is probably not indicative of expected future production.

Conversely, commodity prices, seasonal conditions and crop yields were better than average in 2010-11. Therefore, this year's results were probably also not indicative of expected future production.

A gross value of agricultural commodities of approximately \$140 million per annum appears to be a reasonable estimate for the expected average production in the Parkes local government area.

9.3 Regional Impact

The impact of the Project on gross agricultural income is estimated at approximately \$55,155 per annum (Section 8.2).

This is approximately **<u>0.04%</u>** of the expected average production in the Parkes local government area (\$140 million per annum).

The very small expected impact on agricultural production should mean that any socio-economic effect arising from reduced agricultural income within the region will be negligible. The effect of the Project on income from mining and associated sources has not been considered as it is beyond the scope of this report.

The effect on specialised agricultural services such as rural supply sellers, produce buyers, agents, processors, and contractors will be also be very small.



10 Mitigation

Given the small size of the economic impact on agriculture at both the local and regional scale, it is envisaged that no mitigation activities are warranted. NPM is committed to the operation of current farming practices on its land holdings for the life of the Project ensuring an ongoing positive contribution to the agricultural industry in the region.



11 Abbreviations

-	10 C - C		
-			

AIA	Agricultural impact assessment as a part of Environmental Assessment for the Project.
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences.
ABS	Australian Bureau of Statistics
DGRs	Director Generals Requirements.
DP&I	Department of Planning and Infrastructure.
DPI	NSW Department of Primary Industries.
DSE	Dry sheep equivalent.
EA	The Environmental Assessment for the Project.
EP&A Act	Environmental Planning and Assessment Act 1979.
ha	Hectares.
LSC mapping	Land and Soil Capability mapping for NSW.
NPM	Northparkes Mines.
OEH	Office of Environment and Heritage.
PEA	The Preliminary Environmental Assessment for the Project.
The Project	Northparkes Step Change Project.
SRLUP	Strategic Regional Land Use Plan
Umwelt	Umwelt (Australia) Pty Limited.



12 References

CSIRO (2007a). Climate Change in the Central West Catchment. CSIRO.

CSIRO (2007b). Climate Change in the Lachlan Catchment. CSIRO.

Cunningham, G. (2006) Soils Survey and Land Capability Assessment of the Northparkes Mines - E48 Project. Geoff Cunningham Natural Resource Consultants Pty Ltd

Cunningham, GM, Higginson, F.R., Riddler, A.M.H., and Emery, K.A. (1986) *Systems Used to Classify Rural Lands in New South Wales*. Soil Conservation Service and NSW Agriculture.

Department of Land and Water Conservation (1989) *Land Capability for NSW.* Digital mapping. Department of Infrastructure, Planning and Natural Resources Parramatta

Emery, K.A., (undated) *Rural Land Capability Mapping, Soil Conservation Service of NSW*. Soil Conservation Service and NSW Agriculture.

Hulme, T., Grosskopf, T., and Hindle, J. (2002). *Agricultural Land. Classification*. Agfact AC.25. NSW Agriculture.

Jacquier, D.W, McKenzie, N.J., Brown, K.L., Isbell, R.F. and Paine, T.A. (2001) *The Australian Soil Classification - An Interactive Key. Version 1.0.* CSIRO.

King, D.P. (1998). Soil Landscapes of the Forbes 1 : 250 000 Sheet. Department of Land and Water Conservation, Sydney.

Llewellyn, R. and D'Emden, F.H. (2009) Adoption of no-till cropping practices in Australian grain growing regions. GRDC.

Attachment 1 - Key Features of the Northparkes Mines Step Change Project

Major Project Components/ Aspects	Existing and Approved Operations	Proposed Operations
Mining Areas	 Underground block cave mining of E26 and E48 ore bodies; and Open cut mining of E22 (ceased in 2010). 	 Continued block caving of the E26 and E48 ore bodies (as per current approval); Development of block cave mining in the E22 resource (previously subject to open cut mining); and Development of open cut mining area in existing mine subsidence zone for E26 Development of four small open cuts to extract ore from E28, E28N, E31 and E31N. All proposed open cut mining areas are located within the existing PA 06_0026 Project Area and existing Mining leases.
Ore Processing	Up to 8.5Mtpa of ore, sourced from underground and open cut mining areas	Continuation of processing up to 8.5Mtpa of ore through the existing processing plant sourced from underground and open cut mining areas
Mine Life	• Until 2025	• Extension of mining by 7 years until 2032.
Operating Hours	• 24 hours a day, 7 days per week	No Change.
Number of Employees	Approximately 700 full time equivalents	
Mining Methods	 Multiple Underground Block Cave; and Campaign open cut mining yielding up to 2Mtpa which is stockpiled until required 	 Multiple Underground Block Cave; and Campaign Open cut mining of up to 6Mtpa for stockpiling and processing as required .
Infrastructure	Operation of:	Construction and operation of:
	 tailings storage facilities (TSF 1-4); ore processing plant including surface crusher, crushed ore stockpiles, active grinding mills, froth flotation area and concentrate storage; site offices, training rooms and workshop facilities; 	 tailings storage facilities to be augmented to connect existing and approved tailings facilities, through the development of TSF 3 southward from the existing southern embankment of TSF 2. The proposed TSF 3 will substantially include the approved TSF 3 (Known as Rosedale) (refer to Figure 2);
	 road haulage of concentrate to the Goonumbla rail siding for transport to Port Kembla; and an overland conveyor to 	 establishment of new waste rock dump and stockpiles to store waste material generated during open cut mining campaigns;
	 an overland conveyor to transport ore from the hoisting shaft to the ore processing plant stockpiles. 	 continued operation of existing processing plant, site offices, underground access, water supply

Major Project Components/ Aspects	Existing and Approved Operations	Proposed Operations
		infrastructure and logistics connections;
		 continued road haulage of concentrate to Goonumbla rail siding for transport to Port Kembla;
		 closure of the existing site access road through the development of TSF3;
		 provision of an upgraded site access road along a new alignment from McClintocks Lane;
		 development of a access control and visitors car parking at the intersection of the proposed site access and McClintocks Lane;
		 Upgrade/ sealing of McClintocks Lane between the NPM access road and Bogan Road; and
		 Upgrades as required to the intersection of McClintocks Lane and Bogan Road.



Attachment 2 - Climate (Parkes) PARKES (MACARTHUR STREET)

			<u> </u>	ARKE	5 (MAC		<u>UR 21</u>	REEI)	-							
Station Number:	065026															
Commenced: 1889		Last Red	ord: 201	12												
Latitude: 33.14° South		Longitud	e: 148.	16° Eas	st											
Elevation: 324 m												Sou	irce: Bureau	of Meteorolo	gy (27 Mai	rch 2012)
														Number	Start	End
Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	of Years	Year	Year
Mean maximum temperature (°C)	32.3	31.5	28.5	23.6	18.6	14.9	14.0	15.9	19.5	23.6	27.7	30.6	23.4	102	1907	2012
Decile 9 maximum temperature (°C)	38.0	36.7	33.2	28.5	23.5	19.2	17.8	20.4	24.8	29.7	34.0	36.2		55	1957	2011
Mean number of days >= 35° C	9.3	5.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.4	5.3	24.4	55	1957	2012
Mean minimum temperature (°C)	17.9	17.8	15.0	10.9	7.5	5.2	4.0	4.9	7.3	10.4	13.5	16.2	10.9	102	1907	2012
Decile 1 minimum temperature (°C)	13.0	13.3	10.0	6.1	2.7	1.0	0.0	0.6	2.8	5.4	8.0	11.0		55	1957	2011
Mean number of days <= 2 °C	0.0	0.0	0.0	0.2	2.3	5.7	9.2	5.8	1.6	0.2	0.0	0.0	25.0	55	1957	2012
Mean rainfall (mm)	57.6	49.1	46.5	41.6	47.2	49.6	49.1	49.2	41.8	52.4	49.5	53.0	586.9	122	1889	2012
Decile 1 monthly rainfall (mm)	7.3	5.3	4.3	6.9	6.6	15.9	10.8	13.7	11.0	15.9	5.8	9.9	381.5	121	1889	2012
Decile 5 (median) monthly rainfall (mm)	42.6	34.6	38.8	31.2	46.1	42.0	45.8	47.0	33.8	41.9	39.9	42.8	559.1	121	1889	2012
Decile 9 monthly rainfall (mm)	137.1	109.2	106.1	86.6	97.7	94.3	86.4	87.7	78.2	97.5	118.1	111.6	831.4	121	1889	2012
Mean number of days of rain	5.8	5.4	5.4	5.3	7.2	9.3	10.2	9.3	7.7	7.7	6.4	6.2	85.9	121	1889	2012
Mean daily solar exposure (MJ/(m²))	27.8	24.0	20.9	15.8	11.7	9.2	10.0	13.1	17.7	22.4	25.3	28.0	18.8	22	1990	2012
Mean number of clear days	13.0	11.3	13.8	12.9	10.8	8.9	9.1	9.7	11.2	10.8	10.7	12.8	135.0	54	1957	2010
Mean number of cloudy days	6.7	5.7	6.1	6.9	10.0	11.5	12.7	11.4	8.9	8.6	7.4	7.7	103.6	54	1957	2010
Mean daily evaporation (mm)	7.4	6.6	5.2	3.4	2.0	1.4	1.5	2.1	3.2	4.6	5.9	7.9	4.3	12	1970	1982
Mean 9am temperature (°C)	23.6	22.7	20.5	16.9	12.2	8.8	7.7	9.7	13.2	17.1	19.8	22.4	16.2	55	1955	2010
Mean 9am relative humidity (%)	53.0	58.0	60.0	64.0	76.0	82.0	82.0	75.0	66.0	58.0	54.0	50.0	65.0	53	1955	2010
Mean 9am cloud cover (oktas)	2.4	2.4	2.3	2.5	3.2	3.9	3.8	3.4	2.9	2.9	2.7	2.5	2.9	97	1907	2010
Mean 9am wind speed (km/h)	11.2	10.2	9.1	7.7	5.9	5.5	6.1	8.1	10.1	11.8	12.0	11.3	9.1	53	1957	2010
Mean 3pm temperature (°C)	30.7	30.0	27.2	22.8	17.7	14.3	13.0	14.8	18.1	22.1	25.9	28.9	22.1	55	1955	2010
Mean 3pm relative humidity (%)	34.0	37.0	39.0	43.0	53.0	60.0	60.0	54.0	48.0	42.0	36.0	32.0	45.0	53	1955	2010
Mean 3pm cloud cover (oktas)	3.9	3.9	3.8	3.8	4.3	4.6	4.6	4.5	4.2	4.3	4.1	3.8	4.1	55	1955	2010
Mean 3pm wind speed (km/h)	13.5	12.0	11.7	11.1	11.1	11.4	12.0	13.3	14.1	14.7	14.8	14.3	12.8	53	1957	2010



Attachment 3 - Climate (Peak Hill) <u>PEAK HILL POST OFFICE</u>

Station Number: Commenced: 1890 Latitude: 32.72° South Elevation: 285 m 050031

Last Record: 2012 Longitude: 148.19° East

Elevation: 285 m	Source: Bureau of Meteorology (27 March 2012)								rch 2012)							
														Number	Start	End
Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	of Years	Year	Year
Mean maximum temperature (°C)	33.1	32.4	29.3	25.0	20.0	16.2	15.2	17.0	20.5	24.6	28.1	31.2	24.4	45	1965	2012
Decile 9 maximum temperature (°C)	38.5	37.6	34.1	29.5	24.6	20.3	19.0	21.5	26.2	30.6	34.5	37.1		46	1965	2012
Mean number of days >= 35° C	11.5	7.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.7	6.7	31.1	45	1965	2012
Mean minimum temperature (°C)	19.2	19.3	16.3	12.2	8.8	6.1	4.8	5.8	7.9	11.5	14.4	17.2	12.0	45	1965	2012
Decile 1 minimum temperature (°C)	14.0	14.5	11.1	7.0	3.6	1.5	0.4	1.3	3.2	5.8	8.8	11.7		44	1965	2012
Mean number of days <= 2 °C	0.0	0.0	0.0	0.1	1.0	4.4	7.1	4.9	1.5	0.0	0.0	0.0	19.0	45	1965	2012
Mean rainfall (mm)	58.8	51.7	49.0	42.3	45.0	42.5	44.5	43.2	38.6	48.7	47.8	50.7	563.0	122	1890	2012
Decile 1 monthly rainfall (mm)	8.7	4.0	3.6	2.0	7.4	12.2	10.4	12.5	9.5	12.7	5.7	8.2	361.6	122	1890	2012
Decile 5 (median) monthly rainfall (mm)	43.8	33.7	36.8	27.7	42.2	35.0	39.8	37.7	33.5	41.1	31.4	41.6	546.4	122	1890	2012
Decile 9 monthly rainfall (mm)	138.6	106.9	120.9	95.1	88.3	78.2	77.7	81.6	74.7	95.7	105.9	110.1	775.5	122	1890	2012
Mean number of days of rain	5.1	4.9	4.5	4.4	5.7	7.2	7.4	6.9	6.2	6.4	5.4	5.1	69.2	122	1890	2012
Mean daily solar exposure (MJ/(m²))	27.8	24.1	21.0	16.0	12.0	9.6	10.3	13.5	18.2	22.5	25.3	28.0	19.0	22	1990	2012
Mean number of clear days	13.9	11.6	15.3	14.1	13.1	10.8	10.7	11.6	13.0	13.1	12.3	14.3	153.8	45	1965	2010
Mean number of cloudy days	7.7	6.9	7.3	7.1	10.4	11.3	11.0	10.9	8.6	9.1	8.3	7.5	106.1	45	1965	2010
Mean daily evaporation (mm)																
Mean 9am temperature (°C)	24.8	24.0	21.9	18.6	13.8	10.1	8.9	10.7	14.3	18.6	20.8	23.8	17.5	43	1965	2010
Mean 9am relative humidity (%)	52.0	57.0	58.0	61.0	73.0	81.0	81.0	73.0	64.0	54.0	53.0	49.0	63.0	20	1967	2010
Mean 9am cloud cover (oktas)	2.5	2.6	2.4	2.5	3.2	3.7	3.8	3.4	2.9	3.0	2.8	2.4	2.9	45	1965	2010
Mean 9am wind speed (km/h)	7.8	7.6	6.8	6.3	4.9	4.4	4.3	5.7	7.1	8.7	8.5	8.5	6.7	44	1965	2010
Mean 3pm temperature (°C)	31.6	30.9	28.0	23.9	18.9	15.2	14.2	16.0	19.2	23.4	26.8	29.9	23.2	43	1965	2010
Mean 3pm relative humidity (%)	32.0	36.0	38.0	42.0	52.0	61.0	59.0	51.0	44.0	38.0	36.0	31.0	43.0	20	1967	2010
Mean 3pm cloud cover (oktas)	3.7	4.0	3.7	3.5	4.0	4.3	4.1	4.3	3.9	3.9	4.0	3.7	3.9	45	1965	2010
Mean 3pm wind speed (km/h)	7.8	7.7	7.1	6.3	6.2	6.1	6.8	8.0	8.5	9.1	9.1	9.2	7.7	43	1965	2010



	Rainfall Stations near NPM land holdings												
Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	56.0	59.5	47.3	42.7	50.8	39.1	44.4	45.6	40.7	53.2	55.4	47.5	581.8
Lowest	0.0	1.4	0.0	0.0	1.0	0.4	2.9	0.4	0.4	0.0	0.2	0.0	158.2
5th Percentile	2.7	3.5	2.9	0.5	2.9	4.7	5.3	4.8	4.6	10.0	2.6	2.6	294.9
10th Percentile	7.1	7.4	4.6	3.3	8.0	10.6	7.4	6.2	9.1	16.9	8.6	4.4	352.3
Median	38.1	38.9	34.2	27.8	49.8	30.5	41.7	44.5	35.7	43.0	39.0	29.7	571.4
90th Percentile	120.8	149.6	100.6	77.5	97.6	76.5	87.4	86.3	80.2	103.4	128.2	108.5	809.7
95th Percentile	160.6	185.3	141.2	129.3	111.0	91.9	99.9	90.8	98.4	120.1	132.6	141.1	937.1
Highest	199.4	259.9	210.8	382.4	188.0	126.1	127.8	104.4	116.6	194.1	207.6	190.6	1295.9

Attachment 4 - Rainfall - NPM land holdings

GOONUMBLA (CORADGERY)

Station Number: 050016 · State	: NSW · Opened: 1882	 Status: Open · La 	atitude: 32.97°S · Lo	ongitude: 148.06°E ·	Elevation: 290 m

			•		•				0				
Mean	52.0	47.9	39.1	40.9	43.0	44.0	41.3	42.7	37.1	44.5	45.6	46.7	526.8
Lowest	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	182.0
5th Percentile	3.2	0.8	0.0	0.0	2.2	10.3	5.5	4.8	3.0	9.9	0.9	0.3	293.2
10th Percentile	5.8	2.0	1.2	2.8	5.6	11.8	8.0	11.6	8.4	11.6	6.1	3.7	333.3
Median	35.6	31.8	25.8	29.7	35.6	37.0	38.9	38.8	30.2	34.2	29.8	34.2	514.3
90th Percentile	105.6	127.8	98.9	83.0	88.8	76.6	81.6	78.6	76.7	89.3	103.6	107.0	739.9
95th Percentile	163.1	159.3	128.1	112.1	106.5	102.2	90.8	89.7	87.6	108.9	133.8	122.9	830.3
Highest	255.9	238.2	222.6	323.4	184.0	195.7	136.5	137.2	122.3	176.0	178.3	198.5	1191.9



Attachment 5 - Soil Tests - NPM land holdings

Selected Soil Test Results

	<u>NPM land holdings</u>																
Paddock Name	Sample Depth	pH (1:5 Water)	Elect. Conductivity	Chloride	Nitrate Nitrogen (NO3)	P (Colwell)	Available	Cation Exchange Capacity	Ca Mg Ratio	Sodium % of Cations (ESP)	Al Saturation	Zinc (DTPA)	Boron (Hot CaCl2)	Sulfate Sulfur (KCl40)	Soil Texture	Ca (Amm- acet.)	Mg (Amm- acet.)
			dS/m	mg/kg	mg/kg	mg/kg	mg/kg	meq/100g		%	%	mg/kg	mg/kg	mg/kg		%	%
14	0-10cm	6.5	0.06	<10	6.2	49	540	14.0	2.0	3.4	0.7	0.34	1.5	2.9	Clay Loam	57	29
14	10-20cm	8.0	0.14	<10	5.0	8	370	23.0	1.7			0.23	2.3	4.1	Clay	57	33
14	20-60cm	9.0	0.35	29	2.9								4.9	20.0	Clay		
16	0-10cm	5.9	0.06	10	6.4	63	480	9.3	1.9	3.2	1.1	0.55	1.1	4.2	Clay Loam	54	29
16	10-20cm	6.9	0.07	21	3.4	7	260	19.1	1.3			0.19	1.1	3.8	Clay	50	40
16	20-60cm	8.7	0.40	66	1.3								5.6	35.0	Clay		
32	0-10cm	7.3	0.13	<10	4.2	27	380	16.3	2.0			0.28	0.8	3.1	Clay Loam	61	30
32	10-20cm	8.2	0.24	17	4.4	6	230	24.9	1.8			0.19	1.2	3.9	Clay	60	33
32	20-60cm	8.8	0.37	25	1.5								4.0	11.0	Clay		
2	0-10cm	6.2	0.08	<10	6.3	56	400	13.4	1.2	3.6	0.8			5.7		49	40
4	0-10cm	6.1	0.13	19	17.0	74	490	15.1	1.3	3.8	0.7			12.0		50	37
4	0-10cm	6.0	0.21	12	26.0	76	700	19.2	1.9	2.1	0.5			31.0		57	31
10	0-10cm	6.5	0.08	<10	11.0	53	690	12.7	3.7					5.7		67	18
16	0-10cm	6.8	0.07	<10	3.6	52	480	19.4	1.7					3.1		57	34
16	0-10cm	6.5	0.10	17	10.0	63	480	15.2	1.3					5.3		49	39
6	0-10cm	6.1	0.09	14	9.8	58	400	10.9	1.2	5.2	0.9			8.4		46	39
14	0-10cm	6.3	0.08	<10	13.0	74	590	11.5	2.7	3.0	0.9			5.0		61	23
14	0-10cm	6.8	0.11	10	17.0	54	350	15.4	1.7					7.5		55	32
20	0-10cm	6.9	0.09	13	6.7	41	570	16.7	2.8					3.7		66	23
22	0-10cm	7.8	0.13	<10	6.2	37	690	18.4	5.6					3.0		76	14
28	0-10cm	6.3	0.08	20	6.8	81	460	10.4	1.4	6.3	1.0			4.3		48	34
28	0-10cm	6.6	0.11	38	4.8	85	300	13.8	1.1	10.0	0.7			5.4		43	40
32	0-10cm	6.2	0.08	15	9.2	35	450	10.1	1.4	3.2	1.0			5.0		50	35
32	0-10cm	7.1	0.12	<10	5.8	48	490	15.0	1.7					3.7		57	33
24	0-10cm	7.3	0.09	<10	5.1	61	510	13.5	2.1					3.3		59	28
24	0-10cm	6.8	0.05	<10	3.0	45	370	10.2	2.1					3.7		59	28

Attachment 6 - Soil Fertility Classes

Table 1: Fertility classes of Great Soil Groups

Modified from Charman, P.E.V. 1978 (ed.), Soils of New South Wales: Their Characterisation, Classification an Conservation, Tech. Handbook No. 1, Soil Conservation Service of NSW, Sydney.

Soil Type (Great Soil Group)	Estimate_Fertility	Fertility_value
Acid Peats	Low	1
Alluvial Soils - Light Sandy Textured (Sands to Sandy Loams)	Moderately low	2
Alluvial Soils - Medium Textured (Loams, Clay Loams)	Moderately high	4
Alpine Humus soils	Low	1
Black Earths	High	5
Brown Earths	Moderate	3
Brown Podzolic Soils	Moderate	3
Calcareous Red Earths	Moderately low	2
Calcareous Sands	Low	1
Chernozems	High	5
Chocolate Soils	Moderately high	4
Chocolate Soils - low iron	Moderately high	4
Desert Loams	Moderately low	2
Earthy Sands	Low	1
Euchrozems	Moderately high	4
Gleyed Podzolic Soils	Moderately low	2
Grey Brown and Red Calcareous Soils	Low	1
Grey Brown Podzolic Soils	Moderately low	2
Grey, Brown and Red Clays	Moderate	3
Humic Gleys	Moderately low	2
Humus Podzols	Low	1
Kraznozems	Moderately high	4
Lateritic Podzolic Soils	Moderately low	2
Lithosols	Low	1
Neutral to Alkaline Peats	Low	1
Non Calcic Brown Soils	Moderate	3
Peaty Podzols	Low	1
Podzols	Low	1
Prairie Soils	Moderately high	4
Red and Brown Hardpan Soils	Low	1
Red Brown Earths	Moderate	3
Red Earths - less fertile (granites and metasediment)	Moderately low	2
Red Earths - more fertile (volcanics and granodiorites)	Moderately high	4
· · · · · · · · · · · · · · · · · · ·	Moderately low	2
Red Podzolic Soils - less fertile (granites and metasediment) Red Podzolic Soils - more fertile (volcanics and granodiorites)	Moderately high	4
Rendzinas	Moderate	3
		3
Siliceous Sands	Low	1
Solodic Soils	Moderately low	2
Solodized Solonetz	Moderately low	2
Solonchaks	Low	1
Solonetz	Moderately low	2
Solonized Brown Soils	Moderately low	2
Soloths	Moderately low	2
Terra Rossa Soils	Moderate	3
Weisenboden	Moderate	3
Xanthozems	Moderate	3
Yellow Earths	Moderately low	2
Yellow Podzolic Soils - less fertile (granites and metasediment)	Moderately low	2
Yellow Podzolic Soils - more fertile (volcanics and granodiorites)	Moderate	3



Attachment 7 - Gross Value of Grain Production

Gross Value of Production of Grains

ABARES Agricultural Commodities – Various Issues

Financial	Gross Value of Production (\$ per tonne)										
Year	Wheat	Barley	Canola	Field Peas	Lupins	Oats	Triticale	Maize	Sorghum	Soybeans	Sunflower
2002	\$262	\$208	\$384	\$288	\$250	\$175	\$195	\$198	\$173	\$353	\$390
2003	\$266	\$255	\$446	\$344	\$292	\$219	\$258	\$233	\$205	\$384	\$400
2004	\$216	\$169	\$403	\$232	\$236	\$138	\$153	\$223	\$159	\$365	\$349
2005	\$197	\$159	\$326	\$235	\$206	\$134	\$152	\$193	\$134	\$283	\$341
2006	\$203	\$149	\$334	\$222	\$195	\$147	\$143	\$195	\$143	\$301	\$428
2007	\$242	\$244	\$397	\$283	\$266	\$241	\$223	\$249	\$213	\$377	\$828
2008	\$390	\$313	\$543	\$407	\$335	\$281	\$252	\$258	\$258	\$554	\$814
2009	\$281	\$231	\$548	\$345	\$280	\$216	\$257	\$283	\$205	\$551	\$696
2010	\$218	\$172	\$437	\$241	\$248	\$160	\$220	\$268	\$196	\$551	\$696
2011	\$273	\$207	\$544	\$236	\$268	\$191	\$197	\$294	\$217	\$551	\$677
2012	\$254	\$182	\$493	\$260	\$223	\$195	\$180	\$259	\$162	\$531	\$633
2013	\$248	\$179	\$448	\$257	\$245	\$181	\$174	\$237	\$150	\$492	\$576
10 year Mean	\$254	\$206	\$442	\$279	\$254	\$190	\$200	\$241	\$185	\$441	\$569
5 year Mean	\$255	\$194	\$494	\$268	\$253	\$189	\$205	\$268	\$186	\$536	\$655

Attachment 8 - Wheat Receipts

ABARES Farm Surveys Data State NSW NSW Zone **Central West** All Industry All Cropping 1990 \$314.56 \$303.36 1991 \$207.37 \$230.29 1992 \$278.39 \$297.61 1993 \$249.53 \$230.28 1994 \$237.48 \$240.20 1995 \$457.00 \$405.88 1996 \$359.15 \$332.33 1997 \$250.07 \$249.47 1998 \$299.33 \$289.95 1999 \$231.81 \$230.55 2000 \$227.02 \$197.71 2001 \$199.43 \$229.00 2002 \$210.36 \$248.14 2003 \$797.53 \$538.27 2004 \$262.73 \$241.93 2005 \$253.92 \$220.76 2006 \$192.03 \$191.37 2007 \$454.03 \$311.44 2008 \$418.69 \$458.02 2009 \$230.39 \$252.60 2010 \$243.89 \$219.85 2011 \$201.96 \$192.59 Mean 5 years \$238.40 \$242.81 Mean 10 years \$247.39 \$242.56 Mean All \$249.82 \$247.57

Attachment 9 - Crop Expenses

Crop Expenses (\$ per tonne)

ABARES Farm Surveys Data

NSW - Wheat & Other Crops Industry

Financial Year	Contracts Cropping	Crop and pasture chemicals	Fertiliser	Seed	Total
	\$/ha	\$/ha	\$/ha	\$/ha	
1990	\$30.66	\$38.15	\$22.58	\$10.80	\$102.19
1991	\$41.19	\$54.49	\$33.27	\$10.64	\$139.59
1992	\$38.65	\$40.28	\$53.30	\$10.05	\$142.28
1993	\$63.16	\$77.67	\$73.28	\$17.32	\$231.43
1994	\$43.24	\$59.46	\$68.44	\$14.60	\$185.75
1995	\$47.39	\$59.78	\$81.21	\$23.65	\$212.04
1996	\$47.48	\$62.88	\$100.85	\$15.66	\$226.88
1997	\$54.78	\$67.46	\$91.73	\$13.74	\$227.70
1998	\$50.61	\$58.85	\$92.48	\$17.48	\$219.42
1999	\$44.37	\$62.89	\$88.72	\$14.96	\$210.94
2000	\$44.80	\$82.29	\$92.25	\$18.59	\$237.93
2001	\$43.71	\$75.91	\$87.37	\$13.12	\$220.12
2002	\$44.76	\$64.53	\$90.22	\$15.09	\$214.59
2003	\$29.20	\$44.12	\$55.46	\$12.21	\$140.99
2004	\$25.68	\$59.64	\$59.16	\$11.41	\$155.88
2005	\$19.98	\$44.80	\$42.96	\$5.24	\$112.98
2006	\$28.95	\$57.55	\$58.91	\$10.56	\$155.97
2007	\$26.33	\$50.68	\$62.35	\$16.77	\$156.13
2008	\$26.24	\$62.67	\$56.99	\$7.13	\$153.03
2009	\$29.86	\$67.27	\$56.76	\$8.40	\$162.29
2010	\$35.73	\$66.60	\$45.40	\$10.23	\$157.97
2011	\$62.80	\$70.65	\$62.32	\$10.66	\$206.42
Mean 5 years	\$36.19	\$63.58	\$56.76	\$10.64	\$167.17
Mean 10 years	\$32.95	\$58.85	\$59.05	\$10.77	\$161.63
Mean All	\$39.98	\$60.39	\$67.09	\$13.11	\$180.57

ABARES Farm	n Surveys Data
State	NSW
Zone	Central West
Industry	All
1990	\$425.71
1991	\$449.18
1992	\$358.22
1993	\$415.75
1994	\$532.29
1995	\$507.00
1996	\$478.50
1997	\$540.35
1998	\$408.95
1999	\$531.96
2000	\$396.10
2001	\$388.07
2002	\$508.15
2003	\$557.33
2004	\$417.76
2005	\$303.38
2006	\$413.81
2007	\$451.50
2008	\$543.50
2009	\$515.13
2010	\$387.67
2011	\$483.25
Mean 5 years	\$476.21
Mean 10 years	\$458.15
Mean All	\$455.16

Attachment 10 - Canola Receipts

Canola Receipts (\$ per tonne)

Budget 1

		ss Margin B Dryland Whe			
Income					per hectare
Grain Payment	S	1.93 t/ha	priced at	\$254 per tonne	\$490.33
Variable Costs	<u>s:</u>				per hectare
Machinery Ope	erations				
	Sowing	\$12.22 /ha	over	100% of area	\$12.22
	Spraying	\$2.50 /ha	over	500% of area	\$12.50
	Fertiliser Spreading	\$12.22 /ha	over	100% of area	\$12.22
Aerial Spray	(contract)	\$82.00 /ha	over	0% of area	\$0.00
Seed	(purchased)	35 kg/ha	costing	\$0.92 per kg	\$32.20
Seed Treatmer	nt	0 ml/ha	costing	\$0.000 per ml	\$0.00
Fertiliser	Pre Sowing	80 kg/ha	costing	\$0.70 per kg	\$56.00
	At Sowing	60 kg/ha	costing	\$1.03 per kg	\$61.80
	Topdressing	0 kg/ha	costing	\$0.00 per kg	\$0.00
Herbicides	Fallow	\$12.42 /ha	over	200% of area	\$24.83
	Pre Emergent	\$11.44 /ha	over	100% of area	\$11.44
	Post Emergent	\$8.70 /ha	over	100% of area	\$8.70
Fungicides		\$5.66 /ha	over	100% of area	\$5.66
Insecticides		\$0.00 /ha	over	100% of area	\$0.00
Harvest	(contract)	\$48.00	per hectar	e	\$48.00
Cartage	(contract)	\$17.50	per tonne		\$33.78
Levies		1.02%	of on-farm	crop value	\$4.66
Crop Insurance	9	1.03%	of on-farm	crop value	\$5.05
Total Variable (Costs				\$329.05
Total Gross M	argin				\$161.28

Budget 2

	<u>Gross Margin Budget</u> <u>Dryland Canola</u>										
Income					per hectare						
Grain Payment	S	1.14 t/ha	priced at	\$494 per tonne	\$563.28						
Variable Costs	<u>):</u>				per hectare						
Machinery Ope	rations										
	Sowing	\$12.22 /ha	over	100% of area	\$12.22						
	Spraying	\$2.00 /ha	over	500% of area	\$10.00						
	Fertiliser Spreading	\$0.00 /ha	over	0% of area	\$0.00						
Aerial Spray	(contract)	\$18.15 /ha	over	100% of area	\$18.15						
Seed	(purchased)	3 kg/ha	costing	\$14.50 per kg	\$43.50						
Fertiliser	Pre Sowing	0 kg/ha	costing	\$0.00 per kg	\$0.00						
	At Sowing	150 kg/ha	costing	\$0.94 per kg	\$141.50						
	Topdressing	0 kg/ha	costing	\$0.00 per kg	\$0.00						
Herbicides	Fallow	\$11.74 /ha	over	300% of area	\$35.23						
	Pre Emergent	\$0.00 /ha	over	0% of area	\$0.00						
	Post Emergent	\$14.44 /ha	over	100% of area	\$14.44						
Fungicides		\$0.00 /ha	over	0% of area	\$0.00						
Pesticides		\$7.58 /ha	over	200% of area	\$15.16						
Windrow	(contract)	\$75.00	per hectar	е	\$75.00						
Harvest	(contract)	\$45.00	per hectar	e	\$45.00						
Cartage	(contract)	\$17.50	per tonne		\$19.95						
Levies	\$1.50 per tonne plus	1.02%	of on-farm	crop value	\$7.25						
Crop Insurance	9	1.74%	of on-farm	crop value	\$9.80						
Total Variable (Costs				\$447.20						
Total Gross M	argin				\$116.08						

Budget 3

	<u>Gross Margin Budget</u> <u>Dryland Barley</u>									
	<u> </u>	Dryland Barl	ey							
Income		0.00.1/		A 000	per hectare					
Grain Payment	S	2.02 t/ha	priced at	\$206 per tonne	\$415.77					
Variable Costs	<u>.</u>				per hectare					
Machinery Ope	- rations									
	Sowing	\$12.22 /ha	over	100% of area	\$12.22					
	Spraying	\$2.50 /ha	over	300% of area	\$7.50					
	Fertiliser Spreading	\$0.00 /ha	over	0% of area	\$0.00					
Aerial Spray	(contract)	\$0.00 /ha	over	0% of area	\$0.00					
Seed	(purchased)	35 kg/ha	costing	\$1.07 per kg	\$37.45					
Fertiliser	Pre Sowing	0 kg/ha	costing	\$0.00 per kg	\$0.00					
	At Sowing	60 kg/ha	costing	\$1.03 per kg	\$61.80					
	Topdressing	0 kg/ha	costing	\$0.00 per kg	\$0.00					
Herbicides	Fallow	\$13.28 /ha	over	200% of area	\$26.56					
	Pre Emergent	\$0.00 /ha	over	0% of area	\$0.00					
	Post Emergent	\$46.00 /ha	over	100% of area	\$46.00					
Fungicides		\$0.00 /ha	over	0% of area	\$0.00					
Insecticides		\$0.00 /ha	over	0% of area	\$0.00					
Harvest	(contract)	\$48.00	per hectar	e	\$48.00					
Cartage	(contract)		per tonne	-	\$35.35					
Levies		1 0 2 0/	of on form	crop value	¢0 00					
Crop Insurance				crop value crop value	\$3.88 \$4.28					
Total Variable (1.03%		orop value	\$283.04					
					\$283.04 \$132.73					
Total Gross M	arym				φισ2./3					



Wheat: Short Fallow (No-till) Central Zone - West

Winter 2012

1. GROS	S MARGIN BUDGET:	PREMOUS CROP:	CEREAL Standard Budget	CANOLA Standard Budget	PULSES Standard Budget	Your Budget
Aiter Pulses	INCOME: 1.90 tonnes/na @	\$275.00 /tenne (on farm) (PH)	\$/ha	\$/ha	\$/ha \$522.50	\$/ha
Canola	1.80 tonnes/ha@			\$495.00		-
Cereal	1.50 tonnes/ha@		\$412.50			
		A. TO TAL INCOME \$/ha:	\$412.50	\$495.00	\$522.50	
	VARIABLE COSTS: See opposite page for detail					
	and alliante balle int animi	Cultivation	\$0.00	\$0.00	\$0.00	-
		Sowing	\$44.35	\$44.35	\$44.35	
		Fertiliser	\$130.02	\$130.02	\$130.02	
		Herbicide	\$54,96	\$54.96	\$54.96	
		Insecticide	\$0.00	\$0.00	\$0.00	
		Fungiade	\$8.15	\$8.15	\$8.15	
		Contract-harvesting	\$48.00	\$48.00	\$48.00	
		Levies	\$4.21	\$5.05	\$5.33	
		Crop Insurance.	\$4.23	\$5.07	\$5.36	
		Cartage, grading & bagging	\$0.00	\$0.00	\$0.00	
		B. TO TAL VARIABLE COSTS \$/ha:	\$293.91	\$295.60	\$296.16	
		C. GROSS MARGIN (A-B) \$/ha:	\$118.59	\$199.40	\$226.34	

The bridget is ONLY A GUIDE and all onlides allered for increments a copiand input prices, changes in seaso fail could box and the farm of a activity bits.

L

Wheat: Short Fallow (No-till)

Central Zone - West

Machinery Total Inputs Total Total Cost Cost Cost Operation Month hrs*l*ha rate/ha \$ \$/ha \$/hour \$/ha \$/ha Weed control eg: glyphosate 540 Dec/Jan 0.03 76.36 \$2.50 1.20 L \$8.67AL \$10.40 \$12.90 g/L (Roundup PowerMAX®) Weed control eg: triclopyr 600 g/L Dec/Jan with above 0.10 L \$19.60/L \$1.96 \$1.96 (Garlon®) Weed control eg: glyphosate 540 Feb/Mar 0.03 76.36 \$2.50 1.00 L \$8.67AL \$8.67 \$11.17 g/L (Roundup PowerMAX®) Weed control eg: 2,4-D amine 300 Feb/Mar with above 1.00 L \$3.80A \$3.80 \$3.80 g/L (Surpass®) Nitrogen Fertiliser- After Canola eg: 104.36 80 kg \$0.70/kg 0.12 May \$12.22 \$56.00 \$68.22 Urea Nitrogen Fertiliser- After Cereal eg: 0.12 104.36 \$12.22 80 kg \$0.70/kg \$56.00 \$68.22 May Urea Nitrogen Fertiliser- After Pulses eg: 0.12 104.36 \$12.22 80 kg \$0.70/kg \$56.00 \$68.22 May Urea Sowing 0.12 104.36 \$12.22 35 kg \$0.92/kg \$32.13 \$44.35 May Starter fertiliser eg: MAP May with above 60 kg \$1.03/kg \$61.80 \$61.80 Grass weed control eg:clodinafop-0.03 76.36 2.50 0.09 L \$130.00AL \$11.44 \$13.94 Jun/July propargyl (Topik®) Uptake® Jun/July with above 0.25 L \$6.80AL \$1.70 \$1.70 Broadleaf weed control eg: LVE July 0.03 76.36 \$2.50 0.70 L \$10.00/L \$7.00 \$9.50 Agritone® 500g/L Foliar Fungicide eg: tebuconazole 0.03 76.36 2.50 0.145 L \$39.00AL \$5.66 \$8.15 Julv/Aug 430 g/L (Folicur®) Contract-harvest - After Canola Nov contract \$48.00 \$48.00 Contract-harvest - After Cereal Nov contract \$48.00 \$48.00 Contract-harvest - After Pulses Nov contract \$48.00 \$48.00 1.02% Crop Levies - After Canola of on-farm value \$5.05 Crop Levies - After Cereal 1.02% of on-farm value \$4.21 Crop Levies - After Pulses 1.02% \$5.33 of on-farm value Crop Insurance - After Canola 1.03% of on-farm value \$5.07 Crop Insurance - After Cereal 1.03% \$4.23 of on-farm value Crop Insurance - After Pulses 1.03% of on-farm value \$5.36

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.
NOTES:

noito.		
Sowing Time:	- Sowing at the optimum time for the selected variety is critical for maximum yield.	
	- There is a 4 to 7 % yield loss for every week delay past the optim um sowing time.	
	 Seed price used above is for purchased seed; if using retained seed adjust budget accordingly. 	
Place in rotation:	 Short fallow wheat crops perform differently depending on the previous crop. 	
	- Pulse and canola crops provide an effective disease break and yield benefit for	
	the following wheat crop. Additionally, a pulse crop improves soil nitrogen reducing	
	the amount of fertiliser required to achieve PH quality.	
	- Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop	
	and sowing of the next crop. For example, canola harvested in Novem ber would be under a	
	5-6 m onth fallow until sowing in May of the following year.	
Weed control:	 Timing of fallow herbicide applications vary according to rainfall 	
	 Weed control, if required, should be implemented either pre-emergent or within 	
	6 to 8 weeks after sowing time to limit yield loss.	
	-Uptake oil @ 0.25 L/ha assum es a water rate of 50 L/ha.	
	- An additional knockdown herbicide application (eg. glyphosate 540 g/L @ 1.0 L/ha) should be considered	
	if weeds are present at the time of sowing. Triasulfuron @ 35 g/ha can also be tankmixed with glyphosate	
	immediately prior to sowing for residual control of some weed species.	
	 Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance. 	
Fertiliser:	 Adequate phosphorus is essential before applying extra nitrogen fertiliser. 	
	- To achieve PH quality, wheat must have a protein level of 13% or higher.	
	 Seasonal conditions will also have a large effect on grain size and protein percentage. 	
	- Nitrogen fertiliser applications may be split i.e. som e applied presowing and some applied in	
	the mid to late vegetative stage (2nd node to flag leaf em ergence).	
	- The later nitrogen fertiliser is applied to a crop, the greater its effect on raising protein	
	percentage, and the less effect it has on increasing yield.	
Machinery:	- A tractor with 196 kW (263 HP) pto power and 242kW (325 HP) engine power is assumed.	
	- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.	
	- Contract-harvesting does not include the cost of fuel.	
Labour:	- The labour required for machinery operations is 0.71 hr/ha	
	- Using a labour cost of \$22/hr, an addition al \$15.58 can be deducted from the budget	
Important notes:	 These gross margins are only a guide. They do not include overhead costs. 	
	 Use your own figures and price assumptions to estimate your own gross margin. 	
	 Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI. 	

This bridget is ONLY A GUIDE and should be affered for movements in crop and input proces, changes in seasonal conditions and the farm characteristics.

Winter 2012



C. GROSS MARGIN (A-B) \$/ha:

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

	1000	nne)	IELD ON FARM PRICE (\$/tonne)		YIELD	
	\$540 /t	\$500 /t	\$460 /t	\$420 /t	\$380 /t	tonnes/ha
	\$76	\$37	- 52	- 841	- \$80	1.00
	\$180	\$134	\$87	\$40	- \$6	1,20
G	\$285	\$231	\$176	\$122	\$67	1.40
M	\$390 ┥	\$328	\$265	\$203	\$1.41	1.60
(\$	\$495	\$425	\$355	\$285	\$215	1.80
	\$704	\$618	\$533	\$447	\$362	2.20
	\$809	\$715	\$622	\$529	\$435	2.40

PRODUCT TRADE NAMES

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Your

Budget \$/ha

Canola: Short Fallow (No-till) Central Zone - West CALENDAR OF OPERATIONS:

Winter 2012

CALENDAR OF OPERATIO	ONS:							- / -
	Г		Machinery Cost	Total		Inputs Cost	Total	Total Cost
Operation	Month	hrs/ha	\$/hour	\$/ha	rate/ha	\$	\$/ha	\$/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	\$2.50	1.20 L	\$8.67/L	\$10.40	\$12.90
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	\$19.60/L	\$1.96	\$1.96
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	\$2.50	1.20 L	\$8.67/L	\$10.40	\$12.90
Weed control eg: 2,4-D amine 300 g/L (Surpass®)	Feb/Mar	with above			1.00 L	\$3.80/L	\$3.80	\$3.80
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Apr	0.03	76.36	\$2.50	1.00 L	\$8.67/L	\$8.67	\$11.17
Sowing - treated seed	Apr/May	0.12	104.36	\$12.22	3.00 kg	\$14.50/kg	\$43.50	\$55.72
Nitrogen and Sulfur fertiliser (eg: Extra Sul®)	Apr/May	with above			100 kg	\$0.90/kg	\$90.00	\$90.00
Starter fertiliser eg: MAP	Apr/May	with above			100 kg	\$1.03/kg	\$103.00	\$103.00
Mite control eg: omethoate 290 g/L (Le-mat®)	Мау	0.03	76.36	\$2.50	0.10 L	\$30.00/L	\$3.00	\$5.50
Grass weed control eg: haloxyfop R 520 g/L (Verdict®)	Jul	0.03	76.36	\$2.50	0.075 L	\$61.09/L	\$4.58	\$7.08
Broadleaf weed control eg: clopyralid (Lontrel®)	Jul	with above			0.30 L	\$32.86/L	\$9.86	\$9.86
Heliothis control eg: alpha- cypermethrin (Fastac Duo®)	Sept	contract		\$18.15	0.30 L	\$8.07/L	\$2.42	\$20.57
Aphid control (1 year in 2) eg: pirimicarb (Pirimor WG®)	Sept	contract		\$18.15	0.5 kg	\$43.80/kg	\$21.90	\$20.03
Contract Windrow Contract-Harvest Crop Levies	Oct Nov	contract		\$75.00 \$50.00	• • • • • • • • • • • • • • • • • • • •	e + 1.02% of o		\$75.00 \$50.00 \$9.87
Crop Insurance					1.74%	of on-farm va	lue	\$12.82
*** Input and crop prices are corre	ct at the tir	ne of writing (Ma	arch 2012). Ma	arket uncertaim	ty makes estimati	on of future pri	icing impractio	al.
Notes: Soil type:	Quitoble	for all high forti	lity wheat cails	- Avoid ocid c	oils containing hi	ah oluminium		
Place in rotation	- Short Fa and sow	allow: Fallow or	weedfree per crop. For exan	iod of 5-6 mon nple, wheat ha	ths between harv vested in Novem	est of one crop		
Sowing time:					yield loss/week at)t use retained Ca			
Fertiliser:					majority of nitroge irect contact with		oplied	
					15, or gypsum shi		ed.	
Weed control:	-	of fallow herbicio tional knockdow		•	rding to rainfall. Nphosate 540 g/L	@1.01(ba) si	hould be cons	idered if weeds
	are pres	ent at the time o	f sowing.			- ·		
					entional, triazine t t is for convention			
	•	own herbicide s		o. mio baago				doled
					ton weed and sa veed or fumitory a			ic the case
In sect control:		te control is ess			veed of fulfillory a	i e likely, use li	ningrann n uns	is the case.
		need to be moni for heliothis fror		• –	nen colonies begi	n to spread co	ntrol may be r	needed.
Windrowing:			-		ttering losses and	l allow earlier h	narvest.	
Machinery:		-			N (325 HP) engin			
Labour:		ery costs refer o t-harvesting doe	,		filters, tyres, bat	teries & repairs	à	
	- The lab	our required for	machinery op	erations is 0.23	} hr/ha			
Immostant notos-	-				n be deducted fro	-		
Important notes:	-	-	· -		include overhead estimate your ov		ain.	
	-	-	-	•	commendation of			



Barley: Short Fallow [No-till]

Central Zone - West

1. GROSS MARC	GIN BUDGET:		Mait Standard Budget \$/ha	Feed Standard Budget \$/ha	Your 2006 Budget \$/ha
Feed Barley	2.20 tonnes/ha @	\$140.00 /tonne (on farm) (feed)	\$/IId	\$308.00	.p/IId
Malt Barley	1.90 tonnes/ha @	\$180.00 /tonne (on farm) (mait)	\$342.00		
		A. TOTAL INCOME \$/ha:	\$342.00	\$308.00	-
	RIABLE COSTS: opposite page for detail			1.5	
		Sowing	\$49.70	\$49.70	
		Fertiliser.		\$61,80	
		Herbicide		\$80.05	
		Insecticide		\$0.00	
		Contract-harvesting		\$48.00	
		Levies		\$6.43	
		Crop Insurance.	10.1 million (10.1 million)	\$3.16	
		Cartage, grading & bagging		\$0,00	
		B. TOTAL VARIABLE COSTS \$/ha	\$249.39	\$249.14	-

C. GROSS MARGIN (A-B) \$/ha:

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

Malt Barley

YIELD		ON F	ARM PRICE (\$At	onne)		
tonnes/ha	\$140 /t	\$160 /t	\$180 /t	\$200 /t	\$2.20 /t	
1.40	- \$50	- \$22	\$5	\$33	\$60	
1.60	- \$23	\$9	\$40	\$72	\$103	
1.80	\$5	\$40	\$75	\$110	\$146	Gross
1.90	\$18	\$55	\$93	\$130	\$167 🛥 🗕	— Margir
2.20	\$59	\$102	\$145	\$188	\$231	(\$/ha)
2.40	\$86	\$133	\$180	\$227	\$274	
2.60	\$112	\$163	\$214	\$265	\$316	

\$92.61

\$58.86

Feed Barley

YIELD		ON F	ARM PRICE (\$A	onne)		
tonnes/ha	\$100 /t	\$120/t	\$140 /t	\$160 /t	\$180 /t	
1.70	- \$76	- 342	- \$9	\$24	\$58	
1.90	- \$56	- 819	\$18	\$55	\$93	
2.10	\$37	\$4	\$45	\$86	\$128	Gross
2.20	- \$27	\$16	\$59	\$102	\$145 -	— Margii
2.50	\$2	\$51	\$100	\$149	\$1.98	(\$/ha)
2.70	\$18	\$71	\$124	\$177	\$230	
2.90	\$35	\$92	\$149	\$206	\$263	

PRODUCT TRADE NAMES

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Winter 2012

Barley: Short Fallow [No-till] Central Zone - West

CALENDAR OF ORERATIONS

Winter 2012

CALENDAR OF OPERATIONS:									
	_	Machinery			_	Inputs			Total
	[Cost	Total	ſ		Cost	Total	Cost
Operation	Month	hrs <i>i</i> ha	\$/hour	\$/ha	l	rate/ha	\$	\$/ha	\$⁄ha
/Veed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	\$2.50		1.20 L	\$8.67/L	\$10.40	\$12.90
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above				0.10 L	\$19.60/L	\$1.96	\$1.96
Weed controleg:glyphosate 540 g/L (RoundupPowerMAX®)	Feb/Mar	0.03	76.36	\$2.50		1.20 L	\$8.67/L	\$10.40	\$12.90
Weed control eg: 2,4-D amine 300 g/L (Surpass®)	Feb/Mar	with above				1.00 L	\$3.80/L	\$3.80	\$3.80
Sowing seed	May	0.12	104.36	\$12.22		35 kg	\$1.07/kg	\$37.49	\$49.70
Starter fertiliser eg: MAP Grass weed control eg:	May	with above				60 kg	\$1.03/kg	\$61.80	\$61.80
diclofop+fenoxaprop (Tristar® Advance)	Jul	0.03	76.36	\$2.50		1.50 L	\$26.00/L	\$39.00	\$41.50
Broadleaf weed control eg: MCPA LVE 500 g/L (MCPA LVE®)	Jul	with above				0.70 L	\$10.00/L	\$7.00	\$7.00
Contract-harvest	Nov	contract		\$48.00					\$48.00
Crop Levies - 2 row feed							1.02% of on-farm value		\$6.43
Crop Levies - malt							1.02% of on-farm value		\$6.32
Crop Insurance - 2 row feed						1.03%	of on-farm value		\$3.16
rop Insurance - malt						1.03%	of on-farm va	lue	\$3.51

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.

NOTES:						
Sowing time:	- Sowing at the optimum time for the selected variety is critical for maximum yield.					
	 Seed price used above is for purchased seed; if using retained seed adjust budget accordingly. 					
Place in rotation:	- Barley is a useful crop to follow wheat in the rotation.					
	 Barley will respond to good soil fertility, however it is better adapted to lower nitrogen 					
	fertility situations than wheat.					
	- Select lower nitrogen paddocks for malting barley.					
	- Tulla & Yambla are more tolerant to acid soils.					
	- Barley is a useful break crop where root lesion nematode is a problem, but check the varieties tolerance rating. - Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop					
	and sowing of the next crop. For example, canola harvested in November would be under a					
	5-6 month fallow until sowing in the following May.					
Variety:	 Feed varieties will usually yield more than a standard malting variety. 					
Weed control:	 Timing of fallow herbicide applications will vary according to rainfall. 					
	 Barley is generally more competitive than wheat in relation to weeds. 					
	- An additional knockdown herbicide application (i.e. glyphosate 540 g/L @1.0 L/ha) should be considered					
	if weeds are present at the time of sowing.					
	 Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance. 					
Machinery:	- A tractor with 196 KW (263 HP) pto power and 242KW (325 HP) engine power is assumed.					
	- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.					
	- Contract-harvesting does not include the cost of fuel.					
Labour:	- The labour required for machinery operations is 0.23 hr/ha					
Important notes:	- These gross margins are only a guide. They do not include overhead costs.					
	 Use your own figures and price assumptions to estimate your own gross margin. 					
	 Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI. 					