Millennium Expansion Project

Environmental Impact Statement

December 2010

APPENDICES - VOLUME 4

Peabody

TABLE OF CONTENTS

APPENDICES

VOLUME 3

Final Terms of Reference ..... **A**
Approvals ..... **B**
Study Team ..... **C**
The Standard Criteria ..... **D**
Consultation Report ..... **E**
Soils **F1**
Transport **F2**

VOLUME 4

Surface Water **F3**
Groundwater **F4**
Air **F5**
Noise **F6**
Terrestrial Ecology **F7**
Aquatic Ecology **F8**
Indigenous Cultural Heritage **F9**
European Cultural Heritage **F10**
Social **F11**
Economics **F12**

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F3:

SURFACE WATER

MILLENNIUM EXPANSION PROJECT
SURFACE WATER ASSESSMENT

Met Serve
August 2010

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For and on behalf of
WRM Water & Environment Pty Ltd

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Principal Engineer

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EXECUTIVE SUMMARY

A conceptual water management system (WMS) has been devised to manage the potential impacts of the Millennium Expansion Project (MEP) on surface water quality.

Runoff and groundwater inflows entering the pits, are to be collected and used preferentially to meet the MEP's water demands, so that the risk of off-site discharge is very low. Runoff from waste rock emplacements is to be captured in sediment dams to remove suspended solids and also reused to supply site demands.

The proposed management measures should ensure there will be little impact on off-site runoff water quality, and as a result, no measurable adverse impact on riparian and ecological values of watercourses in the vicinity of the proposed MEP due to changes in surface water quality.

Where possible, clean runoff from undisturbed catchments will be diverted around the MEP workings. However, the capture and reuse of water in the mine water management system will result in reductions in flow in the receiving water catchments. The proportion of the New Chum Creek catchment that is disturbed and intercepted in the water management system will increase to 6.7% in Year 1, and to 17.8% in Year 17. Up to 3.2% of the North Creek and West Creek catchments will be disturbed by the MEP and intercepted in the WMS.

The impact of the MEP on the performance of the mine site water management system is summarised as follows:

- Total water demand will increase due to increased production and increased dust suppression requirements for additional haul roads, During dry periods, if there is insufficient on-site pit water to meet these demands, or if water quality is not suitable for CHPP use, raw water consumption will increase to make up for the shortfall.
- The overall mine water inventory is expected to increase due to the additional catchment area reporting to pits. However, sufficient capacity will be available in the proposed pit water storages to accommodate the potential increase in inventory.
- Long-term modelling indicates the probability of site sediment dam spillway discharge in any year is approximately 20%.

The hydrologic and hydraulic modelling of New Chum Creek and its floodplain in the vicinity of the proposed mining area demonstrates the following:

- With the exception of roads, external waste rock emplacements, and a number of water management dams, the proposed MEP mining activities are outside of the extent of inundation of the 100 year ARI flood event.
- Levees will be provided to protect the pit from flooding in a 1000 year ARI flood event.
- With the exception of localised increases in the immediate vicinity of the proposed haul road crossings, flood velocities along the New Chum Creek channel generally remain unchanged from existing conditions as a result of the proposed MEP.
- There will be minor localised increases in the 100 year ARI flood level adjacent to the external waste rock emplacements. Flood levels will not be increased outside the MEP Area areas.

External waste rock emplacements adjacent to West Creek will be located such that the impact on flood conditions in West Creek will be minimal.

Scour protection will be provided at the proposed haul roads to manage the temporary increased risk of erosion in the vicinity of the crossings. The localised increase in flood velocities associated with the proposed external waste rock emplacements on the edge of the New Chum Creek floodplains will not significantly increase erosion potential in the New Chum Creek channel.

While flow velocities in the vicinity of the proposed out of pit waste rock emplacements will be low, the toe of the external waste rock emplacements will be protected with rock mulch up to the level of the 1000 year ARI flood event to protect it from scour.

The final voids are located at the edge of the probable maximum flood extents, and as a result, the risk of flood inflows to the voids from New Chum Creek is small.

Based on historical simulation analysis, in the long-term, the catchment of the final voids will be insufficient to generate sufficient runoff to exceed evaporative losses from the water surface. Stored water levels in both voids are likely to stabilise – at a considerable depth below the edge of the void.

The salinity of the stored water will tend to increase over time. Water balance modelling of the Mavis and Millennium voids shows that the salinity will eventually increase beyond guideline stock watering levels.

TABLE OF CONTENTS

Page

1 INTRODUCTION 8

1.1 GENERAL 8
1.2 SCOPE OF THIS STUDY 8
1.3 REPORT STRUCTURE 9

2 EXISTING ENVIRONMENT 11

2.1 REGIONAL DRAINAGE NETWORK 11
2.1.1 Geology and Soils 14
2.1.2 Groundwater 14
2.1.3 Catchment Land and Surface Water Use 14
2.2 LOCAL DRAINAGE NETWORK 16
2.2.1 General 16
2.2.2 Geomorphic Conditions 17
2.3 RAINFALL AND EVAPORATION 18
2.3.1 Spatial Variability 18
2.3.2 Temporal Variability 20
2.4 STREAMFLOW 23
2.5 ENVIRONMENTAL VALUES OF RECEIVING WATERS 27
2.6 SURFACE WATER QUALITY 28
2.6.1 Isaac River Water Quality 28
2.6.2 Devlin Creek and Bee Creek Water Quality 29
2.6.3 New Chum Creek Water Quality 29

3 EXISTING MILLENNIUM OPERATIONS 33

3.1 WATER MANAGEMENT SYSTEM 33
3.1.1 Overview 33
3.1.2 Water Quality in Existing Site Water Management System 35
3.2 FLOODING 36

4 POTENTIAL IMPACTS AND MITIGATION MEASURES 38

4.1 OVERVIEW 38
4.2 POTENTIAL CHANGES IN RUNOFF WATER QUALITY 38
4.3 OPERATIONAL WATER MANAGEMENT 39
4.3.1 Pit Water Management 42
4.3.2 Waste Rock Runoff Management 42
4.4 IMPACTS ON RECEIVING WATER SURFACE WATER RUNOFF VOLUME 44
4.5 POST MINING WATER MANAGEMENT 45
4.5.1 Final Void Flood Immunity 45
4.5.2 Final Void Water Levels 45
4.5.3 Long Term Salinity 45
4.6 NEW CHUM CREEK FLOODING AND EROSION 48

5 WATER BALANCE ASSESSMENT 53

5.1 OVERVIEW 53
5.2 WATER BALANCE MODEL 53
5.2.1 General 53
5.3 SITE WATER DEMANDS 54
5.4 ASSESSMENT OUTCOMES 55
5.4.1 Overview 55
5.4.2 Central Worked Water Storage Inventory 55
5.4.3 Active Pit Water Inventory 60
5.4.4 Storage Discharges 62
5.4.5 Overall Site Water Balance 62

6 SURFACE WATER MONITORING 64

7 SUMMARY OF FINDINGS 67

7.1 CHANGE IN RUNOFF WATER QUALITY 67
7.2 CHANGE IN SURFACE WATER RUNOFF VOLUME 67
7.3 SITE WATER BALANCE 67
7.4 NEW CHUM CREEK FLOOD IMPACT 68
7.5 NEW CHUM CREEK EROSION 68
7.6 FINAL VOID WATER MANAGEMENT 68

8 REFERENCES 69

A APPENDIX MEP MINE WATER MANAGEMENT SYSTEM 70

B APPENDIX HYDROLOGIC AND HYDRAULIC FLOOD MODEL DEVELOPMENT 85

C APPENDIX GEOMPORPHOLOGICAL DESCRIPTION OF STREAMS 100

LIST OF TABLES

		Page
Table 2.1	Details of Rainfall Stations in the Area of Interest	20
Table 2.2	Comparison of Summer Rainfall Totals – Site Record and Data Drill	23
Table 2.3	DERM Streamflow Gauges in the Vicinity of MEP	25
Table 2.4	Isaac River Water Quality Data Summary	30
Table 2.5	Devlin Creek and Bee Creek Water Quality Data Summary	31
Table 2.6	Receiving Water Quality in New Chum Creek (source: GHD, 2010)	32
Table 3.1	New Chum Creek Design Discharges	36
Table 3.2	New Chum Creek Median Design Flow Conditions	36
Table 4.1	Catchment Areas Draining to Site Water Storages	41
Table 4.2	Sediment Dam Characteristics	43
Table 4.4	Impacts on New Chum Creek Flood Conditions	52
Table 5.1	Modelled Sediment Dam Spill Characteristics (2027 WMS arrangement)	62
Table 5.2	Summary Average Annual Water Balance (High Runoff)	62
Table 6.1	Contaminant Release Points	64
Table 6.2	Upstream and Downstream Receiving Water Monitoring Points	64
Table 6.3	Proposed Water Management Monitoring Points	65

LIST OF FIGURES

		Page
Figure 1.1	Millennium Expansion Project Locality Plan	10
Figure 2.1	Fitzroy River Basin	12
Figure 2.2	Receiving Water Catchments	13
Figure 2.3	Neighbouring Mining Activities	15
Figure 2.4	Local Catchment Areas	16
Figure 2.5	New Chum Creek Channel in the Vicinity of the Project Area, Location A	17
Figure 2.6	New Chum Creek in the Vicinity of the Project Area, Location B	18
Figure 2.7	Mean Annual Rainfall Isohyets and Climate Recording Stations	19
Figure 2.8	Annual Rainfall at Millennium Site (2006-2009) Compared to DERM DataDrill	21
Figure 2.9	Monthly Rainfall and Pan Evaporation at MEP Site (DERM DataDrill 1970-2010)	21
Figure 2.10	Comparison of DERM Data Drill and Millennium Site Daily Rainfall	22
Figure 2.11	Mean Monthly Rainfall 9/1/2006 to 20/4/2010 - Comparison of Millennium Site Record with DERM Data Drill	22
Figure 2.12	Sample New Chum Creek Streamflow Response	23
Figure 2.13	DERM Streamflow Gauges in the Vicinity of MEP	24
Figure 2.14	Mean Monthly Flow – Isaac River at Deverill	25
Figure 2.15	Sample of Streamflow Record – Isaac River at Deverill	26
Figure 2.16	Recorded Frequency Curves (mm/d - no-flow days included)	26
Figure 2.17	Recorded Frequency Curves (mm/d - no-flow days excluded)	27
Figure 3.1	Local Drainage Network at Existing Millennium Coal Mine	34
Figure 3.2	Extent of New Chum Creek Flood Inundation - 100 year ARI	37
Figure 4.1	2027 Water Management System Layout	40
Figure 4.3	Modelled Behaviour of Final Void – Mavis Pit	47
Figure 4.4	Modelled Behaviour of Final Void – Millennium Pit	47
Figure 4.5	Proposed Flood Protection and Scour Protection Works	49
Figure 4.6	Impact on New Chum Creek Flood Levels - 100 year ARI	51
Figure 5.1	Temporary Sediment Worked Water Storage – Exceedance Probability of Maximum Volume	56
Figure 5.2	Temporary Sediment Worked Water Storage – Simulated Behaviour	56
Figure 5.3	Temporary Pit Worked Water Storage – Exceedance Probability of Maximum Volume	57
Figure 5.4	Temporary Pit Worked Water Storage – Simulated Behaviour	58
Figure 5.5	Millennium Void Worked Water Storage – Exceedance Probability of Maximum Volume	59
Figure 5.6	Millennium Void Worked Water Storage – Simulated Behaviour	60
Figure 5.7	Pit Inventory – Annual Exceedance Probability (AEP)	61

Figure 5.8 Pit Inventory – Daily Exceedance Probability 61

Figure 6.1 Proposed Monitoring Points 66

1 INTRODUCTION

1.1 GENERAL

The Millennium Coal Mine is an existing open-cut coal mine located about 22 km east of Moranbah, as shown in Figure 1.1. The project is operated by Millennium Coal Pty Limited (MCPL), a wholly owned subsidiary of Peabody Energy Pty Limited (Peabody). The Mine has been operating since 2005 with approval to produce at a rate of 2.0 Million tonnes per annum (Mtpa).

The Run-of-Mine (ROM) coal is currently extracted from two granted Mining Leases (ML) namely, ML 70313 "Millennium West" and ML 70344 "Mountain Pit". The ROM coal is washed in a Coal Handling and Preparation Plant (CHPP) on an adjoining infrastructure lease, ML 70312 "Millennium East".

The Proponent, Peabody Energy, proposes to extend the current open-cut mining operation into two new lease areas, while continuing mining within ML 70313. The proposed expansion areas are collectively referred to as the "Millennium Expansion Project" (MEP). Accordingly, the MEP proposal is requesting:

- Authorisation for additional open-cut mining areas and associated activities; and
- Permission to increase the extraction rate up to 5.5 Mtpa of ROM coal.

1.2 SCOPE OF THIS STUDY

This report, prepared by WRM Water & Environment Pty Ltd, presents the methodology and results of the surface water investigations undertaken to assess the potential impacts of the proposed MEP on local surface hydrology and the existing mine water management system. The report will provide the basis for the surface water component of the Project Environmental Impact Study (EIS) for the MEP. The key components of the surface water study include the following:

- A description of the existing environment including local and regional catchments, drainage lines, geomorphology, meteorology, water features of interest, water quality and downstream water users;
- An assessment of flooding in New Chum Creek which drains through the MEP, including;
    - An assessment of the impact of flooding on proposed external waste rock emplacements and conceptual design of appropriate safeguards, such as levees and creek crossings if necessary.
    - An assessment of the impact of the proposed MEP on the depth, extent and frequency of flooding, and the impact on stream stability and erosion in New Chum Creek;

    - An assessment of the potential impacts of the proposed mining operations on downstream surface water quality and quantity;

- The development of surface water control measures to mitigate the potential impacts of the proposed MEP on receiving waters in accordance with the requirements of the Model Water Conditions for Environmental Authorities applying to mines in the Fitzroy River Basin;
- The development of an annual mine site water balance for the whole Millennium Expansion Project;
- An assessment of the long-term (hydrologic) storage behaviour of the final voids.

1.3 REPORT STRUCTURE

This report is structured as follows.

- Section 2 describes the existing environment with respect to surface water resources;
- Section 3 describes the existing mine water management system and summarises the existing water management approach at the Millennium Mine;
- Section 4 outlines the potential impacts of the proposed MEP on surface water resources and identifies the proposed measures to mitigate the impacts;
- Section 5 describes the results of water balance modelling undertaken to assess the performance of the MEP site water management system under historical climatic conditions, and the site water balance;
- Section 6 describes the proposed MEP surface water monitoring system;
- Section 7 summarises the findings of the study;
- Section 8 is a list of references;
- Appendix A details the water management system including changes due to the proposed MEP.
- Appendix B details the hydrologic and hydraulic flood model development and calibration used to assess the impact of the proposed project on flood behaviour in New Chum Creek.
- Appendix C details the geomorphic features of the streams crossing the site at key locations.

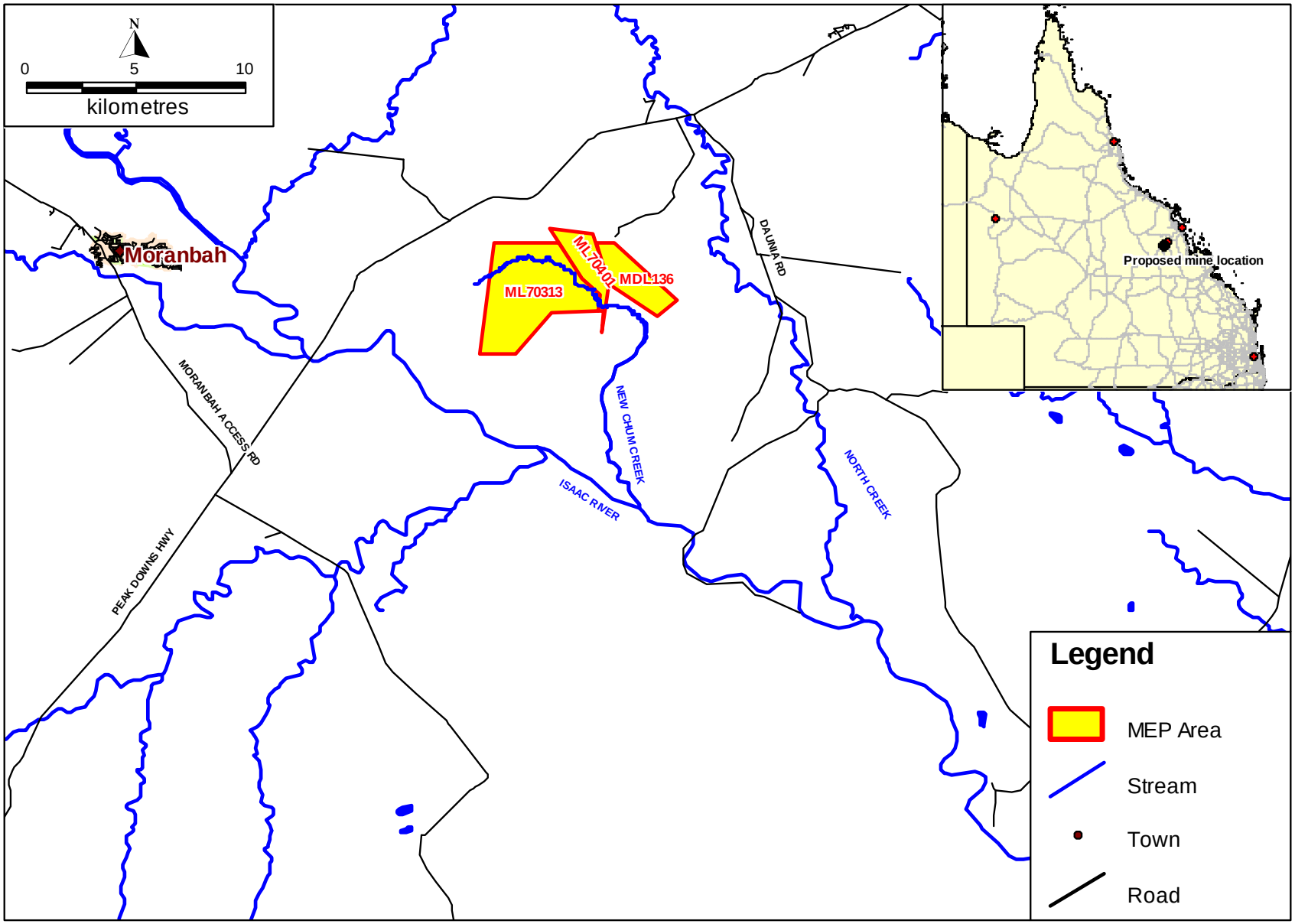

Figure 1.1 Millennium Expansion Project Locality Plan

2 EXISTING ENVIRONMENT

2.1 REGIONAL DRAINAGE NETWORK

As shown in Figure 2.1, the proposed MEP project is located in the Isaac River catchment, which is part of the Fitzroy River Basin. There has been relatively little water resources development in the Isaac River. The only significant water retaining structure in the catchment is Burton Gorge Dam, which is located on the Isaac River approximately 45 km to the north of the project area.

Figure 2.2 shows the majority of the project area is located in the headwaters of New Chum Creek, a south-flowing tributary of the Isaac River. The proposed MEP Area covers an area of approximately 26 km^2, or 0.7% of the Isaac River catchment area of 3,560 km^2 downstream of the New Chum Creek confluence. New Chum Creek has a catchment area of approximately 51km^2 at the Isaac River confluence. The MEP Area covers 17.6 km^2 or 35% of the total New Chum Creek catchment.

The south-western portion of the MEP Area drains approximately 6km south via West Creek to the Isaac River. West Creek joins the Isaac River approximately 9km upstream of the New Chum Creek confluence. Cherwell Creek joins the Isaac River from the south between West Creek and New Chum Creek. The catchment area of the Isaac River at the West Creek confluence is approximately 2,740km^2. West Creek has a catchment area of approximately 22km^2 at the Isaac River confluence. The MEP Area covers 10.2 km^2 or 46% of the total West Creek catchment.

The north-eastern portion of the site drains into headwater tributaries of North Creek, a major south-flowing tributary which joins the Isaac River approximately 15km downstream of New Chum Creek. North Creek has a total catchment area of approximately 338 km^2 at the Isaac River confluence. The MEP Area covers 2.1 km^2 or 0.6 % of the total North Creek catchment. The catchment area of the Isaac River is approximately 4,100 km^2 downstream of the North Creek confluence.

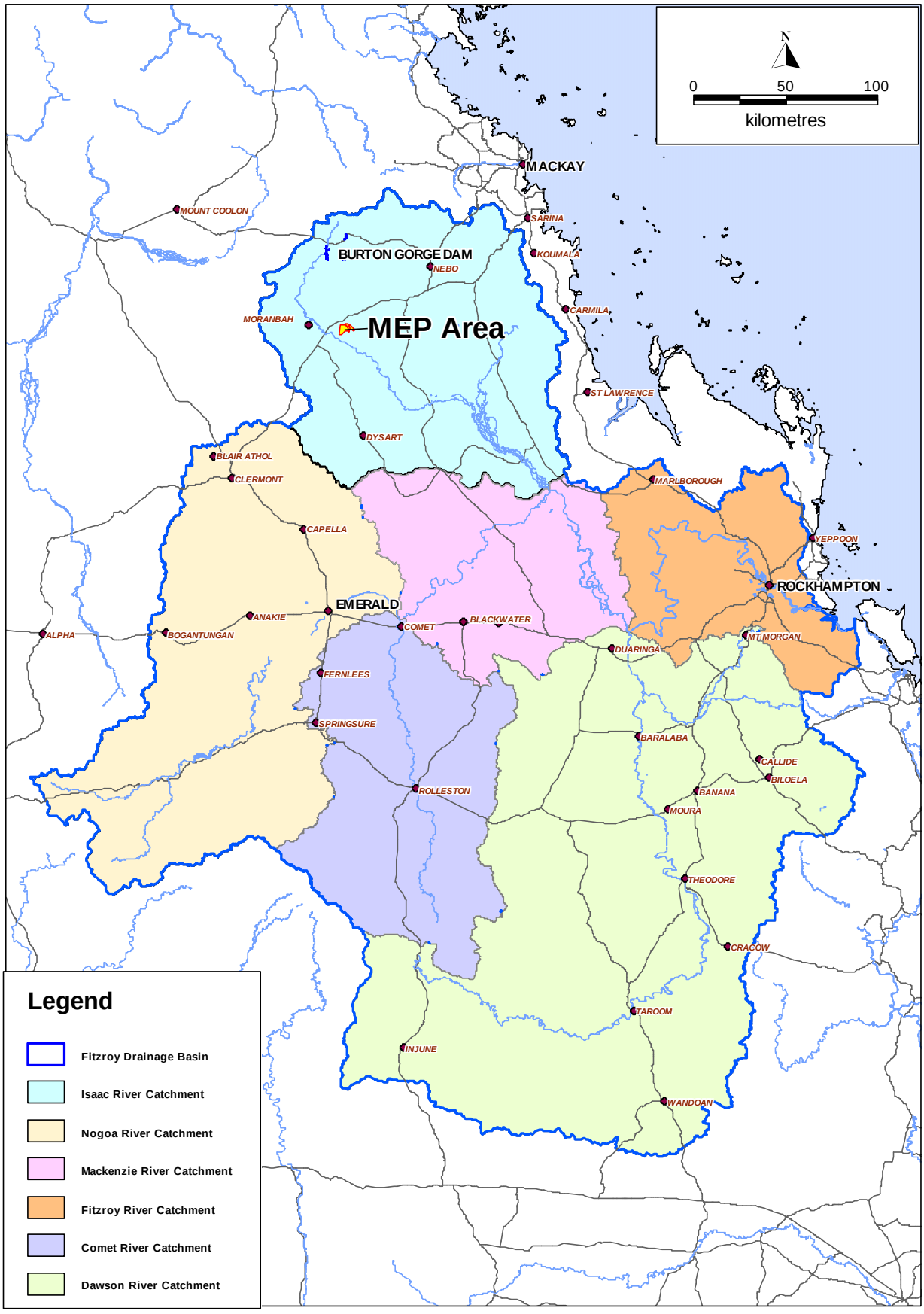

Figure 2.1 Fitzroy River Basin

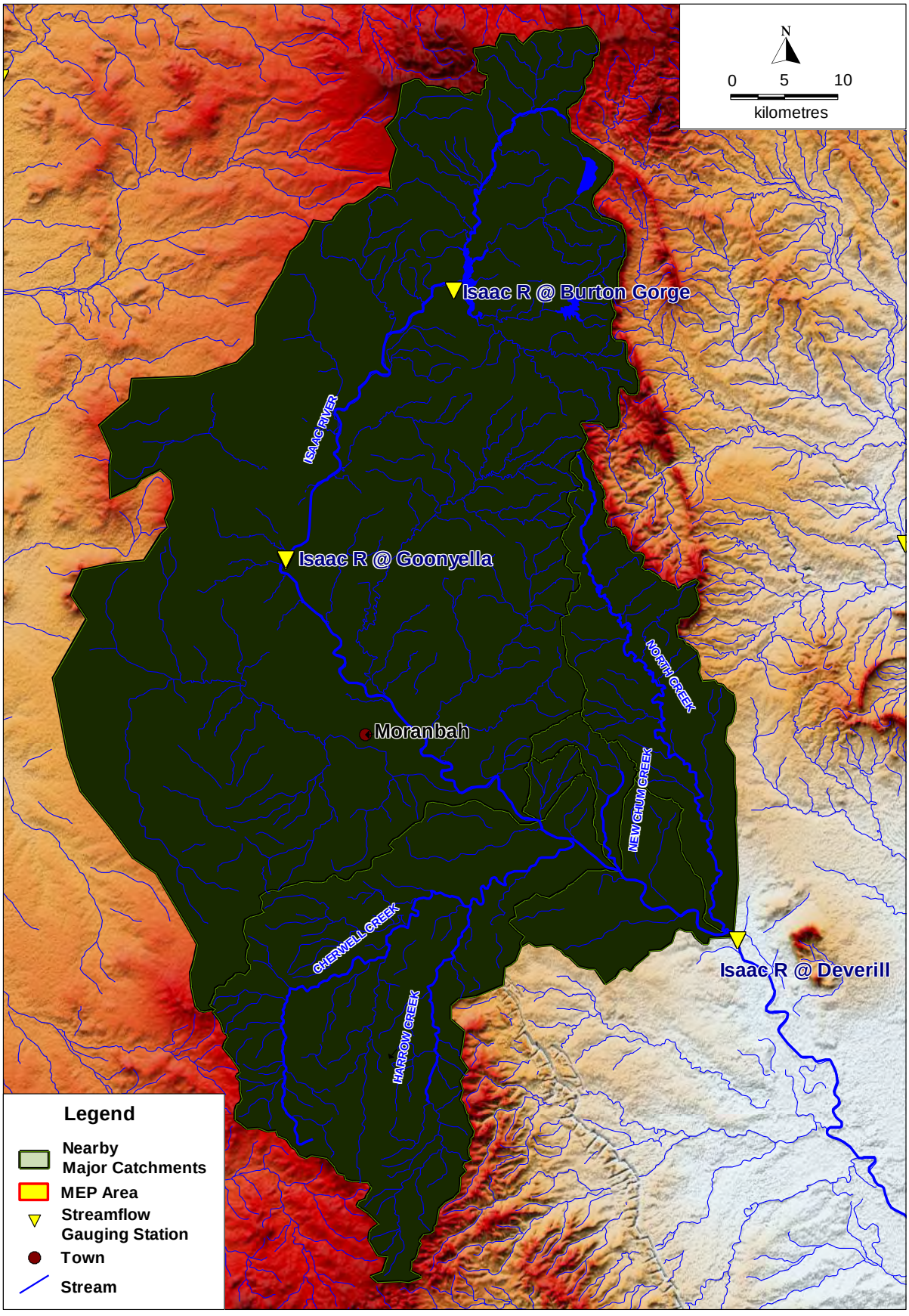

Figure 2.2 Receiving Water Catchments

2.1.1 Geology and Soils

The MEP is located in the Bowen Basin on the western margins of the Taroom Trough. A series of northwest-aligned faults displaying throws of up to 80 m disjoint the assemblage, with the Fort Cooper and Rangal Coal Measures outcropping in the centre of the MEP area.

The majority of the site lies on the Triassic Rewan formation overlying Permian coal measures. In the south, Quaternary aged alluvium associated with the Isaac River overlies the Triassic - Permian sequence. Tertiary sediments occur in isolation east and west of the MEP.

2.1.2 Groundwater

Groundwater investigations carried out by Met Serve (Met Serve, 2010) drew the following conclusions regarding groundwater at the MEP:

- Published and anecdotal evidence suggests that four different hydrogeological systems occur in the region; the Quaternary, Tertiary, Triassic and Permian aquifers;
- Lithological data collected during the MEP exploration drilling suggests that the Tertiary and Triassic aquifers are geologically isolated and hydraulically disconnected, and are unlikely to be affected by proposed mining at the MEP;
- During exploration drilling at Millennium, groundwater was encountered within the targeted Rangal Coal Measures and associated interburden;
- Groundwater quality data suggests that groundwater in the Rangal Coal Measures aquifer is brackish to saline;
- It is expected that minor quantities of water will enter the open cut pits as the mine progresses. Groundwater inflow rates to the Mavis and Millennium pits are likely to be of the order of 1.2 L/s on average.

2.1.3 Catchment Land and Surface Water Use

Land use within the regional catchments is predominantly low intensity grazing. A number of other mines operate in the vicinity as shown in Figure 2.3. The Poitrel coal mine operates within the New Chum Creek catchment immediately downstream of the proposed mining lease area. The North Creek catchment contains a number of existing and proposed coal mine operations, including Moorvale, Carborough, Annandale, Daunia and Olive Downs. Mining operations in the upstream reaches of the Isaac River include Eaglefield, Goonyella/Riverside, Moranbah North and Isaac Plains.

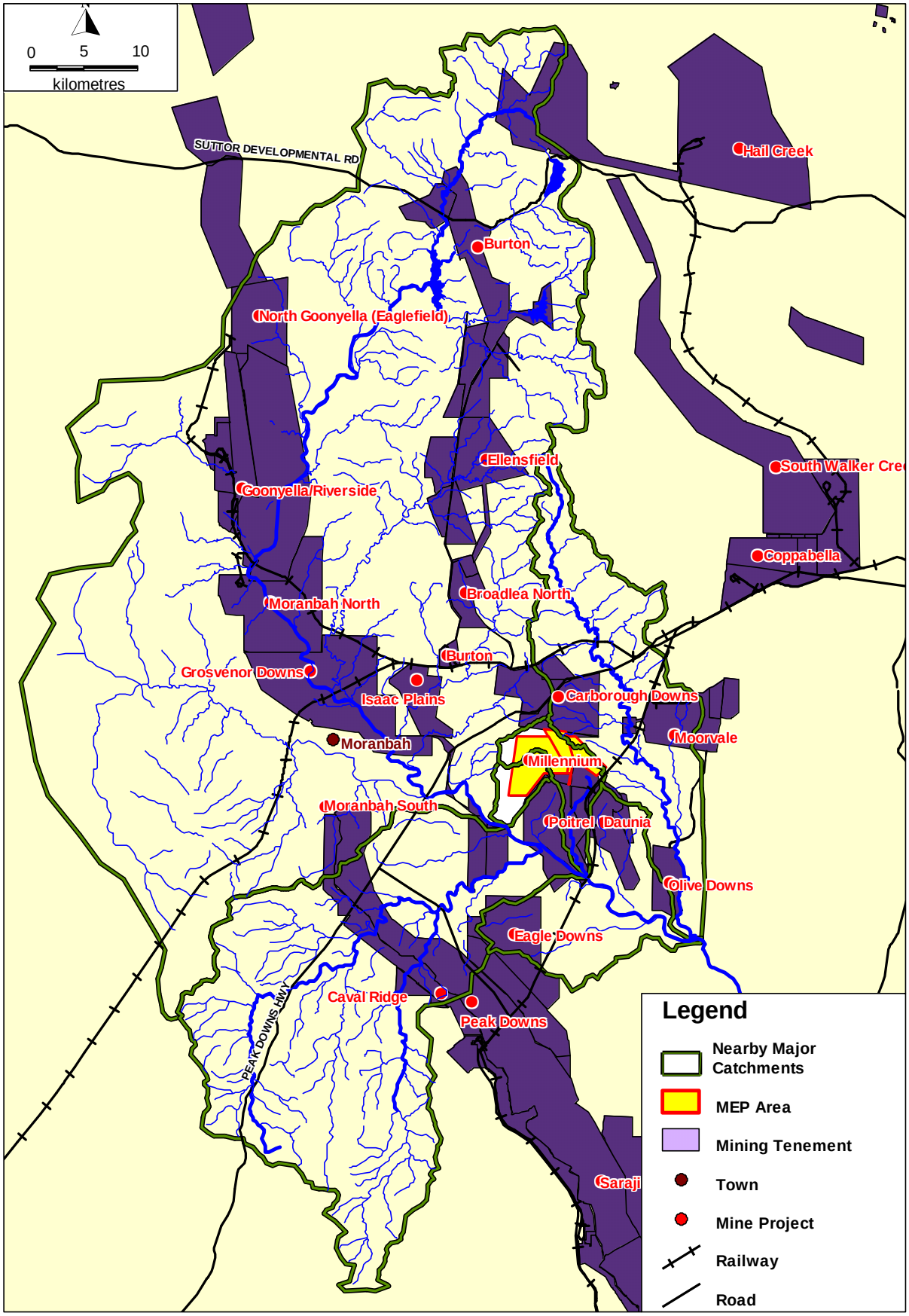

Figure 2.3 Neighbouring Mining Activities

2.2 LOCAL DRAINAGE NETWORK

2.2.1 General

The existing Millennium mining operations are located in small headwater catchments on the southern side of New Chum Creek. The proposed MEP will see disturbance on the northern side of New Chum Creek and over the catchment divide into the North Creek catchment.

The total catchment area of New Chum Creek to the downstream boundary of the proposed mining lease is approximately 29.9 km^2. Of this, 7.7km^2 is located upstream of the MEP Area boundary, including 1.8km^2 draining onto the MEP Area from the neighbouring Carborough Downs operation via minor tributary gullies.

The catchment area of West Creek to the downstream MEP Area boundary is approximately 15 km^2. Of this, 10.2 km^2 is contained in the MEP Area, with most of the remaining catchment joining West Creek near the downstream lease boundary. A surface water impoundment known as the Western Dam is located on West Creek collecting runoff from about 6.4 km^2.

The portions of the North Creek catchment disturbed by the MEP are in small headwater gullies, on the north-eastern edge of the project area. Only 2.0 km^2 is within the MEP Area.

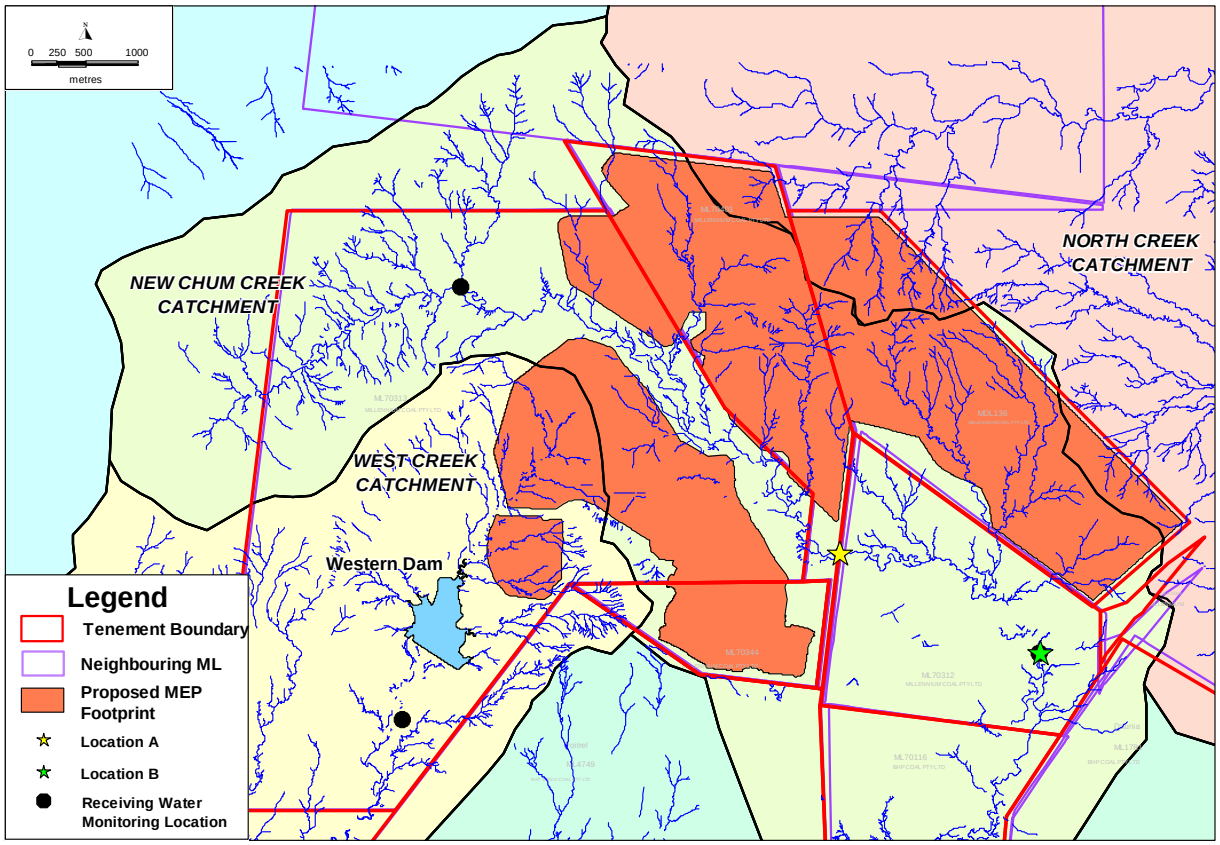

Figure 2.4 Local Catchment Areas

2.2.2 Geomorphic Conditions

Figure 2.5 and Figure 2.6 show the New Chum Creek main channel at Locations A and B within the MEP Area (see Figure 2.4). In the vicinity of the MEP Area, the creek is characterised by a sandy bed channel incised within a wide floodplain.

The main channel typically has a base width of approximately 3m, a depth of 2m, and bank slopes of approximately 1V:2H. The capacity of the channel is sufficient to convey flows up to the 2 year Average Recurrence Interval (ARI) flow before significant overbank flow occurs. The banks are well covered by trees and grass and appear stable. The bed material is coarse sand. Some waterholes persist in the channel for several weeks following rainfall, however the stream is ephemeral, and there is little aquatic vegetation.

As shown in Figure 2.6, the floodplain area is vegetated by scattered trees. The floodplain also contains a number of remnant channels of similar dimensions to the main channel.

New Chum Creek is crossed by two road culvert crossings within the ML boundary and a railway culvert crossing at the downstream boundary. New Chum Creek has been recently diverted downstream on New Chum Creek as part of the neighbouring Poitrel Mine operation.

Further details of the geomorphic conditions in New Chum Creek and West Creek are provided in Appendix C.

Figure 2.5 New Chum Creek Channel in the Vicinity of the Project Area, Location A

Figure 2.6 New Chum Creek in the Vicinity of the Project Area, Location B

2.3 RAINFALL AND EVAPORATION

2.3.1 Spatial Variability

Figure 2.7 shows mean annual rainfall isohyets provided by the Bureau of Meteorology derived for the period 1969 to 1990. The isohyets show that mean annual rainfall does not vary significantly in the immediate vicinity of the project site. However the influence of Carborough Range creates a region of relatively high rainfall to the north-east, and this has some influence over mean annual rainfall at the site. Details of nearby rainfall recording stations are provided in Table 2.1 below.

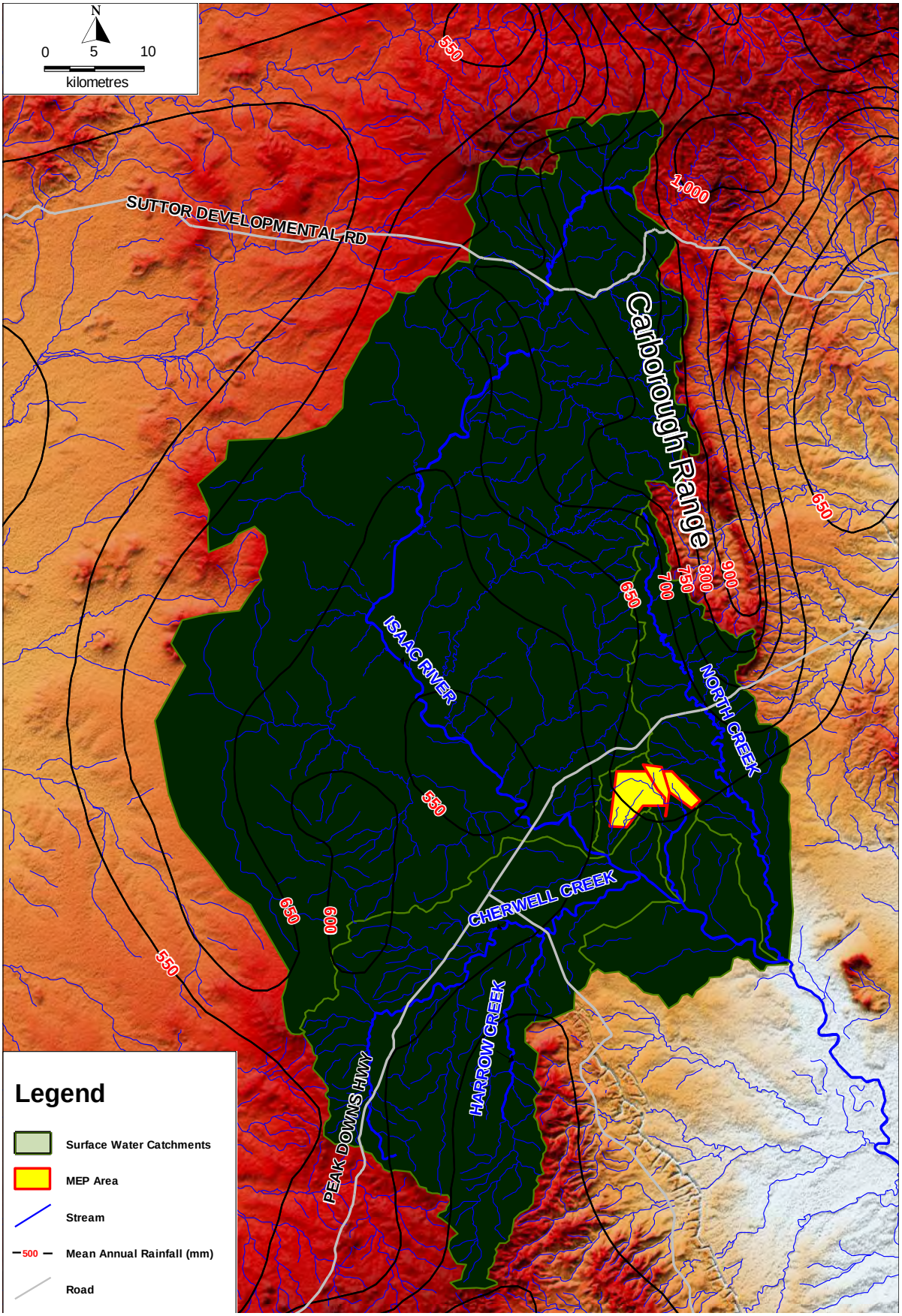

Figure 2.7 Mean Annual Rainfall Isohyets and Climate Recording Stations

Table 2.1 Details of Rainfall Stations in the Area of Interest

Station No.	Station Name	Type	Elevation (m)	Distance from Site (km)	Opened	Closed	Owner
034039	Wotonga	Daily	280.0	7.5	1972	1975	BOM (AUS)
034091	Olive Downs	Continuous	198.0	12.5	1980	1981	BOM (AUS)
034091	Olive Downs	Daily	198.0	12.5	1980	1981	BOM (AUS)
034014	Grosvenor Downs	Daily		17.5	1886	1972	BOM (AUS)
034030	Isaac	Continuous	200.0	19.8	1968	1997	BOM (AUS)
034030	Isaac	Daily	200.0	19.8	1963	1997	BOM (AUS)
534005	Deverill GS 130410A	Continuous		20.8	1995		NRW (QLD)
534003	Deverill TM	Operational	200.0	20.8	1995		BOMQ (Qld)
034038	Moranbah WWTP	Continuous	240.0	23.2	1986		BOM (AUS)
034038	Moranbah WWTP	Daily	240.0	23.2	1972		BOM (AUS)
034038	Moranbah WWTP	Synoptic	240.0	23.2	1972		BOM (AUS)
034100	Iffley	Continuous	175.0	29.6	1998		BOM (AUS)
034100	Iffley	Daily	175.0	29.6	1998		BOM (AUS)
034055	Mount Lebanon	Daily	294.0	36.0	1954		BOM (AUS)
034086	Seloh Nolem	Daily	170.0	38.8	1973		BOM (AUS)
034099	Mt Flora	Continuous	180.0	39.1	1998		BOM (AUS)
034099	Mt Flora	Daily	180.0	39.1	1998		BOM (AUS)
034060	Alameda Downs	Daily	250.0	46.8	1972		BOM (AUS)
034062	Cattle Camp Stn	Daily	170.0	50.0	1972		BOM (AUS)
034074	Oxford Downs	Daily	180.0	50.0	1895		BOM (AUS)

2.3.2 Temporal Variability

Rainfall has been recorded at the existing Millennium operation since 2006. As shown in Figure 2.8, annual rainfall at the site for the period 2006 to 2009 varied from 520 mm in 2009, to 901 mm in 2008. Mean annual rainfall over the period of the site record was 673 mm.

In order to extend the rainfall dataset for the water balance calculations, a synthetic rainfall dataset was also obtained for a location near the project site from the DERM's Data Drill Service. The Data Drill *"accesses grids of data derived by interpolating the Bureau of Meteorology's station records. Interpolations are calculated by splining and kriging techniques. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields. However, the Data Drill does have the advantage of being available for any set of coordinates in Australia"* (Bureau of Meteorology, 2006).

Mean annual rainfall for the Data Drill dataset was 634 mm over the corresponding period of site records, and 577 mm over the period from 1889 to 2009. With the exception of 2007, site rainfall has been slightly higher than the Data Drill rainfall. Annual rainfall in 2007 and 2008 was above average.

Mean monthly rainfall and Pan Evaporation from the Data Drill record is shown in Figure 2.9. Mean rainfall is highest between November and February, and evaporation is highest between October and March. Mean annual pan evaporation is over 2300 mm.

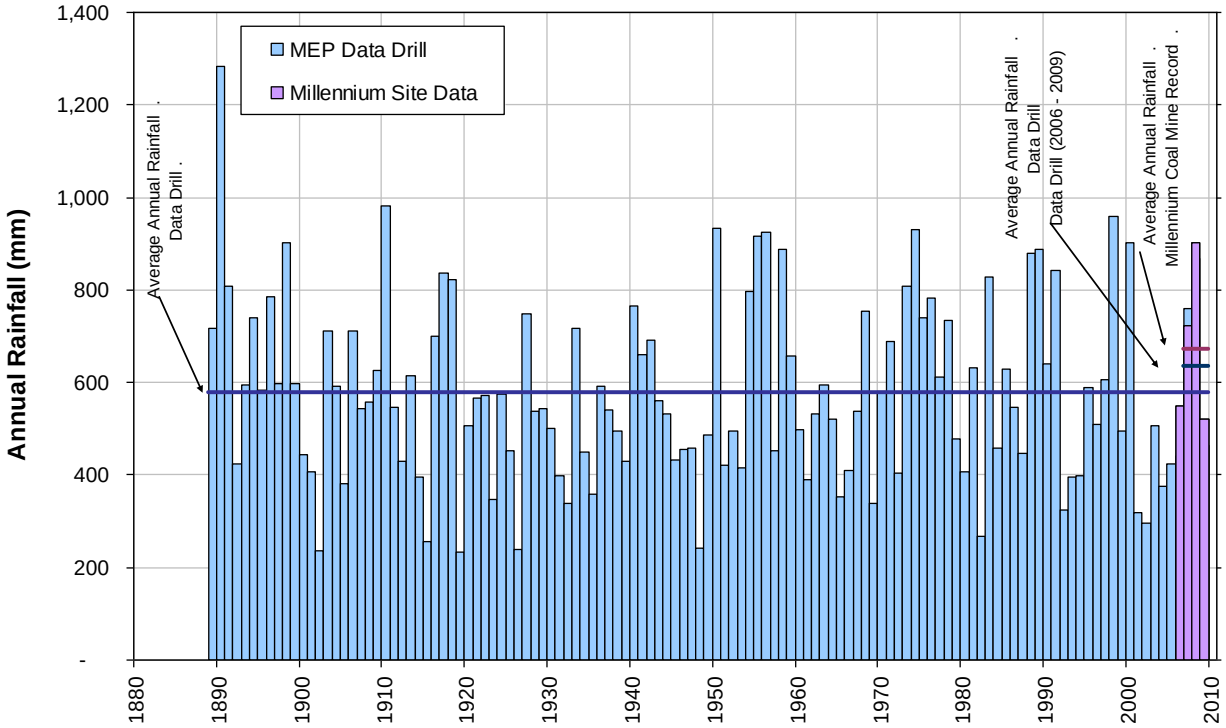

Figure 2.8 Annual Rainfall at Millennium Site (2006-2009) Compared to DERM DataDrill

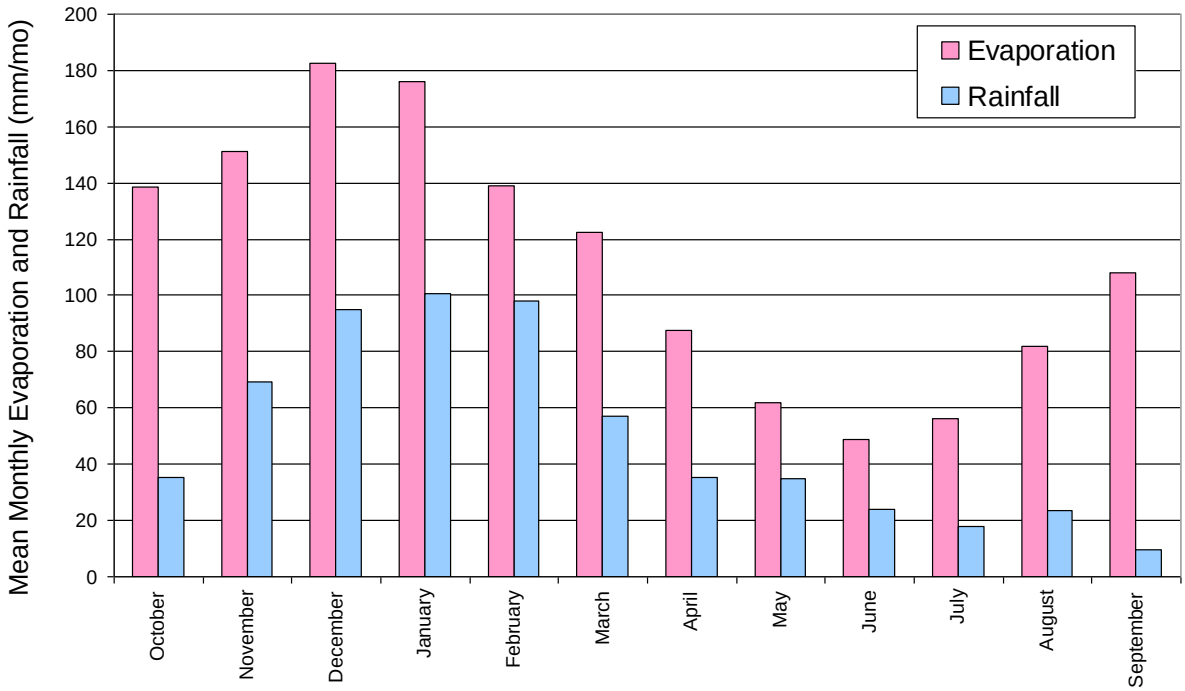

Figure 2.9 Monthly Rainfall and Pan Evaporation at MEP Site (DERM DataDrill 1970-2010)

Figure 2.10 compares daily rainfall recorded at the Millennium Coal Mine with daily readings from the Data Drill. The figure suggests the Data Drill tends to underestimate daily rainfall compared to the site recordings. However, closer examination of the site data indicates that a number of the higher daily totals were recorded either after weekends or public holidays, and therefore probably represent totals over several preceding days.

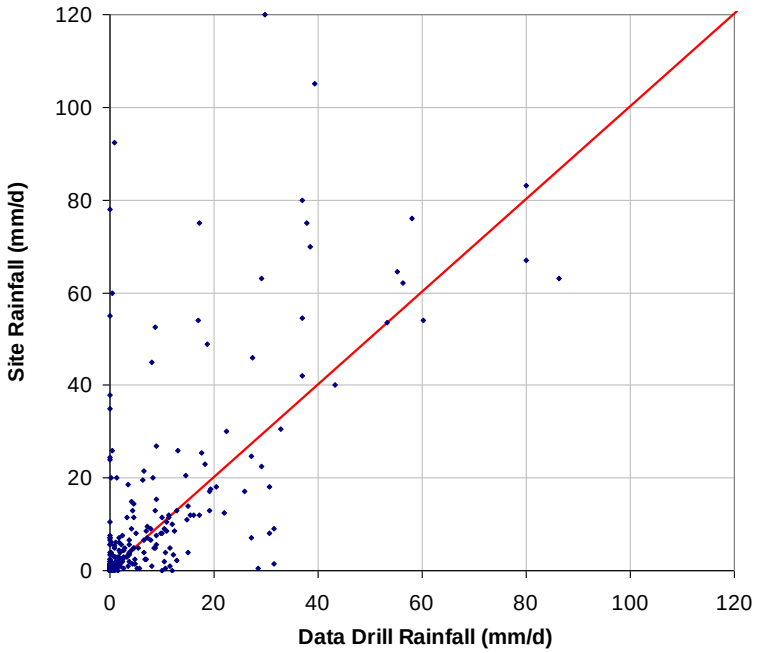

Figure 2.10 Comparison of DERM Data Drill and Millennium Site Daily Rainfall

Figure 2.11 compares the mean monthly site rainfall with the mean monthly DERM Data Drill rainfall for the common period of record. The figure shows the Data Drill record provides a good estimate of average monthly rainfall over the period.

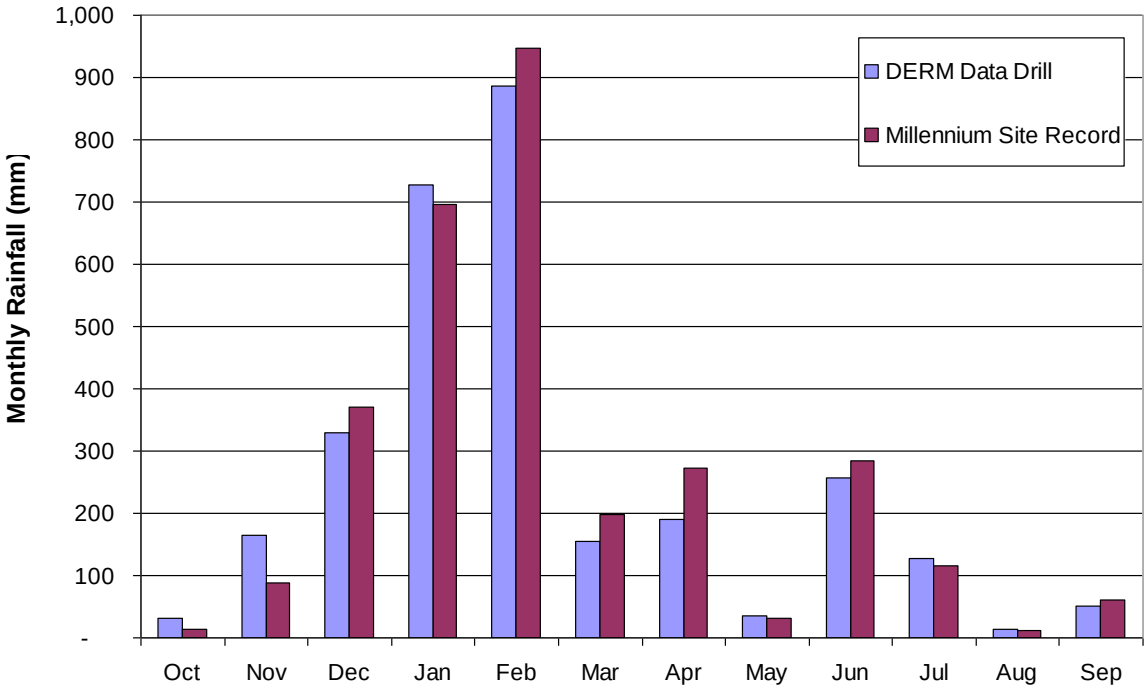

Figure 2.11 Mean Monthly Rainfall 9/1/2006 to 20/4/2010 - Comparison of Millennium Site Record with DERM Data Drill

Three-month summer rainfall totals (starting November 1) from the two data sets are also compared in Table 2.2 below. The table shows that the Data Drill provided a good representation of site rainfall, and overestimated it for the 2009-2010 summer. The Data Drill rainfall record is therefore suitable for the purposes of these surface water management catchment investigations.

Table 2.2 Comparison of Summer Rainfall Totals – Site Record and Data Drill

Summer Commencing November	3 Month Rainfall Depth (mm)	
	Data Drill	Site Record
2006	189	197
2007	511	511
2008	243	280
2009	219	101
Total	1,162	1,088

2.4 STREAMFLOW

Limited recording of New Chum Creek water levels has been undertaken by BHP Mitsui upstream and downstream of the existing Poitrel operation.

The catchment runoff response is characterised by long periods of no flow interspersed with short periods of streamflow persisting for several days. A sample of the data during a runoff event in February 2009 is shown in Figure 2.12.

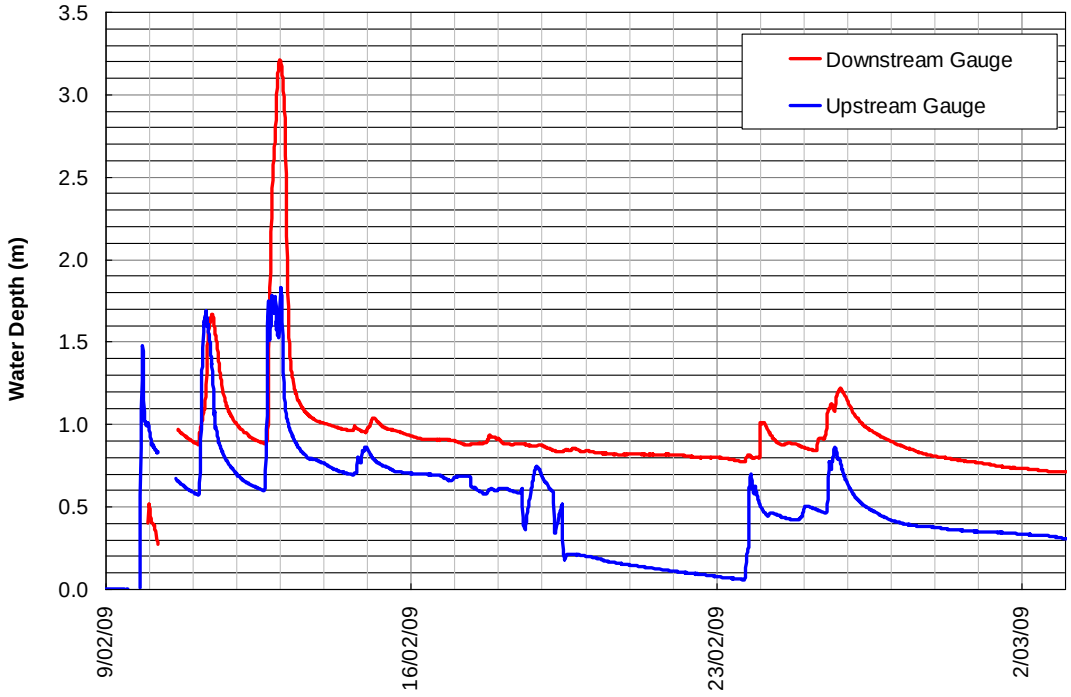

Figure 2.12 Sample New Chum Creek Streamflow Response

Catchment runoff characteristics can also be inferred from measurements at DERM streamflow gauges in nearby catchments shown in Figure 2.13 and Table 2.3.

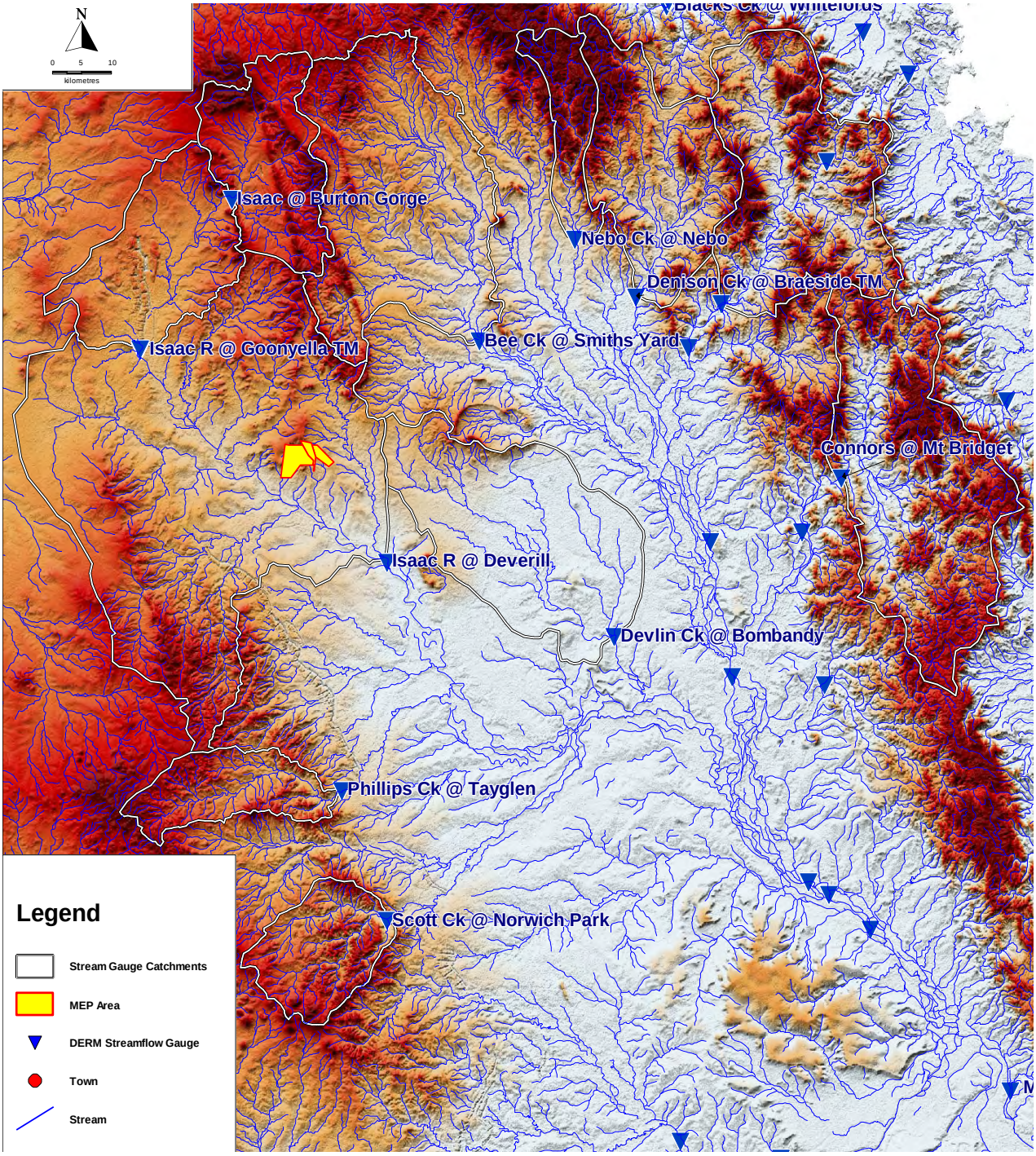

Figure 2.13 DERM Streamflow Gauges in the Vicinity of MEP

Table 2.3 DERM Streamflow Gauges in the Vicinity of MEP

Gauge No.	Gauge Name	Stream	Adopted Middle Thread Distance (km)	Catchment Area (km²)	Start	Finish
130410A	Deverill	Isaac	174.7	4,092	20/05/1968	
130411A	Smiths Yard	Bee Ck	65.2	1,306	06/12/1971	30/09/1988
130402A	Burton Gorge	Isaac	280.3	551	01/05/1964	30/09/1988
130414A	Goonyella	Isaac	242.8	1,214	24/05/1983	
130407A	Nebo	Nebo Ck	28.2	258	01/12/1965	06/10/1988
130413A	Braeside	Denison Ck	29.8	757	07/12/1971	
130412A	Bombandy	Devlin Ck	19.7	1,023	27/05/1971	30/09/1988
130409A	Tayglen	Phillips Ck	34.3	344	18/05/1968	27/10/1988
130415A	Norwich Park	Scott Ck	25.0	388	20/10/1972	28/02/1988
130403A	Mt Bridget	Connors	95.3	1,291	12/12/1965	

Flow conditions in the region are illustrated in the following figures derived from the Isaac River streamflow data. Most Isaac River streamflow occurs between December and March, as shown in Figure 2.14. Streamflow is highly variable. Periods of streamflow are interspersed with long dry spells, as illustrated by the 18 month sample of the streamflow record shown in Figure 2.15.

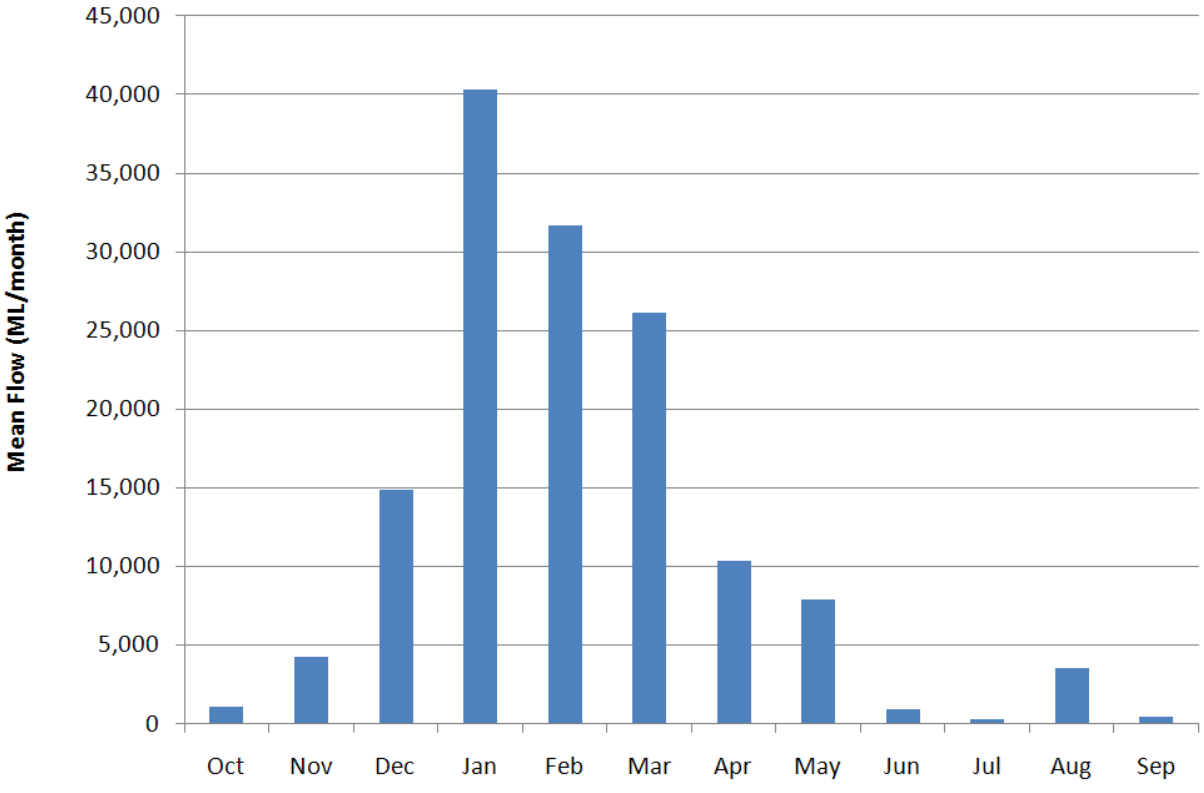

Figure 2.14 Mean Monthly Flow – Isaac River at Deverill

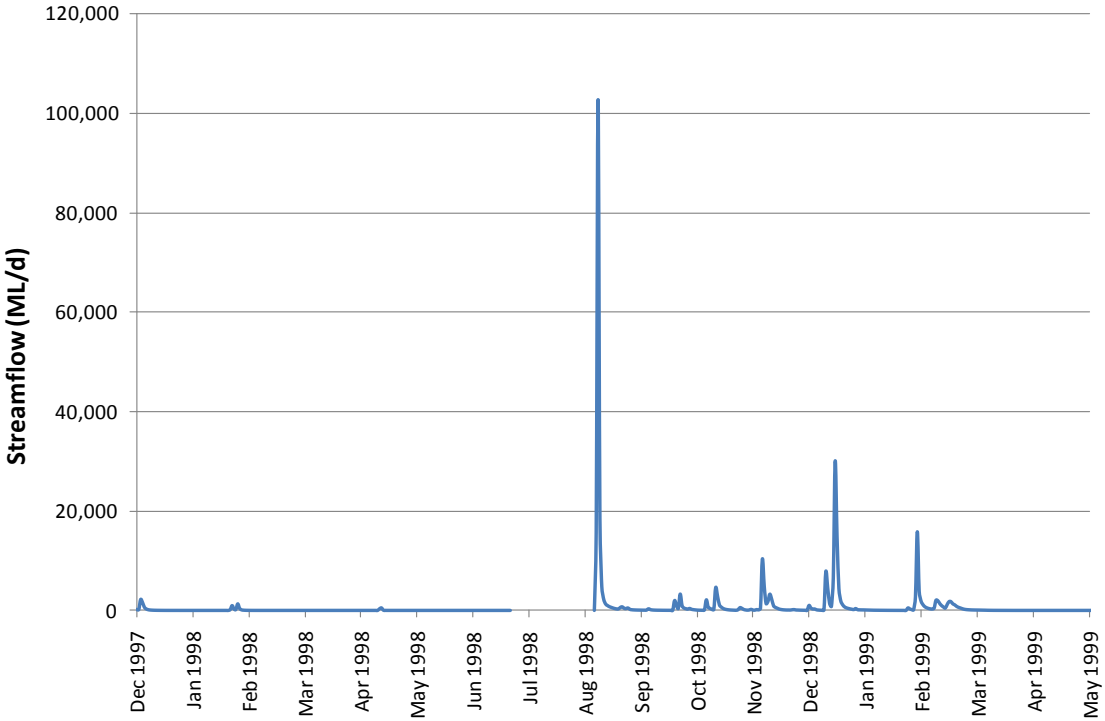

Figure 2.15 Sample of Streamflow Record – Isaac River at Deverill

The flow frequency curves based on the recorded data at key gauges in the vicinity of the MEP are shown in Figure 2.16 below. The figure shows all gauged streams in the region are ephemeral.

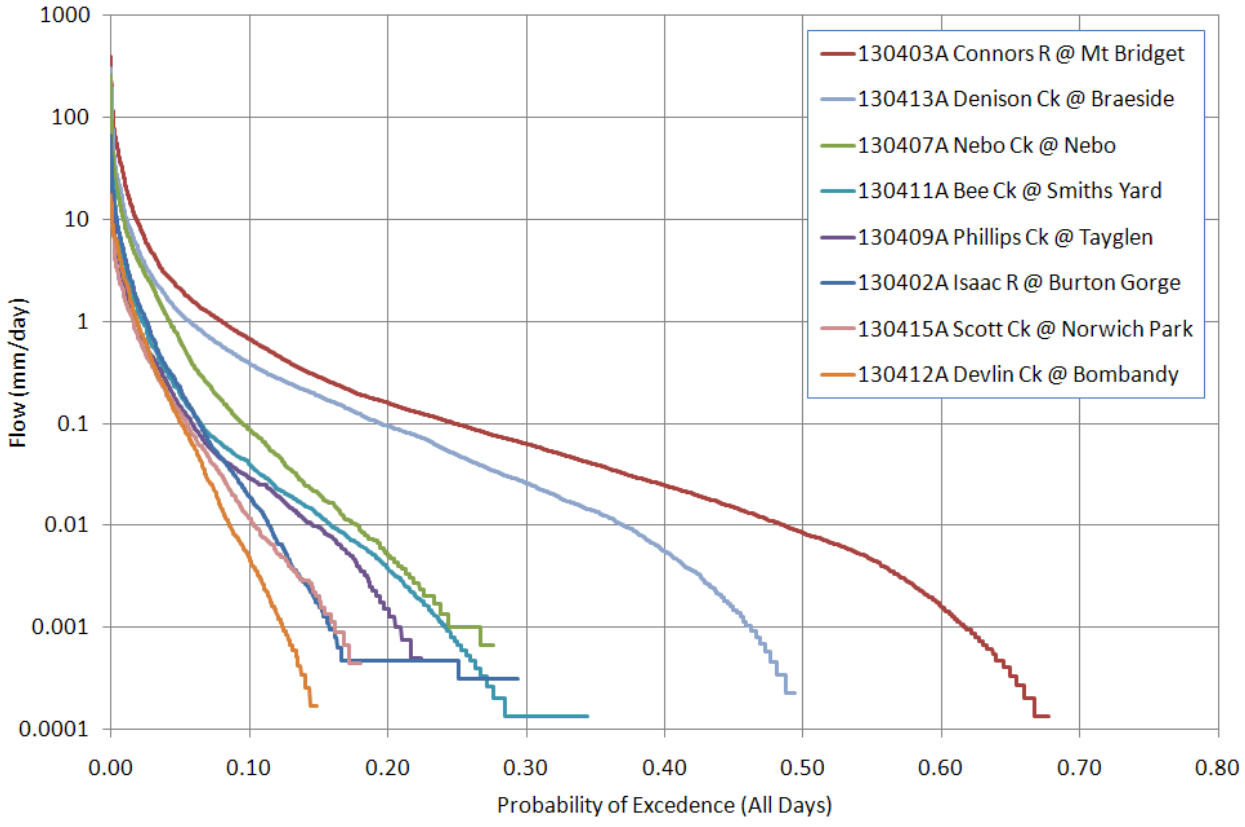

Figure 2.16 Recorded Frequency Curves (mm/d - no-flow days included)

The curves suggest that the upper Connors River and Denison Creek catchments are not hydrologically similar to the western catchments in the vicinity of the MEP. Streams originating in the east of the Isaac River catchment have more persistent flows than those originating in the west, where streamflow typically occurs less than 30% of the time. The significantly higher flow in the eastern catchments is probably largely due to higher catchment rainfall.

Figure 2.17 shows the frequency curves estimated from recorded data at the gauge locations listed in Table 2.3, with no flow days excluded.

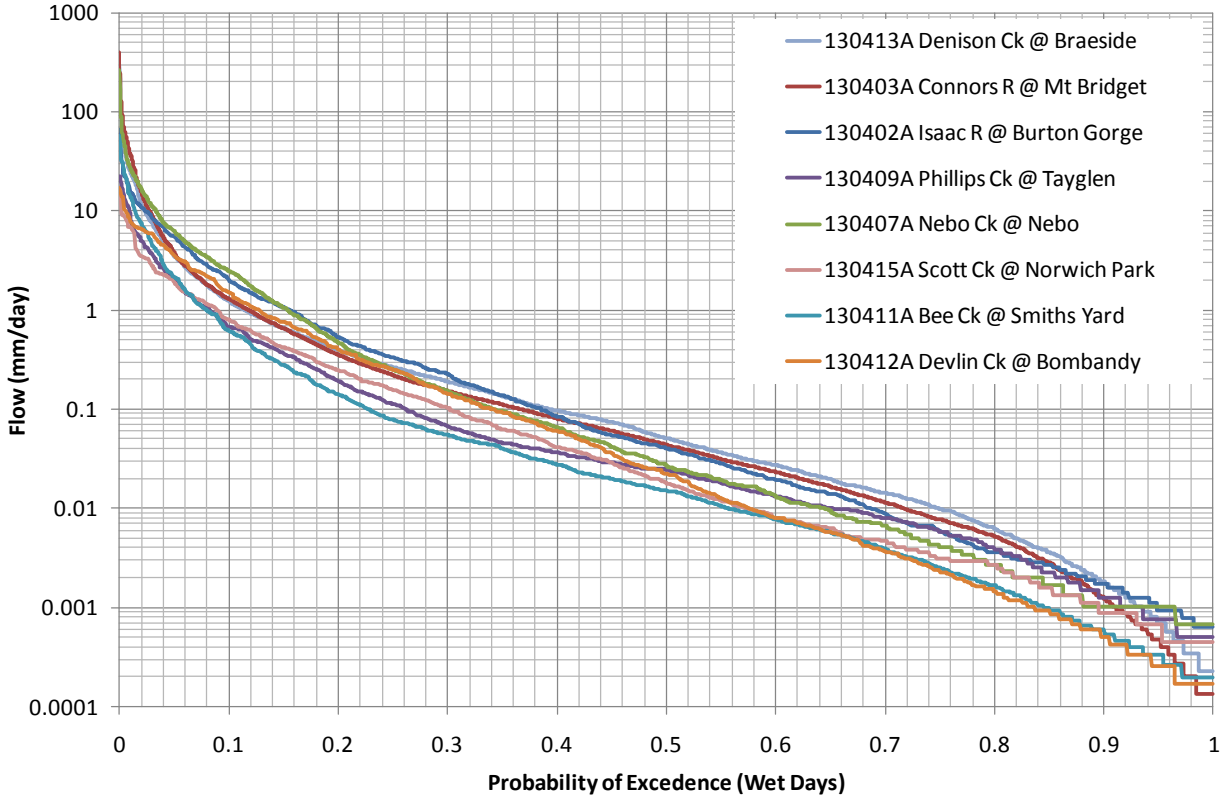

Figure 2.17 Recorded Frequency Curves (mm/d - no-flow days excluded)

2.5 ENVIRONMENTAL VALUES OF RECEIVING WATERS

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) (ANZECC Guidelines) define the 'Environmental Values' of receiving waters as those values or uses of water that the community believes are important for a healthy ecosystem.

Under Section 7 of the Queensland Environmental *Protection Policy (Water) 2009* (EPP Water), there are no particular environmental values attributed to the specific waterways located within the MEP as they are not listed in Schedule 1. Section 7 (2) however, assigns the environmental values in the receiving water to be protected under the category 'other waters' as:

- ecosystem protection (Level 2 – disturbed ecosystems, Queensland Water Quality Guidelines (QWQG) 2006); and
- agricultural uses (Irrigation and Stock Watering).

The ANZECC guidelines specify levels of protection corresponding to each of the following measures of the receiving water ecosystem condition:

- of high conservation value;
- slightly to moderately disturbed; or
- highly disturbed.

The receiving waterways adjacent to the project area are slightly to moderately disturbed. The Isaac River catchment has seen significant changes in land use over the past 50 years. Widespread land clearing and coal mine development have occurred throughout the receiving water catchments.

2.6 SURFACE WATER QUALITY

The extent to which previous activities in the catchment have affected receiving water quality is difficult to ascertain. Coal mines have historically discharged mine-affected water immediately following significant rainfall events, but few records are publicly available of the timing and quality of these releases. Typically, under normal conditions, water is conserved on site to provide water supplies. It is likely that during most of the historical record, except under relatively wet conditions, streamflow and water quality records are not significantly affected by mine releases.

Background water quality monitoring in the Fitzroy Basin has been undertaken by DERM. Of relevance to this operation are the monitoring stations at three sites on the Isaac River (Burton Gorge, Deverill and Goonyella) and two stations located on Devlin Creek and Bee Creek (see Figure 2.13).

Receiving water quality data has also been collected by Peabody Energy Ltd at locations on New Chum Creek. The locations of the New Chum Creek monitoring stations are shown in Figure 2.4.

The following sections present water quality assessment results for parameters of relevance to the MEP. The variability of flow in ephemeral streams can lead to changes in the physical and chemical properties of flow compared to perennial streams. The current Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC Guidelines) (ANZECC, 2000) therefore may not be well suited to the characteristics of water quality for ephemeral streams. Notwithstanding this, the recorded water quality data has been compared with the Millennium Coal Mine Environmental Authority dated 30 November 2009.

2.6.1 Isaac River Water Quality

There are three DERM streamflow gauges along the Isaac River at which water quality data has been collected:

- The Deverill station is located just downstream of the North Creek confluence, and was operational between 1964 and 2000,
- Goonyella is located approximately 70 km upstream of Deverill and was operational between 1982 and 2002, and
- Burton Gorge is approximately 40 km upstream of Goonyella and was operational between 1964 and 1988.

Very little data is available on metals at these stations. Table 2.4 summarises the available data along the Isaac River. The following is of note:

- Median Electrical Conductivity (EC) values in the Isaac River vary from 240 µS/cm to 570 µS/cm;
- pH is generally neutral to slightly alkaline;
- Median Total Suspended Solids (TSS) values in the Isaac River are naturally in the range 130 to 230mg/L;
- Sulphate, Boron and Iron levels are generally lower than the adopted trigger values and end-of pipe release limits, but Iron can exceed these limits occasionally;
- Copper levels are significantly higher than the adopted trigger values and end-of pipe release limits.

2.6.2 Devlin Creek and Bee Creek Water Quality

DERM has recorded water quality at locations on the nearby Bee Creek and Devlin Creek:

- The Bee Creek station is located approximately 24 km north-east of the site and was operational between 1972 and 1988; and
- The Devlin Creek station is approximately 52 km south-east of the site and was operational between 1971 and 1988.

Table 2.5 summarises the available data at these stations. The following is of note:

- Median EC values in Devlin Creek and Bee Creek are 155 µS/cm and 245 µS/cm respectively, and
- pH is slightly alkaline and the pH in Bee Creek naturally reaches values higher than the receiving waters contaminant trigger level of 8.0.

2.6.3 New Chum Creek Water Quality

Table 2.6 summarises water quality at the upstream New Chum Creek monitoring site. The table shows that Turbidity, Sulphate, Aluminium and Iron levels are naturally elevated in the receiving waters. These analytes and a number of others (Zinc, Copper, Nitrogen and Phosphorous) exceed the ANZECC Guideline trigger levels (GHD, 2010).

Table 2.4 Isaac River Water Quality Data Summary

Parameter	Millennium EA Conditions		Isaac R. (Burton Gorge)			Isaac R. (Goonyella)			Isaac R. (Deverill)		
	End Of Pipe Limit	Receiving Water Trigger	Count	Median	90th %ile	Count	Median	90th %ile	Count	Median	90th %ile
Conductivity (µS/cm)	2,500	1,000	19	458	756	30	566	**2,363**	43	241	585
pH	6.5 – 9.0	6.5 – 8.0	19	7.8	8.1	30	7.7	8.2	44	7.6	8.3
Turbidity	-	-	4	-	-	29	100	514	14	46	3,142
TSS (mg/L)	5,000	-	15	230	5,416	29	170	4,137	40	128	2,500
Sulphate (mg/L)	1,000	1,000	13	4	18	29	19	106	36	10	35
Aluminium (µg/L)		27				10	30	60	9	-	-
Antimony (µg/L)		1									
Arsenic (As III) (µg/L)		1									
Cadmium (µg/L)		0.1				1	-	-			
Chromium (CrVI) (µg/L)		1				1	-	-			
Copper (µg/L)		1				10	**40**	**61**	11	**20**	**60**
Iron (µg/L)		300	4	-	-	27	40	**2,760**	12	35	**735**
Lead (µg/L)		10									
Mercury (inorganic) (µg/L)		0									
Nickel # (µg/L)		11									
Zinc (µg/L)		8				9	-	-	9	-	-
Boron (µg/L)		370	4	-	-	27	100	168	16	65	100
Cobalt (µg/L)		90									
Manganese #(µg/L)		1,900				12	10	20	8	-	-
Molybdenum (µg/L)		34									
Selenium (µg/L)		10									
Silver (µg/L)		1									
Uranium (µg/L)		1									
Vanadium (µg/L)		10									
Ammonia (as N) (µg/L)		320				2	-	-	7	-	-
Nitrate (µg/L)		1,100	8	-	-	26	2,050	5,000	28	1,965	3,860
Pet. hydrocarbon (C6-C9)		20									
Pet. hydrocarbon (C10-C36)		100									
Fluoride (total) (µg/L)		2,000	19	190	380	30	200	404	41	150	200

Table 2.5 Devlin Creek and Bee Creek Water Quality Data Summary

Parameter	Millennium EA Conditions		Devlin Creek (Bombandy)			Bee Creek (Smiths Yard)		
	End Of Pipe Limit	Receiving Water Trigger	Count	Median	90th %ile	Count	Median	90th %ile
Conductivity (µS/cm)	2,500	1,000	21	155	235	18	245	448
pH	6.5 – 9.0	6.5 – 8.0	21	7.2	7.9	18	7.6	8.0
Turbidity	-	-	4	-	-	6	-	-
TSS (mg/L)	5,000	-	14	64	249	17	40	668
Sulphate (mg/L)	1,000	1,000	8	-	-	9	-	-
Aluminium (µg/L)		100						
Arsenic (total) (µg/L)		13						
Cadmium (µg/L)		0						
Chromium (CrVI) (µg/L)		1						
Copper (µg/L)		2						
Iron (µg/L)		300	5	-	-	6	-	-
Lead (µg/L)		10						
Mercury (inorganic) (µg/L)		0						
Nickel # (µg/L)		11						
Zinc (µg/L)		8						
Boron (µg/L)		370	4	-	-	6	-	-
Cobalt (µg/L)		90						
Manganese #(µg/L)		1,900				1	-	-
Molybdenum (µg/L)		34						
Selenium (µg/L)		10						
Silver (µg/L)		1						
Uranium (µg/L)		1						
Vanadium (µg/L)		10						
Ammonia (as N) (µg/L)		1,000						
Nitrate (µg/L)		1,100	9	-	-	7	-	-
Pet. hydrocarbon (C6-C9)		20						
Pet. hydrocarbon (C10-C36)		100						
Fluoride (total) (µg/L)		2,000	14	100	270	19	200	440

Table 2.6 Receiving Water Quality in New Chum Creek (source: GHD, 2010)

Statistic	pH	EC (μS/cm)	Turbidity (NTU)	Sulphate (mg/L)	Aluminium (μg/L)	Iron (μg/L)
Minimum	6.7	77	159	3.0	50	640
20th Percentile	7.1	140	1,243	4.0	170	640
Media	7.2	150	1,711	7.3	532	1,880
80th Percentile	7.4	150	2,328	12.0	730	2,300
Maximum	7.6	250	2,520	16.0	1500	3,800

3 EXISTING MILLENNIUM OPERATIONS

3.1 WATER MANAGEMENT SYSTEM

3.1.1 Overview

The existing mine water management system is operated in accordance with the Millennium Coal Mine Water Management Plan (GHD, 2010) and the Red Mountain Infrastructure Joint Venture (RMIJV) Water Management Plan (GHD, 2010), which were prepared to comply with the conditions of the Environmental Authorities (EAs) MIN100344305 and MIN100846708 respectively.

The key objectives of the Water Management Plans are:

- Diversion of clean surface water runoff away from areas disturbed by mining activities;
- Collection of surface water runoff from areas disturbed by mining activities to control suspended sediment prior to release from site or re-use via the mine water management system;
- Transfer of open cut pit water to storage dams for re-use in the mine water management system;
- Maximising the re-use and recycling of stored water on site, especially for use as the process supply to the CHPP's and other related activities; and
- Using stored water for dust suppression on haul roads, trafficable areas and stockpiles.

The key existing storages are described below. The storages (with the exception of Western Dam on West Creek) are shown in Figure 3.1.

Figure 3.1 Local Drainage Network at Existing Millennium Coal Mine

Environmental Dam (Red Mountain area)

The Environmental Dam Captures surface runoff from the CHPP infrastructure area . Water is pumped from the Environmental Dam to the Process Water Dam for reuse in the plant. The Environmental Dam has a capacity of 80ML.

Process Water Dam (Red Mountain area)

The Process Water Dam is the primary process water storage for the Red Mountain CHPP. The storage is shared between the Millennium Coal Pty Ltd and BHP Mitsui Coal Pty Ltd as part of the Red Mountain Joint Venture operations. The dam captures surface runoff from the Millennium waste rock emplacements. Pit water is pumped to the Process Water Dam. Water from Western Dam on ML 70313 is also pumped to the Process Water Dam. The Process Water Dam has a capacity of 408ML.

Western Dam (Millennium area)

Western Dam currently does not receive runoff from the Millennium mining operation, and occasionally receives small quantities of pit water following prolonged rainfall. In the past, it has received saline water from the neighbouring coal seam gas operation. Water stored in the Western Dam is pumped to the Process Water Dam for use in the CHPP. The Western Dam has a large undisturbed catchment upstream, and overflows into West Creek. It has a capacity of 563 ML.

Millennium Sediment Dam (Millennium area)

The Sediment Dam is located on the western side of the mine access road and discharges to New Chum Creek. It has a capacity of less than 5 ML.

Windmill Dam (Millennium area)

The Windmill Dam is a converted farm dam used as a sediment dam. The Windmill Dam has a capacity of less than 20ML and overflows into New Chum Creek.

3.1.2 Water Quality in Existing Site Water Management System

Pit Water

Pit water in the existing Millennium water management system tends to be relatively saline, with a median Electrical Conductivity (EC) of around 4,500 μS/cm. Following prolonged dry periods, salinity can exceed 10,000 μS/cm. Pit water is also moderately alkaline, with a pH of approximately 8.3.

Groundwater inflow rates to the existing Millennium Pits are observed to be small (less than 1L/s). Details of existing groundwater characteristics are provided in the MEP Groundwater Impact Assessment Report (Met Serve, 2010). Groundwater bores in the Rangal Coal Measures indicate groundwater EC ranges between 2,000 μS/cm and 18,000 μS/cm, with a median of 14,200μS/cm. The monitoring data also indicates that groundwater in the Rangal Coal Measures aquifer on site is typically neutral to slightly alkaline, with a median pH of 7.70.

Compared with the aquatic ecosystem guideline levels, the groundwater samples at Poitrel Mine have elevated levels of salinity, arsenic, chromium, copper, manganese and zinc. Pit water quality at the proposed MEP pits is expected to be similar to this groundwater.

Environmental Dam

Water stored in the Environmental Dam has a median EC of 1,185 μS/cm, but has at times exceeded 5,000 μS/cm. This is possibly partly attributable to the use of coal seam gas water as a plant feed source. pH is generally in the range 8 to 9. Some dissolved metal concentrations have been observed to significantly exceed receiving water concentrations (examples are Aluminium, Copper, Chromium, Iron and Nickel).

Process Water Dam

The Process Water Dam has a median EC of around 2,500 μS/cm, and has approached 5,000 μS/cm in the past. pH is generally in the range of 8 to 9. Some dissolved metal concentrations have been observed to significantly exceed receiving water concentrations (examples are Aluminium, Arsenic, Copper, Iron and Nickel).

3.2 FLOODING

A flood study was undertaken to estimate existing design flood levels and the flood extent along New Chum Creek. Full details of the methodology and results of the flood study are provided in Appendix B.

As shown in Figure 3.2, the existing Millennium operations are outside the 100 year ARI flood extent from New Chum Creek.

Design peak flow rates for New Chum Creek in the vicinity of the site are summarised for a range of Average Recurrence Intervals in Table 3.1. Existing flow velocities, stream power and bed shear are summarised in Table 3.2.

Table 3.1 New Chum Creek Design Discharges

Average Recurrence Interval (years)	Design Discharge (m^3/s)	
	Upstream Boundary	Downstream Boundary
10	37	65
100	69	126
1,000	129	243
PMF	553	964

Table 3.2 New Chum Creek Median Design Flow Conditions

Average Recurrence Interval	Velocity	Main Channel Stream Power	Total Section Stream Power	Main Channel Shear Stress	Total Section Shear Stress
	min-median-max	min-median-max	min-median-max	min-median-max	min-median-max
y	m/s	N/m^2	N/m^2	N/ms	N/ms
10	0.3 - 1.4 - 3.3	5.2 - 56 - 831	1.7 - 12 - 427	11.9 - 43 - 250	3.8 - 17 – 142
100	0.4 - 1.6 - 2.5	7.6 - 86 - 287	4.3 - 21 - 287	16.5 - 56 – 117	10.5 - 26 – 117
1000	0.5 - 2 - 4.6	14.1 - 146 - 1705	1.7 - 28 - 1705	15.4 - 79 – 369	5.6 - 35 – 369
PMF	0.2 - 2.6 - 5.1	0.2 - 288 - 2260	0.2 - 62 - 503	0.9 - 121 – 441	0.8 - 61 - 225

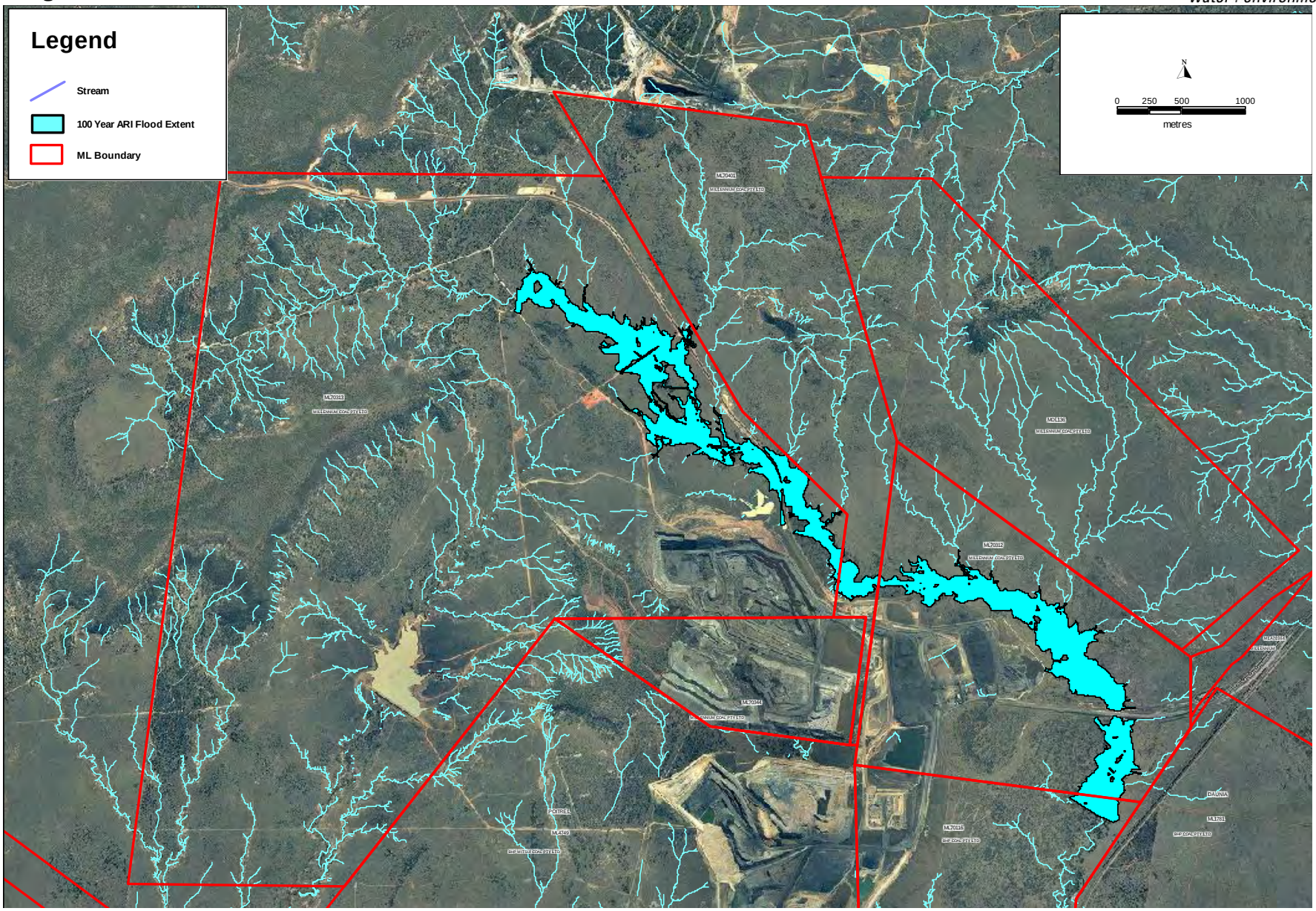

Figure 3.2 Extent of New Chum Creek Flood Inundation - 100 year ARI

4 POTENTIAL IMPACTS AND MITIGATION MEASURES

4.1 OVERVIEW

The proposed MEP is expected to extend the mine life by approximately 17 years (nominally 2011-2027).

The project will feature two open cut pits; an expansion of the existing Millennium Pit and a new pit, to the north of New Chum Creek, Mavis Pit. Waste Rock will mostly be stockpiled in pit, with some external waste rock emplacements created during pit establishment. The potential impacts on surface water and water management during the life of the project summarised below, are discussed in the following sections:

- Potential change in runoff quality from disturbed catchments;
- Additional open cut pit water (including surface runoff and groundwater inflow) to be managed within the minesite water management system, due the increased size of the open cut pit and its catchment;
- Additional runoff from areas disturbed by mining (including waste rock emplacement areas and rehabilitated areas) to be managed within the minesite water management system;
- Potential reduction in streamflows due to need to contain mine-affected water and reduced discharge opportunities;
- Potential increase in New Chum Creek flooding due to haul road crossings and filling within the floodplain associated with the proposed external waste rock emplacements and flood protection works;
- Potential erosion impacts in New Chum Creek, due to haul road crossings and filling within the floodplain associated with the proposed external waste rock emplacements and flood protection works.

4.2 POTENTIAL CHANGES IN RUNOFF WATER QUALITY

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff by increasing sediment loads and transporting contaminants from waste rock and coal seams.

The Millennium project overburden is mostly weathered and un-weathered clayey Permian sediments with some areas of lateritised fine Tertiary sands. The clays are moderately dispersive and sodic, with low to moderate salinity. Dissolved metal concentrations are expected to be similar to background levels (GHD, 2010). Analyses of overburden have indicated that it is alkaline, with low salinity and nil to very little acid producing potential. The coal seam partings

have a higher acid-producing potential, but make up a very small proportion of overburden (GHD, 2010).

4.3 OPERATIONAL WATER MANAGEMENT

A conceptual water management system (WMS) design has been devised to mitigate the potential impacts of the project on water quality.

The proposed WMS aims to manage two types of dirty or "worked water":

- water from the open cut pits (referred to here as "pit water")
- water from waste rock runoff (referred to here as "waste rock runoff").

Clean water from undisturbed catchments is diverted around the active mining areas to minimise the volume of dirty water generated.

The WMS layout evolves over the 17 year design life. As additional catchments are disturbed, new sediment dams are brought on line to treat waste rock runoff. Figure 4.1 shows the site water management system at the end of the mine life. For the purposes of concept design, water balance modelling and impact assessment, a number of stages have been assumed to be in place as follows:

1. Stage 2012 - applies for 2011-2012 – 2 years;
2. Stage 2015a - applies for 2013-2014– 2 years;
3. Stage 2015b – applies for 2015-2016– 2 years. The arrangement is as for 2015a, but the central storage location changes;
4. Stage 2020 - applies for 2017-2021– 5 years;
5. Stage 2027 - applies for 2022-2027– 6 years.

Plans showing the conceptual water management layout at each of these stages are provided in Appendix A.

The areas draining to each of the proposed water management dams are summarised in Table 4.1 below. The table shows that the area intercepted by the planned MEP water management system increases from 1,343 ha to 1,952 ha over the project life (785 ha to 1,508 ha excluding Western Dam). By comparison, approximately 460 ha is captured in the existing Millennium WMS (excluding Western Dam), of which approximately 350 ha will be unaffected by the proposed MEP, and will continue to be captured in the Environmental and Process Water Dams.

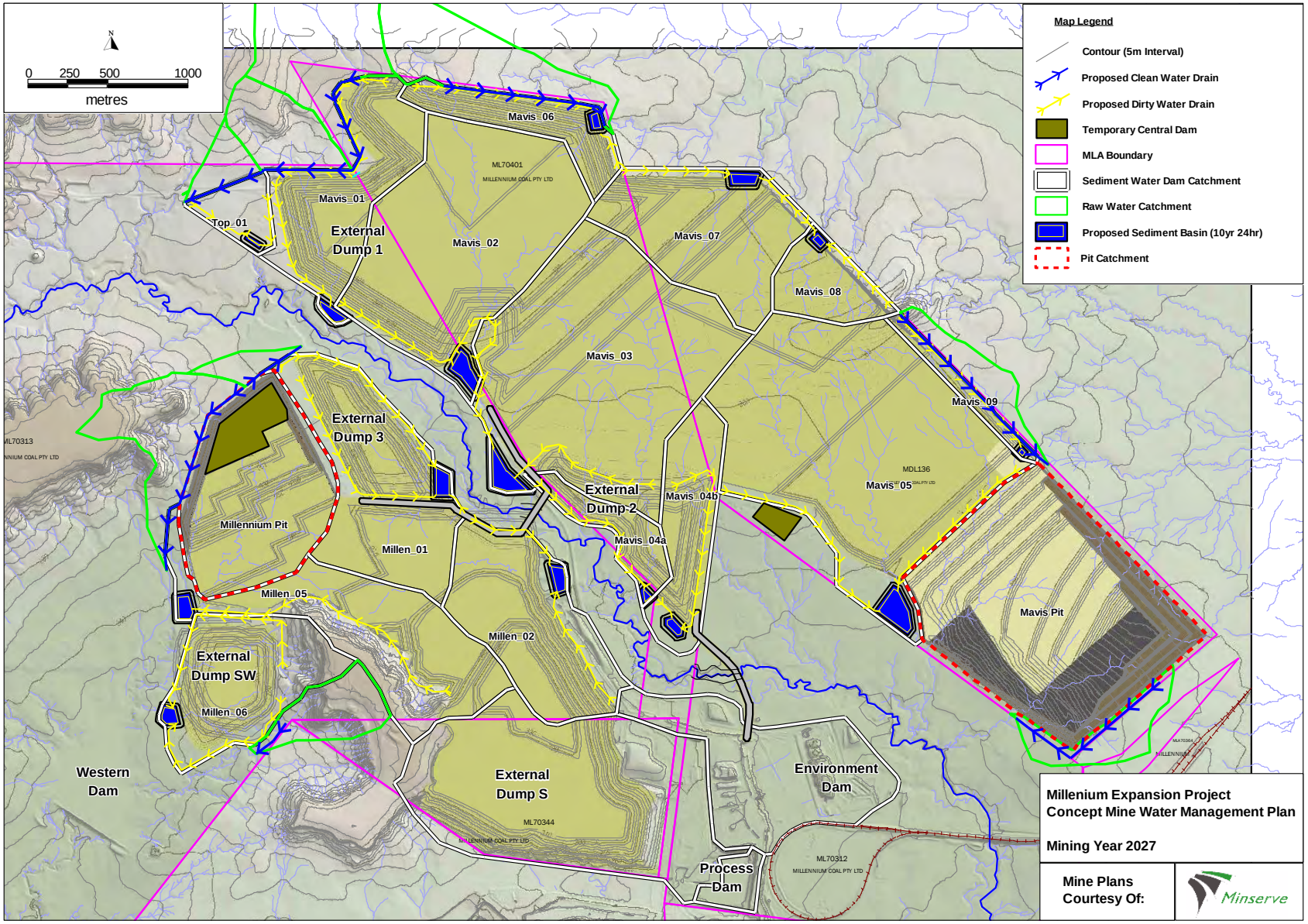

Figure 4.1 2027 Water Management System Layout

Table 4.1 Catchment Areas Draining to Site Water Storages

	Catchment Area (ha)					
Water Storage	2012	2015a	2015b	2020	2027	Comment
Millennium Pit	216.1	192.6	192.6	97.5	97.5	Pit Floor + Unrehabilitated waste rock
Mavis Pit	155.9	308.3	308.3	478.5	182.7	Pit Floor + Unrehabilitated waste rock
Mavis 01	51.5	73.5	73.5	73.5	73.5	Unrehabilitated waste rock
Mavis 02	62.8	62.8	62.8	153.5	153.5	Unrehabilitated waste rock
Mavis 03	80.9	13.0	13.0	21.0	195.4	Unrehabilitated waste rock+ Undisturbed (2012)
Mavis 04a	22.5	22.5	22.5	22.5	22.5	Unrehabilitated waste rock
Mavis 04b	39.2	39.2	39.2	39.2	47.3	Unrehabilitated waste rock
Mavis 05					216.6	Unrehabilitated waste rock
Mavis 06		19.3	19.3	34.7	34.7	Unrehabilitated waste rock
Mavis 07				13.2	83.2	Unrehabilitated waste rock
Mavis 08					28.3	Unrehabilitated waste rock
Mavis 09					10.8	Unrehabilitated waste rock
Millen 01		55.4	55.4	100.0	100.0	Unrehabilitated waste rock
Millen 02	49.2	42.8	42.8	81.8	81.8	Unrehabilitated waste rock
Millen 05		94.1	94.1	94.1	94.1	Unrehabilitated waste rock
Millen 06	70.7	70.7	70.7	70.7	70.7	Unrehabilitated waste rock
Temporary Pit Water Storage	10.0	10.0	10.0			Compacted Surface
Temporary Waste Rock Runoff Storage	10.0	10.0	10.0			Compacted Surface
Western Dam	558.2	514.0	514.0	444.0	444.0	Undisturbed
Top 01	15.9	15.9	15.9	15.9	15.9	Unrehabilitated waste rock
Total	**1,343**	**1,544**	**1,544**	**1,740**	**1,952**	

4.3.1 Pit Water Management

Groundwater inflows into the proposed pits are expected to be relatively small. The Groundwater Impact Assessment Report (Met Serve, 2010), predicts pit inflow rates to the proposed Mavis and expanded Millennium Pit will be of the order of 1.2L/s. Groundwater inflows of this magnitude will be collected in small in-pit sumps where it will either evaporate or be used for in-pit dust suppression.

Additional pit water would be generated by the collection of surface water runoff from areas draining to the open cut pit area, and groundwater inflow to the pits. Pit water can have elevated levels of salinity and may also contain elevated levels of suspended sediment and dissolved metals.

Contaminant concentrations in pit water at the MEP are likely to be in excess of levels required for protection of downstream receiving water values, and will be contained in a system with a low risk of discharge. Groundwater seepage and catchment runoff water collecting in the pit will be temporarily stored in small in-pit sumps and re-used for dust suppression. Water in excess of dust suppression requirements will be transferred to a large Central Pit water storage for longer-term storage and reuse at the CHPP as required. The Central Pit water storage will be constructed in stages:

- Stage 1 (from 2011 to 2015) - Use a new Temporary Pit Water Storage excavated well ahead of the future Mavis Pit mine area (to eventually be mined through);
- Stage 2 (from 2015 to 2027) - Use the disused Millennium Pit Void as a mixed “worked water” storage.

The areas of the proposed Millennium and Mavis Pits are significantly larger than the existing Millennium Pit, and if an extended wet period was to occur, the volume of water collected in the pit is likely to significantly exceed the on-site water demand in the short-term.

On the basis of conservative water balance modelling of the site water management system described in Section 5 and Appendix A, the Stage 1 storage will be constructed to provide 2,600 ML of storage. The volume stored in the storage will be constantly re-evaluated. In the event that water inventories become so high that the risk of future pit inundation is unacceptable, additional storage compartments may be constructed.

The available storage volume in the Millennium void will be well in excess of the maximum modelled accumulated combined pit and waste rock runoff water volume.

4.3.2 Waste Rock Runoff Management

Waste rock runoff is expected to have elevated suspended solids but only moderate levels of salinity and other pollutants. Waste rock runoff will be captured and temporarily stored in sediment dams. A total of 15 sediment dams are required over the project life to intercept runoff from waste rock emplacements around the site. Ten dams are associated with the proposed Mavis Pit, and four are associated with the proposed Millennium Pit.

The dams will be sized to contain runoff from the 10 year ARI 24 hour rainfall event. The storage will allow coarse sediment to settle and reduce the turbidity of runoff. This design storage will be sufficient to limit the frequency of uncontrolled off-site discharge during periods of relatively high and prolonged rainfall (when there is a reasonable prospect of natural flow in the receiving waters). However, the risk of off-site discharge will be further limited by adopting an active waste rock runoff management system, whereby water levels in the sediment dams are constantly maintained below a set level by pumping to a central waste rock runoff water storage. The sediment dams then comprise an active storage, above the pump set level, and a passive

storage, below which water is simply allowed to pond unless required to meet a shortfall in demand.

The volumes of the proposed sediment dams are shown in Table 4.2. The dam Top-01 is required to capture runoff from a topsoil stockpile. Given the risk of environmental harm caused by runoff from this stockpile is small and temporary (until vegetation establishes), this dam may be sized for the 10 year ARI time-of-concentration runoff event, and may not be pumped to the central "worked water" storages.

Table 4.2 Sediment Dam Characteristics

Storage	Capacity	Spills to	Pump Capacity	Modelled Active Period		Number of
	ML		L/s	Start	Finish	Modelled Years
Mavis01	56	New Chum Ck	45	2,011	2027	17
Mavis02	115	New Chum Ck	95	2,011	2027	17
Mavis03	146	New Chum Ck	123	2,011	2027	17
Mavis04a	18	New Chum Ck	15	2,011	2027	17
Mavis04b	38	New Chum Ck	30	2,011	2027	17
Mavis05	164	New Chum Ck	130	2,022	2027	6
Mavis06	30	North Ck	20	2,013	2027	15
Mavis07	63	North Ck	50	2,017	2027	11
Mavis08	24	North Ck	65	2,022	2027	6
Mavis09	11	North Ck	10	2,022	2027	6
Millen01	79	New Chum Ck	65	2,013	2027	15
Millen02	64	New Chum Ck	50	2,011	2027	17
Millen05	67	West Ck	55	2,013	2027	15
Millen06	52	West Ck	45	2,011	2027	17
Top_01	12	New Chum Ck	10	2,011	2027	17

The Central Waste Rock Runoff Water Storage will be constructed in stages:

- Stage 1 (from 2011 to 2015) - Use a new Temporary Central Waste Rock Runoff Water Storage excavated well ahead of the future Mavis Pit mine area (to eventually be mined through);
- Stage 2 (from 2015 to 2027) - Use the disused Millennium Pit Void as a mixed "worked water" storage.

On the basis of conservative water balance modelling of the site water management system described in Section 5 and Appendix A, the Temporary Central Waste Rock Runoff Water Storage will be constructed to provide a storage capacity of 2,600ML in a dam excavated ahead of the advancing Mavis Pit. The available volume would be re-evaluated annually to ensure that inflows from the next 2 years of sediment dam operation could be accommodated by constructing additional water storage cells if required. Once mining in the Millennium Pit was complete, the final void could be used for central waste rock runoff and pit water storage, and the temporary Central Water Storages mined out.

Consideration could be given to combining the Temporary Central Waste rock runoff Water Storage with the Temporary Central Pit Water Storage. However, there is merit in keeping the waste rock runoff water separate, as it is likely to have significantly lower contaminant concentrations.

4.4 IMPACTS ON RECEIVING WATER SURFACE WATER RUNOFF VOLUME

DERM's "Model Conditions for Environmental Authorities for Coal Mines in the Fitzroy Basin" contain provisions which implicitly require site runoff water to be contained on site even when its quality complies with licensed discharge water quality limits. As a result, the proposed water management system has been designed such that discharge would only occur during relatively large rainfall events. The major effect of this requirement is the proposed MEP will reduce the magnitude and frequency of downstream flows through the capture of additional catchment area within the expanded open cut pits.

The water balance modelling described in Section 5 simulated the system's performance under long-term historical climate conditions. The results show that discharges from the mine water dams would be infrequent and relatively small in volume. As a result, the change in catchment area summarised in Table 4.3 is a reasonable estimate of the reduction in mean annual flow in the receiving waters. For the North Creek and West Creek Catchments, the loss of catchment as a proportion of the downstream catchment is small, and hence the impact is small and limited to a short reach immediately downstream of the mine. For New Chum Creek, the impact is more significant.

Much of the catchment loss would be gradually reinstated over the mine life as waste rock emplacements are rehabilitated, and sedimentation dams are decommissioned. The reduction in catchment area at the end of the mine life will be small, with only a small catchment area being captured in the Mavis and Millennium Pit final voids.

Table 4.3 Catchment Interception & Reduction in Runoff

		Stage				
		2012	2015a	2015b	2020	2027
New Chum Ck						
Area Intercepted by WMS	ha	342.0	345.1	345.0	507.3	906.5
Percentage reduction in 2010 catchment (and flow)		6.7%	6.8%	6.8%	9.9%	17.8%
North Ck						
Area Intercepted by WMS	ha	0.0	19.3	19.3	47.9	157.0
Percentage reduction in 2010 catchment (and flow)		0.0%	0.4%	0.4%	0.9%	3.1%
West Ck						
Area Intercepted by WMS	ha	70.7	164.7	164.7	164.7	164.7
Percentage reduction in 2010 catchment (and flow)		1.4%	3.2%	3.2%	3.2%	3.2%

4.5 POST MINING WATER MANAGEMENT

4.5.1 Final Void Flood Immunity

The final voids will be located away from New Chum Creek to reduce the risk of inundation in large flood events. Figure 4.2 shows that both the Millennium and Mavis Pits are on the edge of the extent of inundation of the PMF. Flooding in the vicinity of the Mavis Pit is affected by the existing rail loop. The impact of the rail loop on the extent of PMF flooding is indicated in Figure 4.2, which shows that without the rail loop in place, the PMF flood extent would be just outside the proposed Mavis Pit boundary.

4.5.2 Final Void Water Levels

Final void water levels in each pit have been simulated using a simplified OPSIM water balance model assuming groundwater inflows and outflows are nil. The sensitivity of the model results was investigated by undertaking separate model runs with different initial water levels, as shown in Figure 4.3 and Figure 4.4. At both voids, which will be approximately 100m deep, the modelled water levels eventually stabilise at a level at which the average net contribution to the pit from rainfall, runoff and infiltration are balanced by evaporative losses from the open water void. The results are as follows:

- The Mavis Pit void stabilised water level of around 100m AHD is at a level approximately 42m below the “spill” elevation at the top of the void.
- The Millennium Pit void stabilised water level of around 180m AHD is at a level approximately 62m below the “spill” elevation at the top of the void.

The overall general behaviour of the water stored in the void was found to be relatively insensitive to basic assumptions regarding runoff parameters and evaporation and seepage rates. If the proportion of rainfall that becomes runoff is less than expected, the long-term water level will be reduced. Results of the sensitivity analysis are provided in Appendix A.

4.5.3 Long Term Salinity

In any void which does not have a mechanism for salts to flow out (e.g. by flushing through flood inflows and discharges, or by fresh groundwater inflows), salinity will tend to increase over time. OPSIM modelling of the Mavis and Millennium voids shows that if initial water levels are low, the salinity will eventually increase beyond safe stock watering levels.

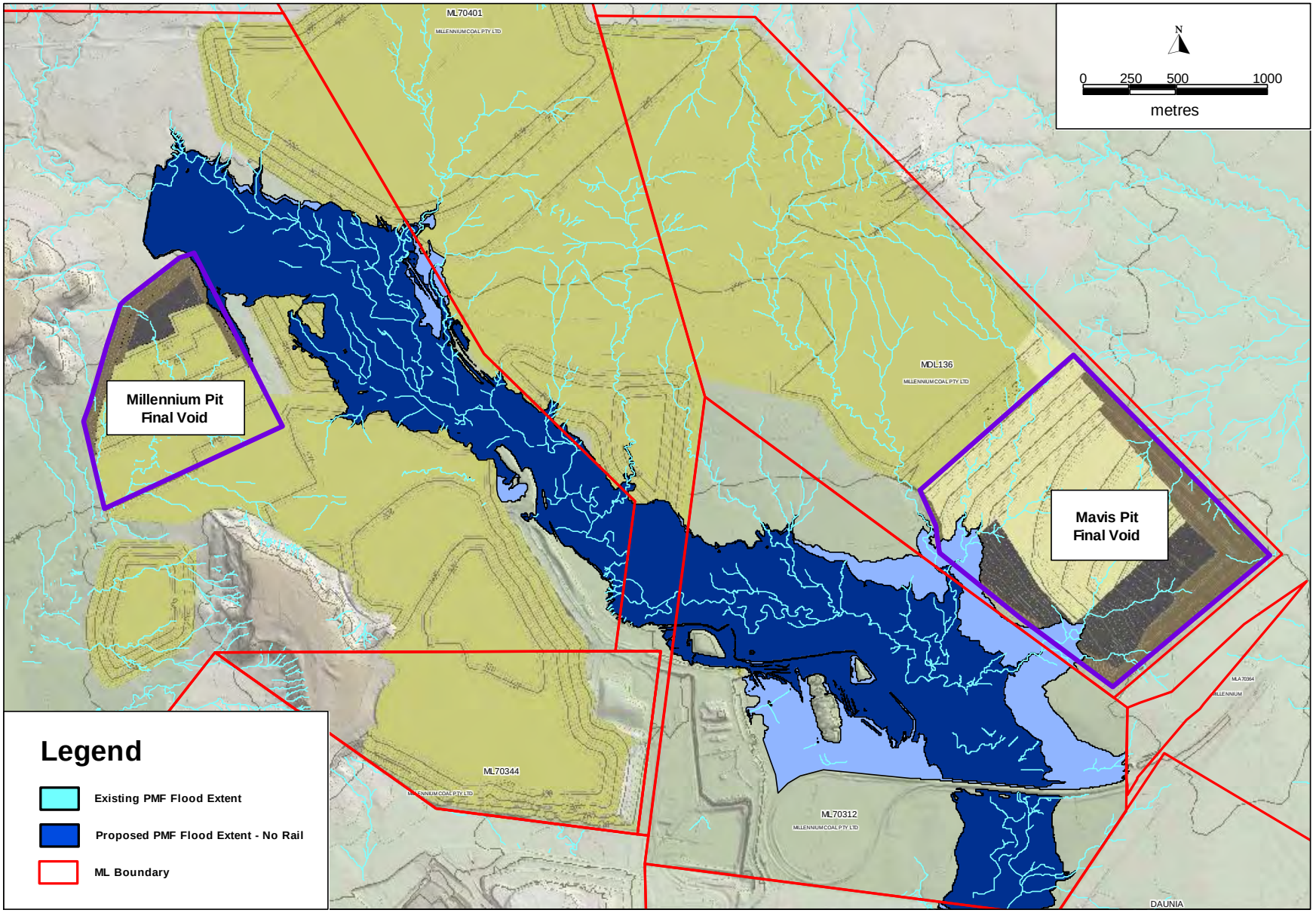

Figure 4.2 Location of Final Voids Compared to PMF Flood Extent

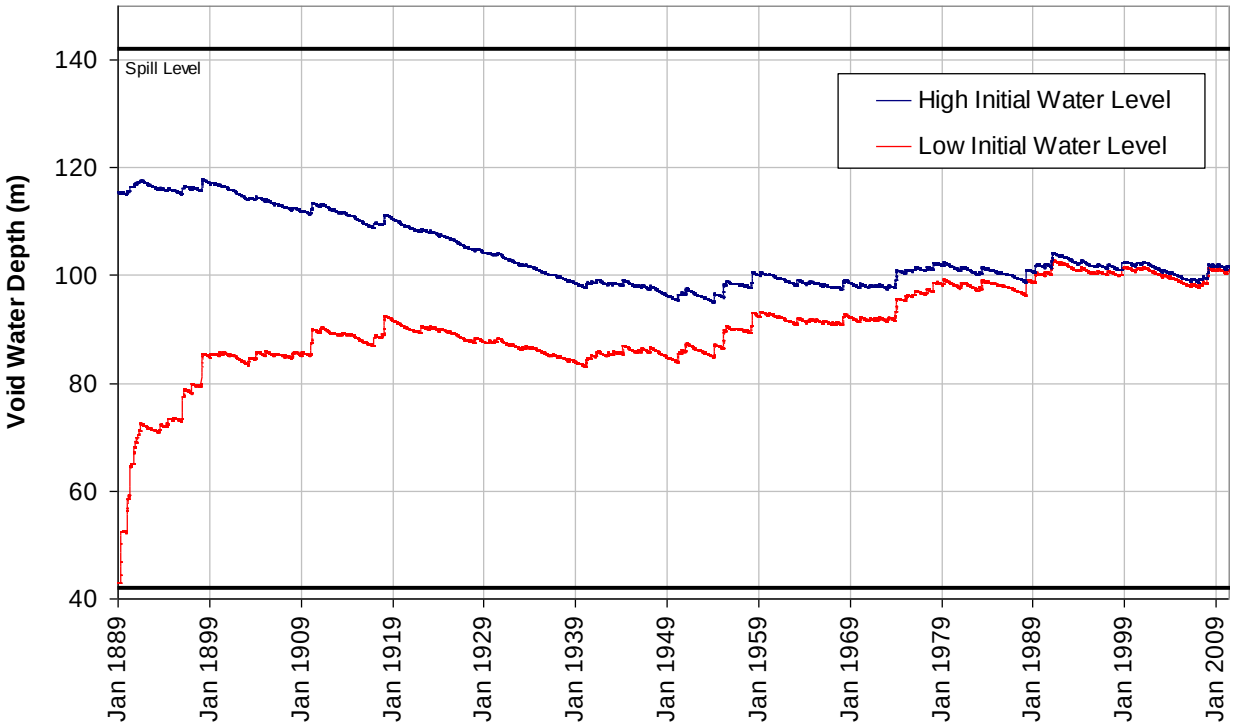

Figure 4.3 Modelled Behaviour of Final Void – Mavis Pit

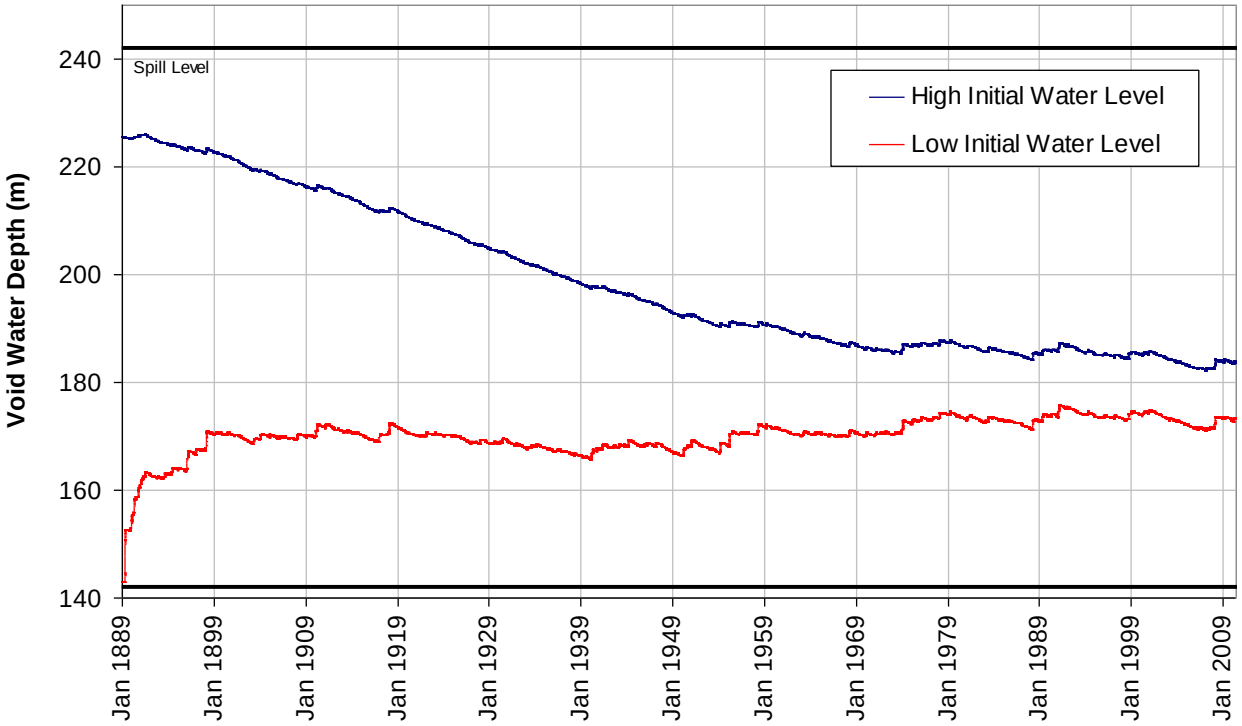

Figure 4.4 Modelled Behaviour of Final Void – Millennium Pit

4.6 NEW CHUM CREEK FLOODING AND EROSION

Details of the flood modelling investigation are provided in Appendix B.

The layout of the proposed mine workings for the MEP has been chosen to, where possible, maintain a buffer strip with a minimum width of 100m between the New Chum Creek channel and the proposed workings. As a result, (as shown in Figure **4**.5) the proposed waste rock emplacements and water management infrastructure are generally outside the 1,000 year ARI flood extents. The main exceptions are:

1. Areas where out-of-pit waste rock emplacements encroach onto the floodplain:
   - External Dump 1, to the west of the initial Mavis Pit,
   - External Dump 2 at the eastern edge of ML70401; and
   - External Dump 3 to the east of the Millennium Pit final void.

   While flow velocities in these locations are generally low, the toes of these waste rock emplacements will be protected with a rock mulch to reduce the risk of scour during large flood events.

2. Areas where the pit temporarily crosses the floodplain:
   - A portion of Millennium Pit immediately to the north of the existing pit;
   - A small portion of Mavis Pit on the opposite bank to the above portion of Millennium Pit.

   In these areas, levees will be provided to protect the pit from the 1000 year ARI flood event, with an appropriate freeboard allowance.

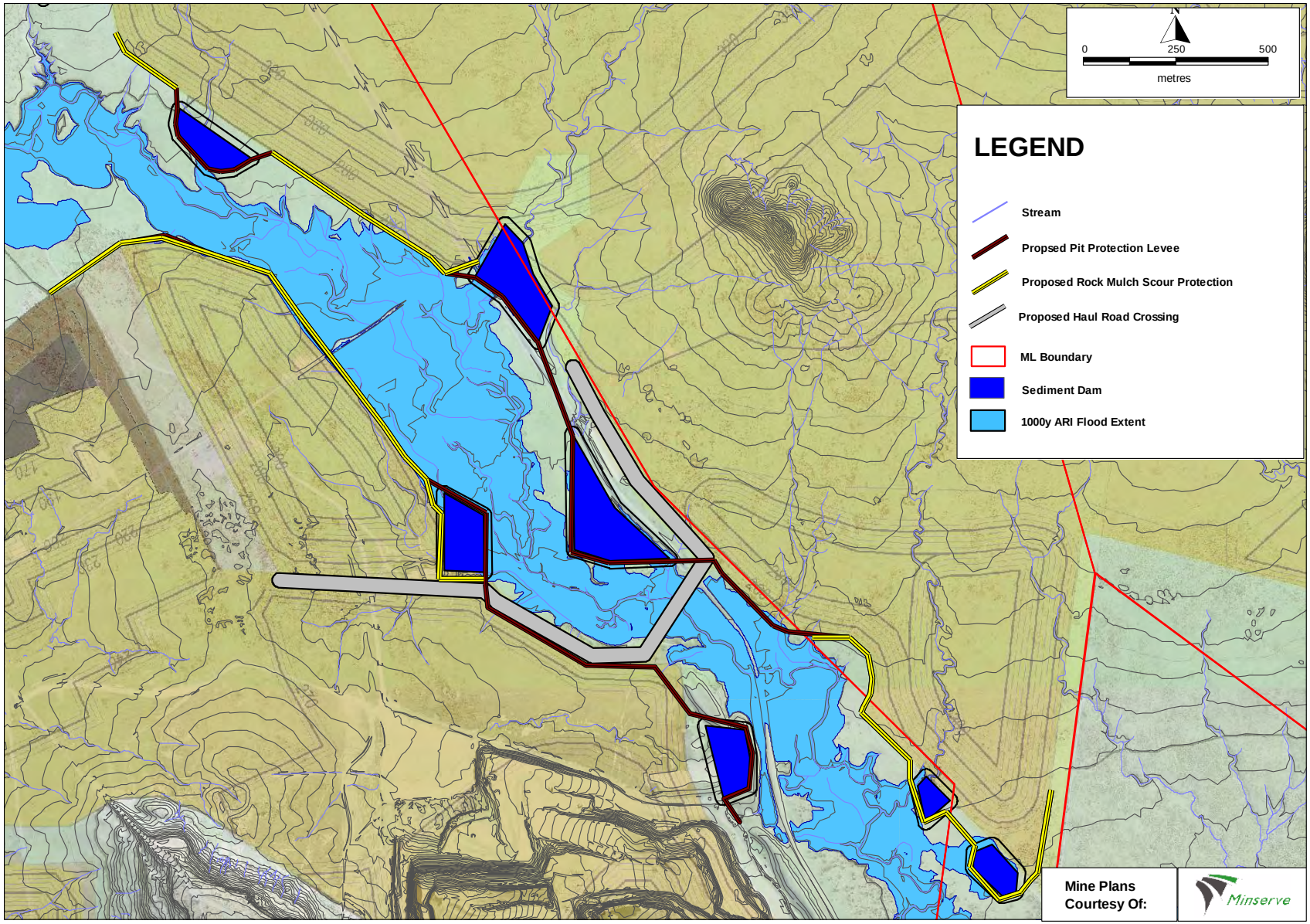

Figure 4.5 Proposed Flood Protection and Scour Protection Works

The proposed Haul Roads from Mavis Pit will require two new culvert crossings of New Chum Creek at the locations shown in Figure 4.6. For the purposes of the impact assessment, the crossings were designed as low level floodways with low flows conveyed by dual 1800mm corrugated steel pipes mitred to the embankment profile. Alternative arrangements will be considered during detailed design.

These proposed structures will have only a localised impact on upstream flood levels. This is illustrated in Figure 4.6, which shows the increase in flood level in the 100 year ARI flood event, assuming that the waste rock emplacements or levees are constructed to the edge of the buffer strip, and the new haul road crossings are in place.

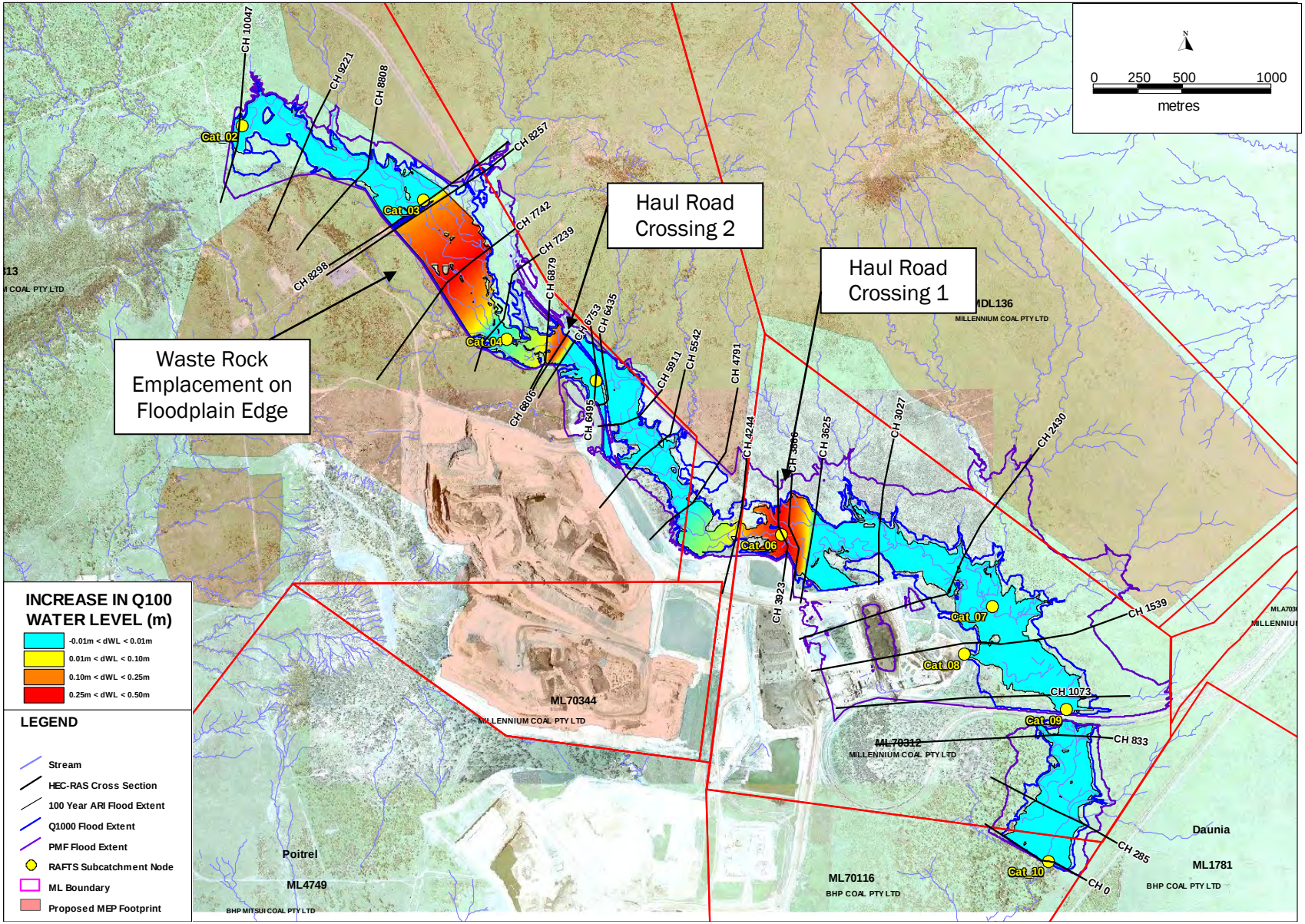

Figure 4.6 Impact on New Chum Creek Flood Levels - 100 year ARI

The hydraulic modelling shows that flood levels and flood velocities along New Chum Creek channel are virtually unchanged by the proposed MEP for events up to and including the 100 year ARI event. Localised erosion protection will be required to manage scour in the channel downstream of the culvert outlets and on the downstream haul road embankments. Changes in flood conditions in New Chum Creek are summarised in Table 4.4 below.

Table 4.4 Impacts on New Chum Creek Flood Conditions

River Station	Increase in average channel velocity (m/s)		Increase in water level (m)	
	10 year ARI	100 year ARI	10 year ARI	100 year ARI
10047.2	0.0	0.0	0.0	0.0
9220.9	0.0	0.0	0.0	0.0
8808.0	**0.1**	**0.1**	0.0	0.0
8298.0	**0.5**	**0.4**	0.0	0.0
8276.0	Access Track			
8257.3	0.0	**0.1**	**0.1**	**0.1**
7742.0	**0.2**	**0.2**	**0.3**	**0.5**
7238.7	0.0	0.0	0.0	0.0
6878.9	-0.4	-0.3	**0.2**	**0.1**
6806.0	-0.8	-0.6	**0.5**	**0.4**
6780.0	Proposed North Haul Road			
6753.0	**1.6**	**0.1**	0.0	0.0
6495.4	0.0	0.0	0.0	0.0
6455.0	Existing Road			
6434.7	0.0	0.0	0.0	0.0
5911.1	0.0	0.0	0.0	0.0
5542.4	0.0	0.0	0.0	0.0
4791.1	0.0	0.0	0.0	0.0
4244.4	-0.2	-0.1	**0.1**	**0.1**
3923.0	0.0	**0.1**	**0.6**	**0.5**
3896.0	Proposed South Haul Road			
3866.0	**2.7**	**0.8**	-0.1	**0.4**
3624.8	0.0	0.0	0.0	0.0
3026.9	0.0	0.0	0.0	0.0
2430.5	0.0	0.0	0.0	0.0
1539.5	0.0	0.0	0.0	0.0
1073.7	0.0	0.0	0.0	0.0
1000.0	0.0	0.0	0.0	0.0
965.0	Railway			
930.0	0.0	0.0	0.0	0.0
832.2	0.0	0.0	0.0	0.0
285.2	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0

Further details of the flood impact assessment are provided in Appendix B.

5 WATER BALANCE ASSESSMENT

5.1 OVERVIEW

An OPSIM daily water balance model (Water Solutions, 2009) was built to simulate the proposed MEP water management system over the 17 years of extended mine life. OPSIM is a daily timestep water balance model that dynamically simulates the operation of the site water management system. The model estimates daily catchment yield using the AWBM model (Boughton, 2003).

The effectiveness of the proposed surface water control measures in managing potential water quantity and quality impacts is the focus of this section. The assessment methodology and outcomes of the analysis are outlined in the following sections. Additional details of the OPSIM model, including a schematic diagram, are provided in Appendix A.

5.2 WATER BALANCE MODEL

5.2.1 General

The OPSIM model simulates the operation of the major components of the MEP water management system, including:

- Climatic variability – rainfall and evaporation;
- Catchment runoff and collection;
- Pit dewatering;
- Pump transfers;
- Water storage filling, spilling, evaporation and leakage;
- Industrial water extraction, usage and return;
- Regional groundwater inflows.

For the purposes of the modelling described in this section of the report, catchment runoff parameters were adopted to ensure that estimated runoff was conservatively high for the purposes of sizing water containment structures. The sensitivity of the model results to reduction in catchment runoff parameters is described in Appendix A.

5.3 SITE WATER DEMANDS

Water is supplied to the MEP through a number of sources, including:

- Recycled Water captured in the site water management system (as a priority);
- Raw Water supply from the Burdekin pipeline (assumed to always be available when site water supplies are unavailable);
- Potentially from other Peabody operations.

For impact assessment purposes, the existing Millennium and Red Mountain Joint Venture site water management system (WMS) have not been included in the model. That is, it was assumed that the existing WMS will be unaffected by the MEP, and the existing Red Mountain Process Water Dam and Environmental Dam were not included in the model. It has been assumed that the proposed MEP system behaves in isolation, except that there is an additional CHPP demand on the WMS resulting from the increase in coal production due to the MEP.

The modelled CHPP demand is based on a make-up requirement of 150L/t ROM (after belt filter return) a 3.6Mtpa ROM production rate, which is the design expanded production rate (5.5 Mtpa ROM) minus the existing production rate (1.9 Mtpa). The additional demands listed in Table A.4 have been adopted for the MEP.

Table A.4 Adopted MEP Water Demands

Description	Demand (ML/a)
Additional vehicle washdown water demand	100
Additional haul road dust suppression demand	350
Additional CHPP Make-up Water Demand	540

5.4 ASSESSMENT OUTCOMES

5.4.1 Overview

The performance of the proposed water management system was assessed against the following key indicators:

- Dirty or "Worked Water" storage inventory;
- Active pit water inventory;
- Storage discharges (quantity, frequency, duration); and
- Overall site water balance.

The OPSIM forecast simulation feature was used for this analysis. Rolling 17 year climate periods (105 starting on 1/1/1889) were sampled from the climate record and used to simulate the system behaviour. Each simulation was run for 17 years starting one year after the previous simulation start date.

5.4.2 Central Worked Water Storage Inventory

As discussed in Section 4, during the first 4 years of operation, waste rock runoff captured in sediment dams will be pumped to a temporary central waste rock runoff water storage. Inflows to the pits will be transferred to the adjacent central pit water storage. After Year 4, water from both these systems will instead be pumped to the disused Millennium void. Any water in the temporary storages will also be transferred there prior to the Mavis Pit advancing through the temporary storages.

Temporary Central Sediment Worked Water Storage

Figure 5.1 and Figure 5.2 show the range of maximum modelled storage volumes in the Temporary Sediment "Worked Water" Storage based on 105 climate sequences of 4 years used in the model. The results show that the wet period commencing in 1988 would have generated significantly more stored water than other periods in the historical record. Up to 3,400ML would be required to store water pumped from the sediment dams during this period. A storage volume of 2,600ML would have been sufficient in all other periods. On the basis of this analysis, a design storage volume of 2,600ML has been adopted for the initial Temporary Waste Rock Runoff Water Storage. If large volumes of water accumulate during the early years of operation, the available storage will be re-evaluated annually to ensure there is sufficient volume to store the coming wet season rainfall.

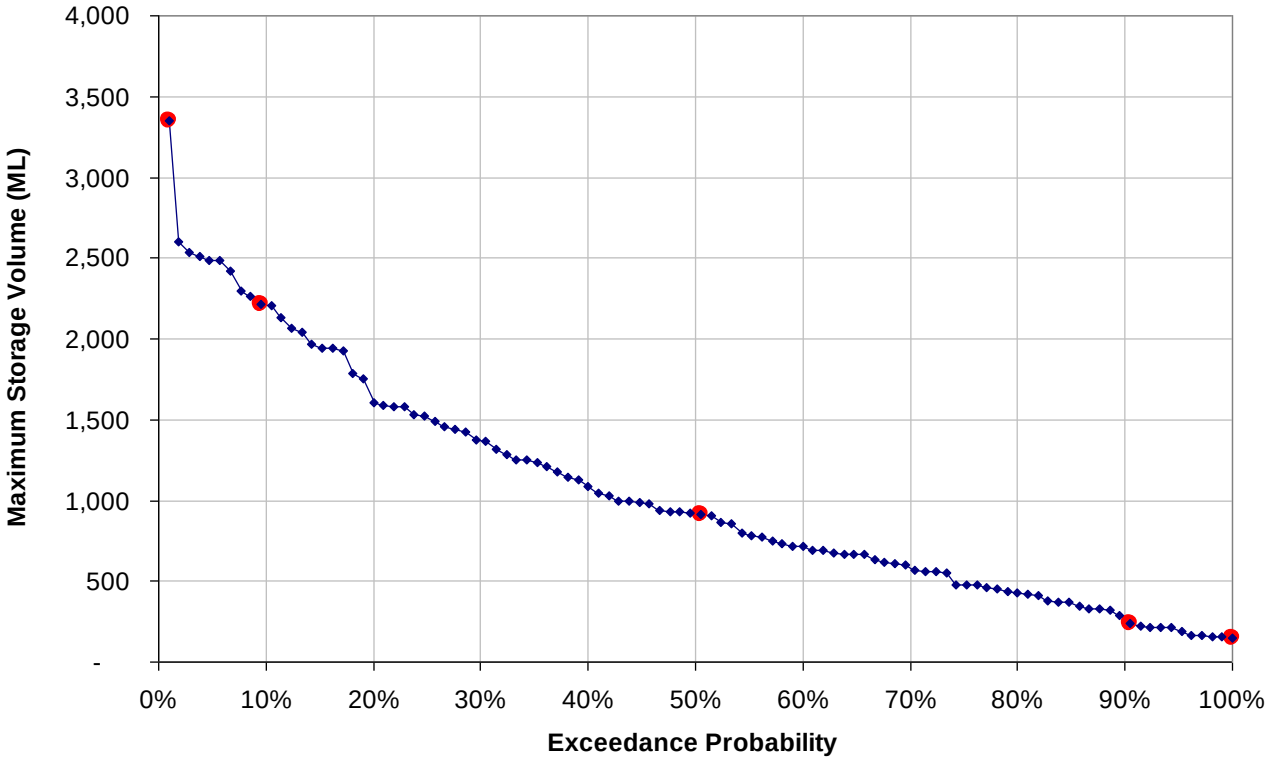

Figure 5.1 Temporary Sediment Worked Water Storage – Exceedance Probability of Maximum Volume

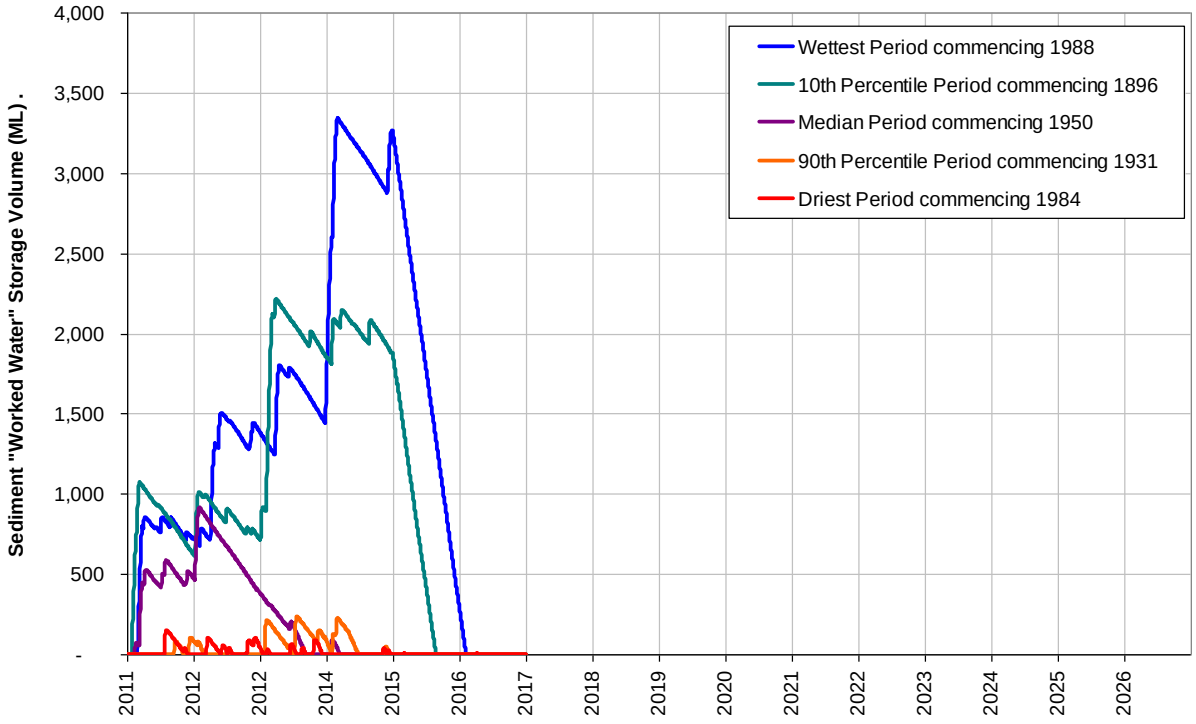

Figure 5.2 Temporary Sediment Worked Water Storage – Simulated Behaviour

Temporary Central Pit Worked Water Storage

Figure 5.3 and Figure 5.4 show the range of maximum modelled storage volumes in the Temporary Pit "Worked Water" Storage based on 105 climate sequences of 4 years used in the model. The results show that the wet period commencing in 1988 would have generated significantly more stored water than other periods in the historical record. Up to 3,800ML would be required to store water pumped from the sediment dams during this period. A storage of 2,600ML would have been sufficient in all but 3 other sequences. On the basis of this analysis, a design storage volume of 2,600ML has been adopted for the initial Temporary Pit Water Storage. If large volumes of water accumulate during the early years of operation, the available storage will be re-evaluated annually to ensure there is sufficient volume to store the coming wet season rainfall.

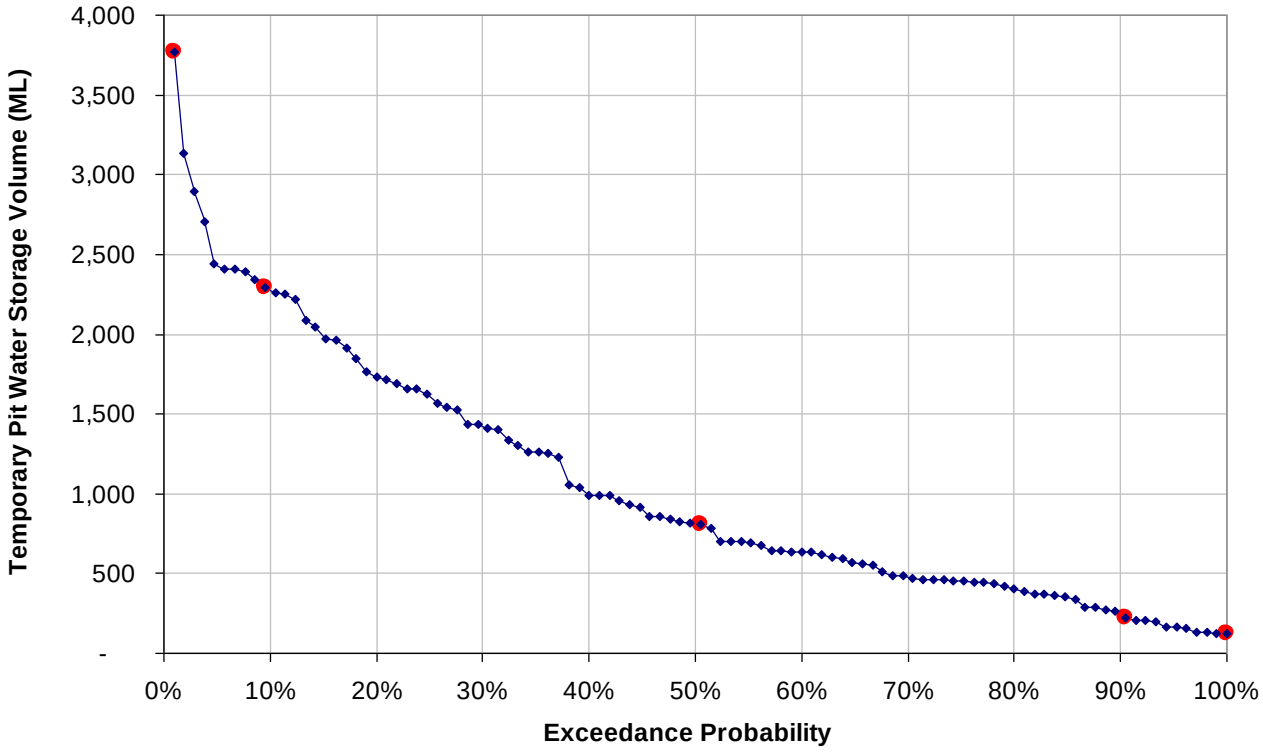

Figure 5.3 Temporary Pit Worked Water Storage – Exceedance Probability of Maximum Volume

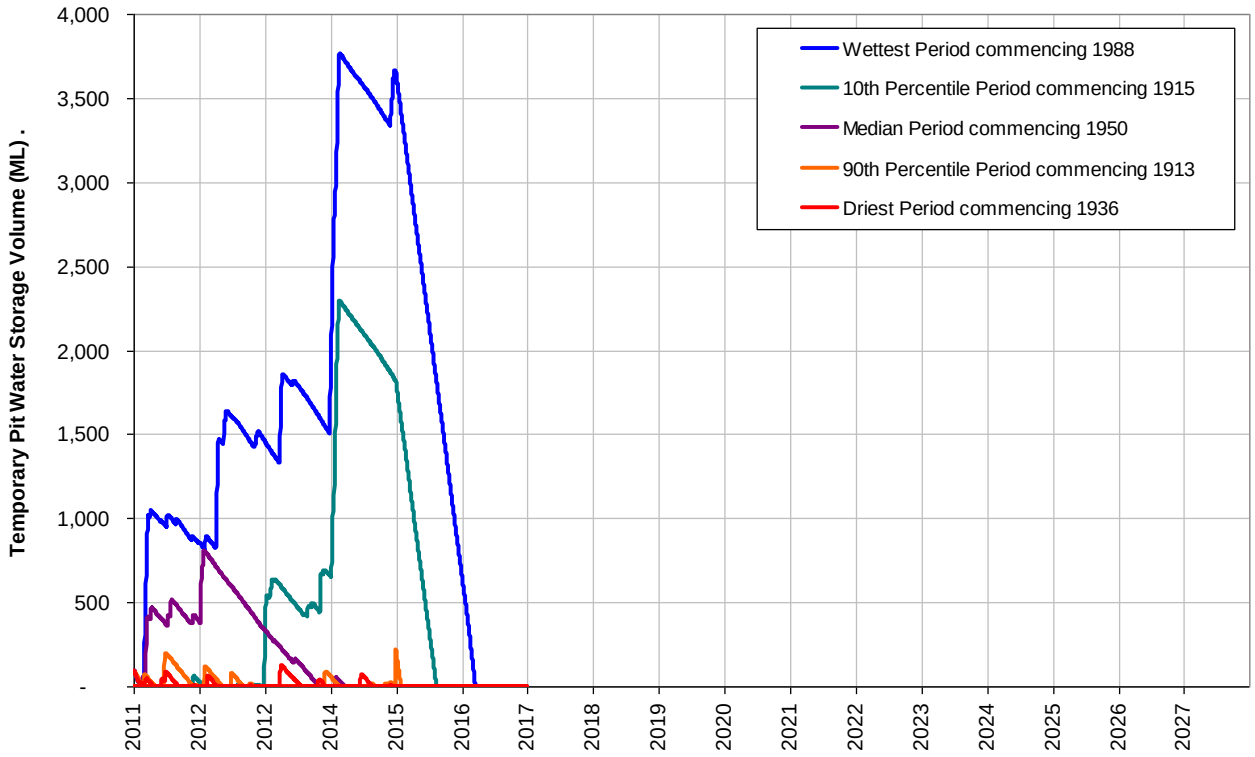

Figure 5.4 Temporary Pit Worked Water Storage – Simulated Behaviour

Millennium Void Worked Water Storage

Figure 5.5 and Figure 5.6 show the range of maximum modelled storage volumes in the Millennium Void which will store water pumped from Mavis Pit and the sediment dams after Year 4. There is a wide range of potential volumes required. Up to 17,000ML would have been required toward the end of the project if it had commenced in 1963. As the Millennium Void will have a total available storage of approximately 31,000ML, it will easily accommodate the modelled storage requirement.

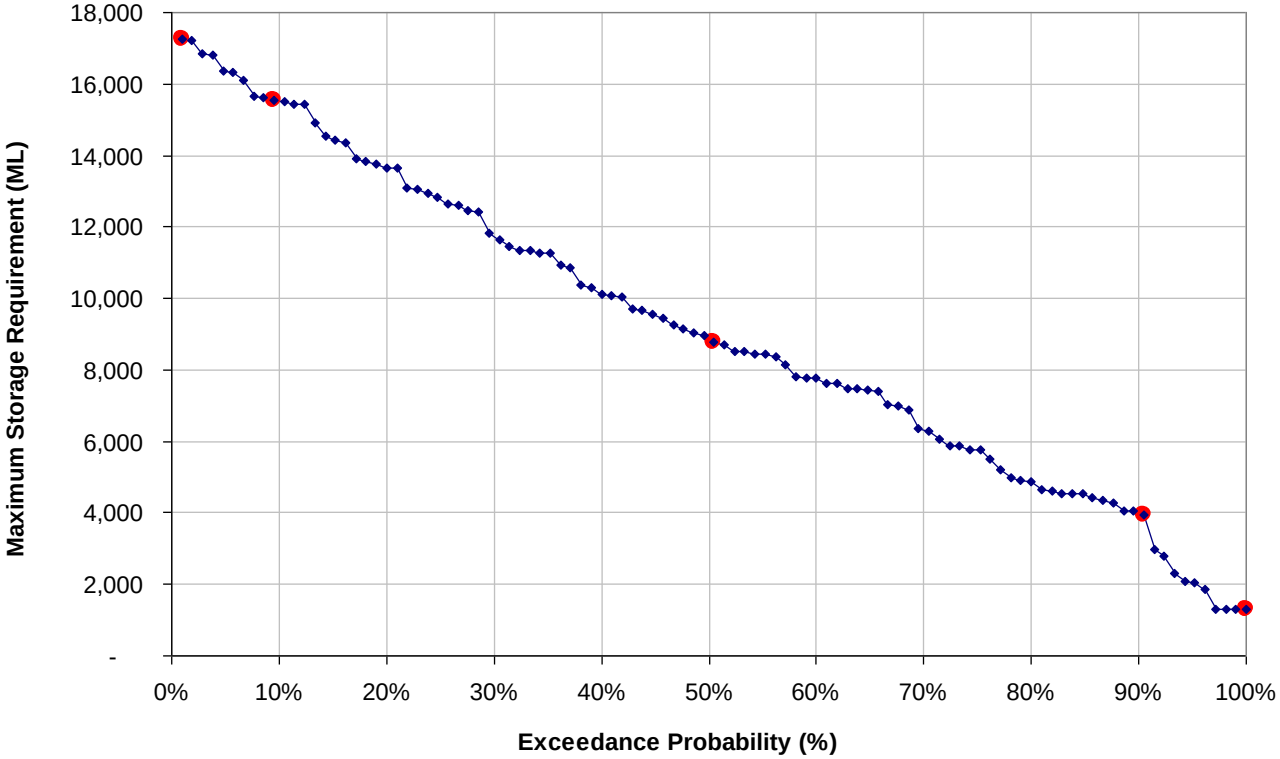

Figure 5.5 Millennium Void Worked Water Storage – Exceedance Probability of Maximum Volume

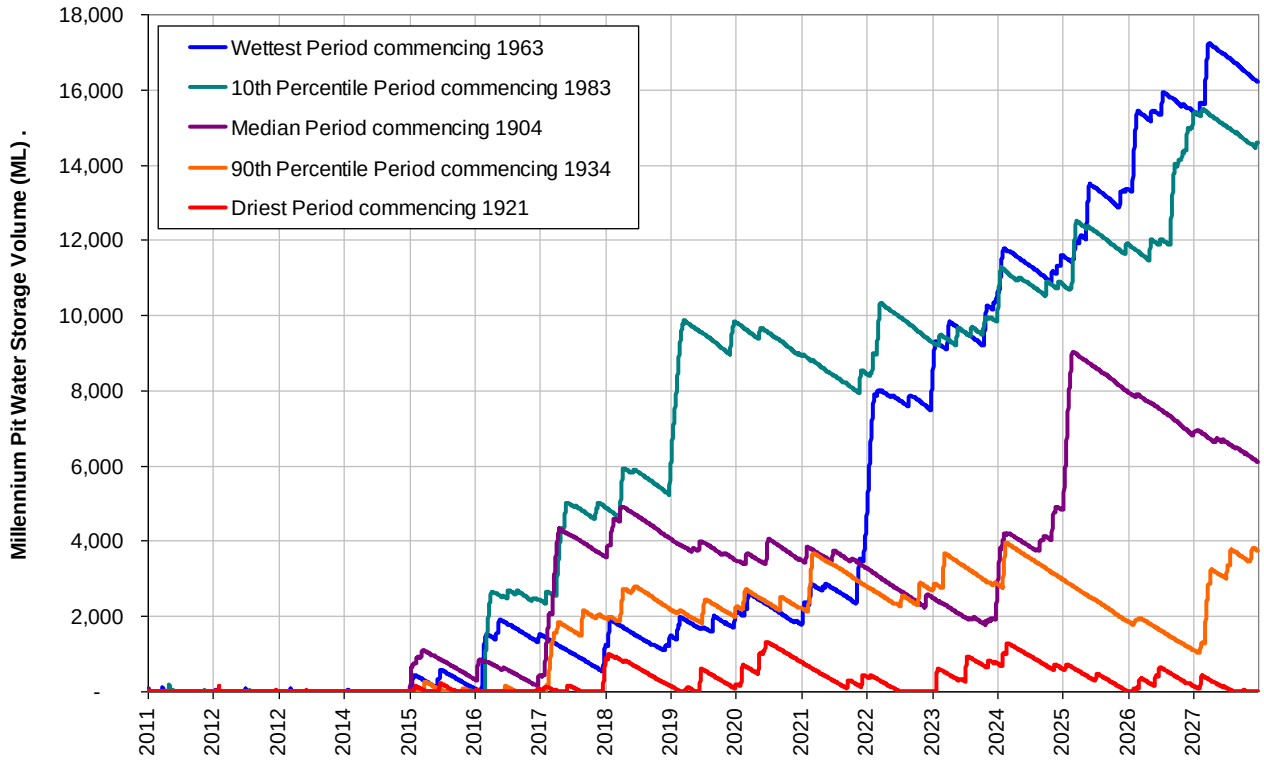

Figure 5.6 Millennium Void Worked Water Storage – Simulated Behaviour

5.4.3 Active Pit Water Inventory

Figure 5.7 and Figure 5.8 show the annual exceedance probability (AEP) of in-pit inventory for the mine layout as at 2015 (which is the stage of the operation with the largest catchment areas reporting to the active mine pits). The analysis was undertaken assuming the 2015 arrangement remained in place for the full 122 year period of the available climate record.

Figure 5.7 shows that for the 10% AEP, the maximum modelled pit inundation for each scenario is as follows:

- Millennium Pit - 140ML
- Mavis Pit - 360ML

However, with the proposed pit dewatering system, it is likely these volumes will only be exceeded for short periods of time. As shown in Figure 5.8 modelled volumes in excess of 100ML were only experienced for less than 0.3% of the time at Millennium Pit and 1.2% of the time at Mavis Pit. The impacts of water accumulation in the pits on mining would therefore be expected to be minimal.

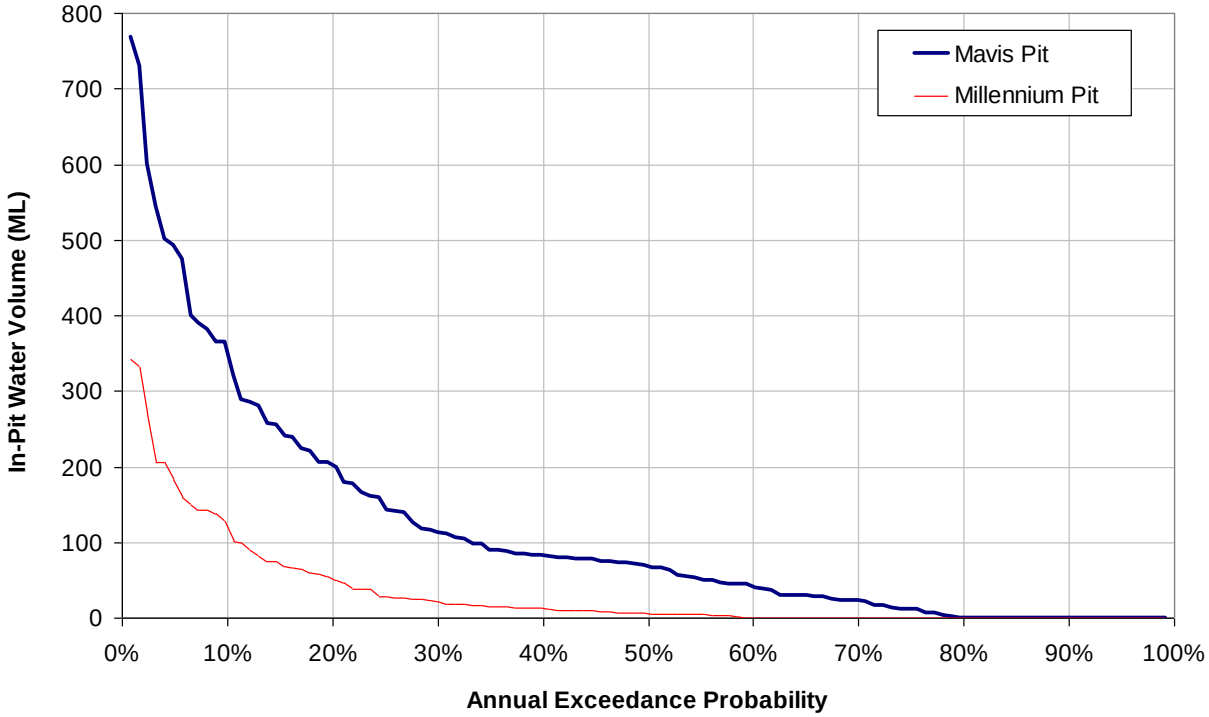

Figure 5.7 Pit Inventory – Annual Exceedance Probability (AEP)

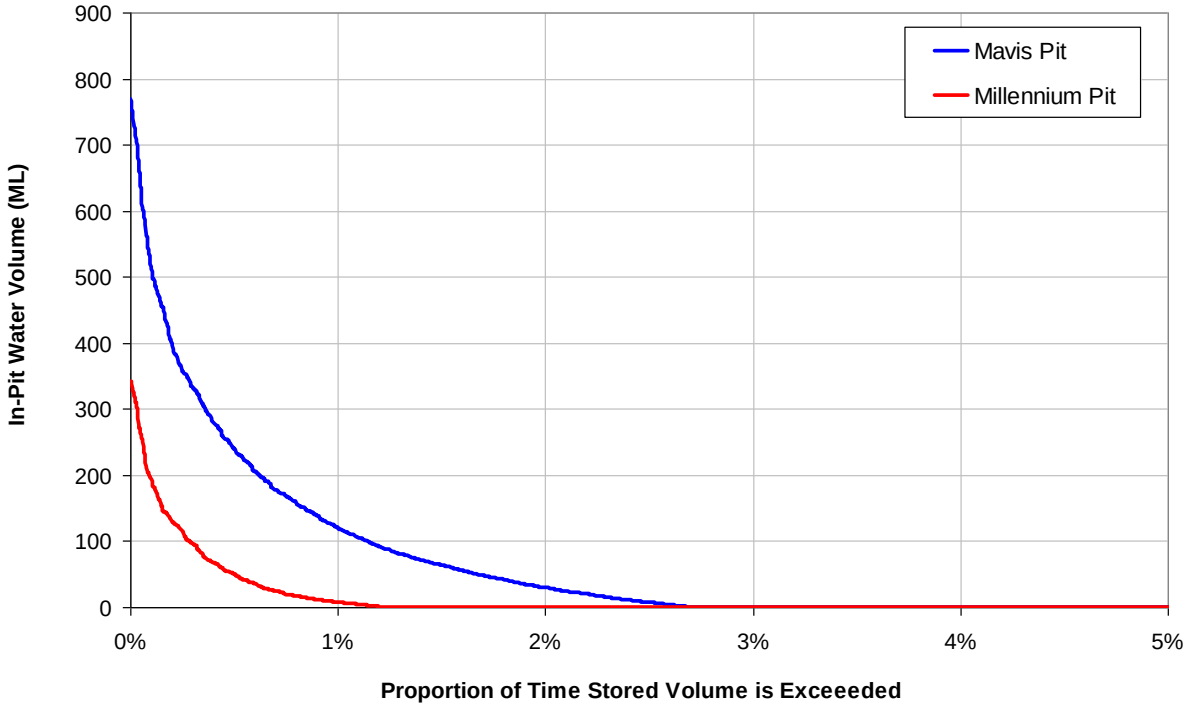

Figure 5.8 Pit Inventory – Daily Exceedance Probability

5.4.4 Storage Discharges

Table 5.1 describes the magnitude, frequency and duration of sediment dam spillway discharges to the receiving waters. The model of the final MEP footprint and water management system was used for this estimate. During the earlier stages of mining, when the disturbed area is smaller, the magnitude of modelled discharges would be smaller, however the frequency and duration of discharges would be similar.

The table shows the average results from all 105 simulations of the 17 year mine life sampled from the available climate record. Within the historical record, there were sustained dry and wet periods. As the project life is relatively short, the frequency and duration of discharges will be highly dependent on whether the 17 year MEP project period is relatively dry or relatively wet.

Table 5.1 Modelled Sediment Dam Spill Characteristics (2027 WMS arrangement)

	West Creek (incl. West Creek Dam)	North Creek	New Chum Creek
Total Spills	173	26	26
Average Spills per Year	1.42	0.21	0.21
Average Spill Duration (d)	13	6	6
Average Spill Volume (ML)	150	66	479
Maximum Spill Duration (d)	55	14	14
Maximum Spill Volume (ML)	1,846	269	1,868

5.4.5 Overall Site Water Balance

A representative long-term water balance for each stage of mining is presented in Table 5.2. The data presented in the table has been derived from 105 simulations using 17 year climate sequences sampled from the 122 year long climate record.

Table 5.2 Summary Average Annual Water Balance (High Runoff)

	2012 (2 yrs)	2015a (2 yrs)	2015b (2 yrs)	2020 (5 yrs)	2027 (6 yrs)
Inflows (ML/a)					
Groundwater Millennium	25.6	25.6	25.6	0.0	0.0
Groundwater Mavis	40.2	40.2	40.2	51.1	29.2
Catchment Inflow	1,538	1,860	1,906	2,242	2,593
Burdekin Pipeline	156.3	109.3	64.2	30.5	7.9
Sum of Inflows	**1,760**	**2,035**	**2,036**	**2,324**	**2,630**
Outflow (ML/a)					
CHPP	540.0	540.0	540.0	540.0	540.0
Haul Rd Dust Suppression	350.0	350.0	350.0	350.0	350.0
Vehicle Washdown	100.0	100.0	100.0	100.0	100.0
Evaporation	298.1	395.4	438.5	511.8	610.5
Spills					
New Chum Ck	8.8	14.8	15.3	46.8	82.1
North Creek	0.0	0.2	0.2	3.3	11.2
West Creek	214.8	214.0	232.4	223.5	184.4
Sum of Outflows	**1,512**	**1,615**	**1,677**	**1,775**	**1,878**
Change in volume (ML)	248.4	420.3	359.1	548.2	751.6

It should be recognised that the following items are subject to climatic variability:

- Rainfall and runoff.
- Evaporation.
- Imported water requirement.
- Site releases/spills.

Whilst the above table provides an indication of the long-term average rates for each of the above items, application of the above information for other purposes should only be undertaken with due consideration of its suitability. Note that this water balance has been prepared with runoff parameters that will tend to overestimate the quantities of surface runoff from waste rock emplacements. As a result, the above water balance will tend to underestimate the quantities of water to be imported via the Burdekin Pipeline. The results of a sensitivity analysis with lower catchment runoff are presented in Appendix A.

6 SURFACE WATER MONITORING

A surface water monitoring program will be required to measure compliance with the EA conditions. Monitoring points will be provided at points where contaminants could potentially be released from the WMS at concentrations that could cause environmental harm in the receiving waters. Monitoring points will also measure receiving water quality upstream and downstream of the release points.

Table 6.1 lists the contaminant release points from the mine water management system and the associated receiving waters. The locations of the release points are shown in Figure 6.1.

Table 6.1 Contaminant Release Points

Release Point	Easting	Northing	Contaminant Source and Location	Monitoring Point	Receiving Waters
MEP RP1 (Discharge Point 1)	630620	7564870	Temporary Central Waste Rock Runoff Water Storage Spillway	Spillway	New Chum Creek
MEP RP2 (Discharge Point 2)	630030	7564995	Temporary Central Pit Water Storage Spillway	Spillway	New Chum Creek

Receiving water monitoring locations are listed in Table 6.2 and shown in Figure 6.1.

Table 6.2 Upstream and Downstream Receiving Water Monitoring Points

Monitoring Point	Easting	Northing	Receiving Waters	Description
UP MEPP1	626644	7566139	New Chum Creek	New Chum Creek (Existing Upstream Monitoring Point)
DN MEPP1	631977	7562721	New Chum Creek	New Chum Creek (Existing Downstream Monitoring Point - 3200m D/S of RP1 & RP3)
DN MEPP2	626080	7562157	West Creek	West Creek (Existing Downstream Monitoring Point – 700m D/S of RP2)

Monitoring requirements to comply with the model EA conditions are listed in Table 6.3 below.

Table 6.3 Proposed Water Management Monitoring Points

Monitoring Point	Description	Water Level (Flow)	Storage Contaminant Limits	Continuous Sampling of Trigger Levels	Full suite as per note below
DN MEPP1	New Chum Creek (Existing Monitoring Point)West Creek (Existing Monitoring Point)	X	-	-	Daily During Release
DN MEPP2	West Creek (Existing Monitoring Point)	X	-	-	Daily During Release
MEP RP1	Temporary Central Waste Rock Runoff Water Storage Spillway	X	-	X	Daily During Release
MEP RP2	Temporary Central Pit Water Storage Spillway	X	-	X	Daily During Release
Temporary Central Waste Rock Water Storage	Storage	-	X	X	Quarterly
Temporary Central Pit Water Storage	Storage	-	X	X	Quarterly

Gauge boards will be provided at all dams to allow storage water levels and volumes to be monitored and enable inflows and outflows to be estimated. Automatic monitoring equipment may be installed at key storages.

The event-based sampling will enable quantification of discharge water quality from the site and any potential corresponding impact on receiving waters. On-site monthly sampling from the water storages allows for any potential problem areas with respect to pollutant generation to be identified in advance ensuring appropriate remedial action can be taken.

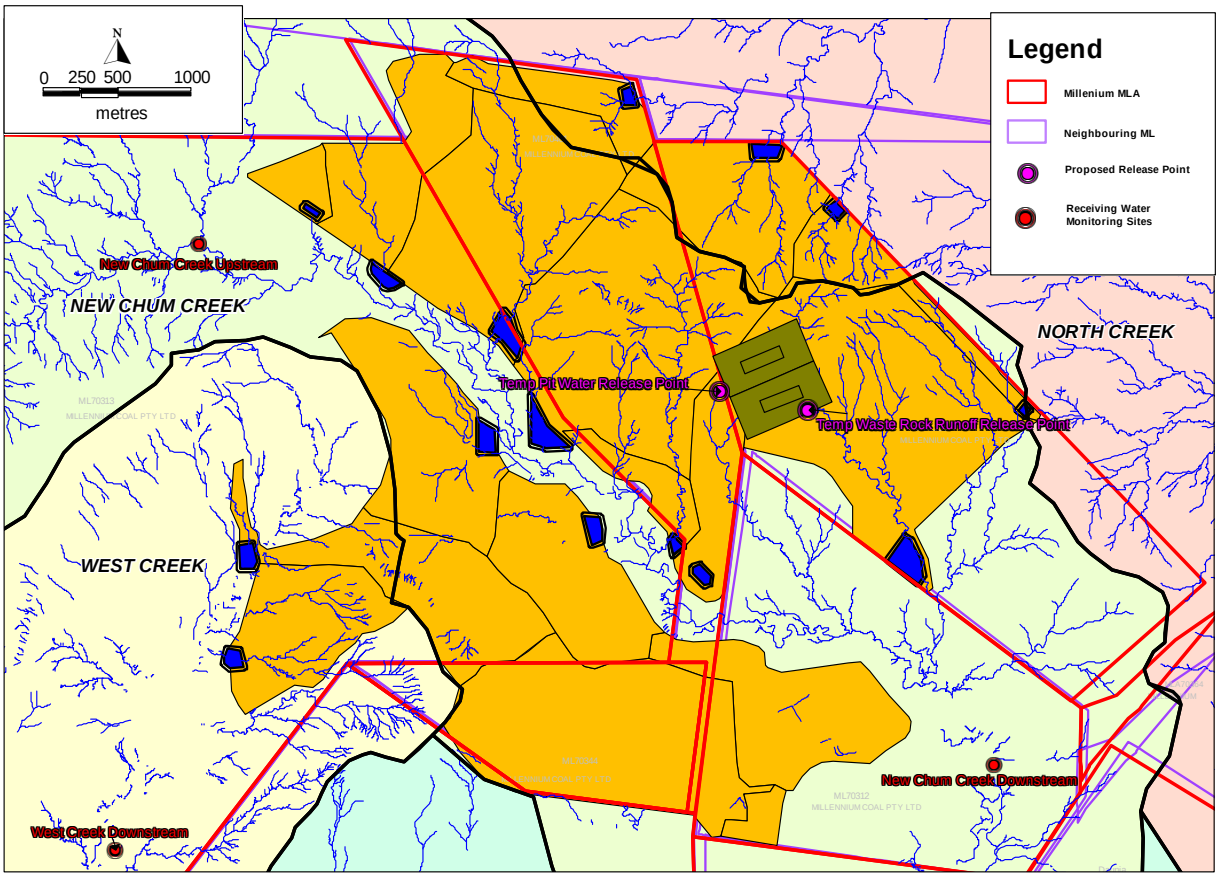

Figure 6.1 Proposed Monitoring Points

7 SUMMARY OF FINDINGS

7.1 CHANGE IN RUNOFF WATER QUALITY

A conceptual water management system has been devised to manage the potential impacts of the MEP on surface water quality. Runoff and groundwater inflows entering the pits, is to be collected and used preferentially to meet the MEP's water demands, so that the risk of off-site discharge is very low. Runoff from waste rock emplacements is to be captured in sediment dams to remove suspended solids and also reused to supply site demands.

The proposed management measures should ensure there will be little impact on off-site runoff water quality, and as a result, no measurable adverse impact on riparian and ecological values of watercourses in the vicinity of the proposed MEP due to changes in surface water quality.

7.2 CHANGE IN SURFACE WATER RUNOFF VOLUME

Where possible, clean runoff from undisturbed catchments will be diverted around the MEP workings. However, the capture and reuse of water in the mine water management system will result in reductions in flow in the receiving water catchments. The proportion of the New Chum Creek catchment that is disturbed and intercepted in the water management system will increase to 6.7% in Year 1, and to 17.8% in Year 17. Up to 3.2% of the North Creek and West Creek catchments will be disturbed by the MEP and intercepted in the WMS.

7.3 SITE WATER BALANCE

The impact of the MEP on the performance of the mine site water management system is summarised as follows:

- Total water demand will increase due to increased production and increased dust suppression requirements for additional haul roads, During dry periods, if there is insufficient on-site pit water to meet these demands, or if water quality is not suitable for CHPP use, raw water consumption will increase to make up for the shortfall.
- The overall mine water inventory is expected to increase due to the additional catchment area reporting to pits. However, sufficient capacity will be available in the proposed pit water storages to accommodate the potential increase in inventory.
- Long-term modelling indicates the probability of site sediment dam spillway discharge in any year is approximately 20%.

7.4 NEW CHUM CREEK FLOOD IMPACT

The hydrologic and hydraulic modelling of New Chum Creek and its floodplain in the vicinity of the proposed mining area demonstrates the following:

- With the exception of roads, external waste rock emplacements, and a number of water management dams, the proposed MEP mining activities are outside of the extent of inundation of the 100 year ARI flood event.
- Levees will be provided to protect the pit from flooding in a 1000 year ARI flood event.
- With the exception of localised increases in the immediate vicinity of the proposed haul road crossings, flood velocities along the New Chum Creek channel generally remain unchanged from existing conditions as a result of the proposed MEP.
- There will be minor localised increases in the 100 year ARI flood level adjacent to the external waste rock emplacements. Flood levels will not be increased outside the MEP Area areas.

External waste rock emplacements adjacent to West Creek will be located such that the impact on flood conditions in West Creek will be minimal.

7.5 NEW CHUM CREEK EROSION

Scour protection will be provided at the proposed haul roads to manage the temporary increased risk of erosion in the vicinity of the crossings. The localised increase in flood velocities associated with the proposed external waste rock emplacements on the edge of the New Chum Creek floodplains will not significantly increase erosion potential in the New Chum Creek channel.

While flow velocities in the vicinity of the proposed out of pit waste rock emplacements will be low, the toe of the external waste rock emplacements will be protected with rock mulch up to the level of the 1000 year ARI flood event to protect it from scour.

7.6 FINAL VOID WATER MANAGEMENT

The final voids are located at the edge of the PMF flood extents, and as a result, the risk of flood inflows to the voids from New Chum Creek is small.

Based on historical simulation analysis, in the long-term, the catchment of the final voids will be insufficient to generate sufficient runoff to exceed evaporative losses from the water surface. Stored water levels in both voids are likely to stabilise – at a considerable depth below the edge of the void.

The salinity of the stored water will tend to increase over time. OPSIM modelling of the Mavis and Millennium voids shows that the salinity will eventually increase beyond guideline stock watering levels.

8 REFERENCES

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A APPENDIX

MEP
MINE WATER MANAGEMENT SYSTEM

A.1 OVERVIEW

The following sections provide detailed information relating to the proposed mine water management system. Further details of the water balance model are provided, along with the results of sensitivity analysis.

A.2 EVOLUTION OF SITE WATER MANAGEMENT SYSTEM

The volume of surface runoff water entering the mine water management system is dependent on rainfall and the catchment areas of the open pits, active waste rock emplacement areas, industrial areas and rehabilitation areas, which can vary considerably over the life of the proposed MEP. The following figures show the key water management structures at the project evolves. These diagrams form the basis of the modelled water management system. The modelled catchment areas and types are summarised in Table A.1 below, and in Figure A.5, which shows the OPSIM water balance model setup schematically.

Table A.1 MEP Catchment Areas and Types

Catchment Type	Catchment Area (ha)			
	2012	2015	2020	2027
Natural/Undisturbed	6.2	5.1	4.4	4.4
Open Cut Pits	3.7	5.0	5.8	2.8
Prestrip	0.2	0.2	0	0
Waste rock – Unrehabilitated	3.3	5.1	7.2	12.3
Total	13.4	15.4	17.4	19.5

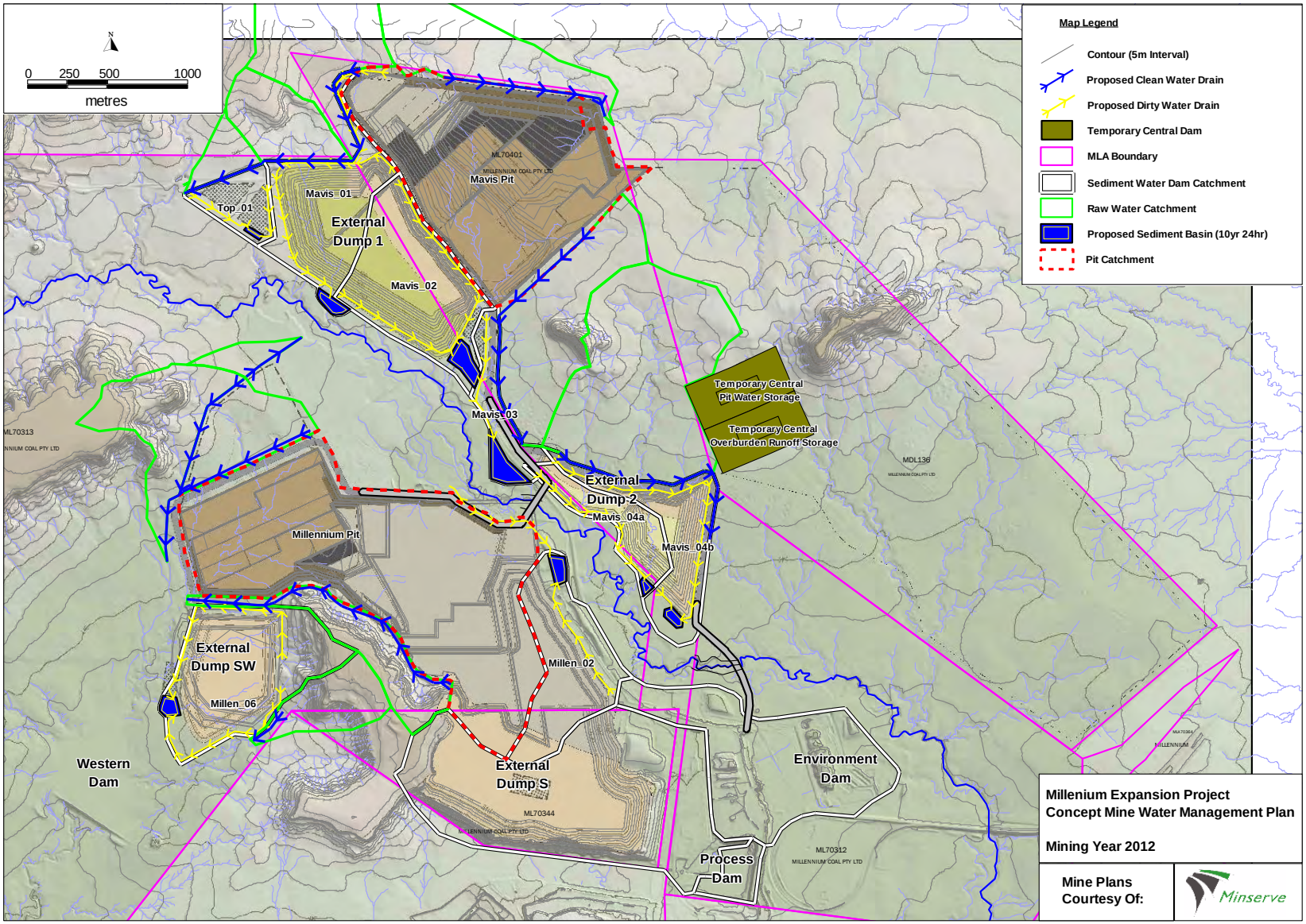

Figure A.1 2012 Water Management System Layout

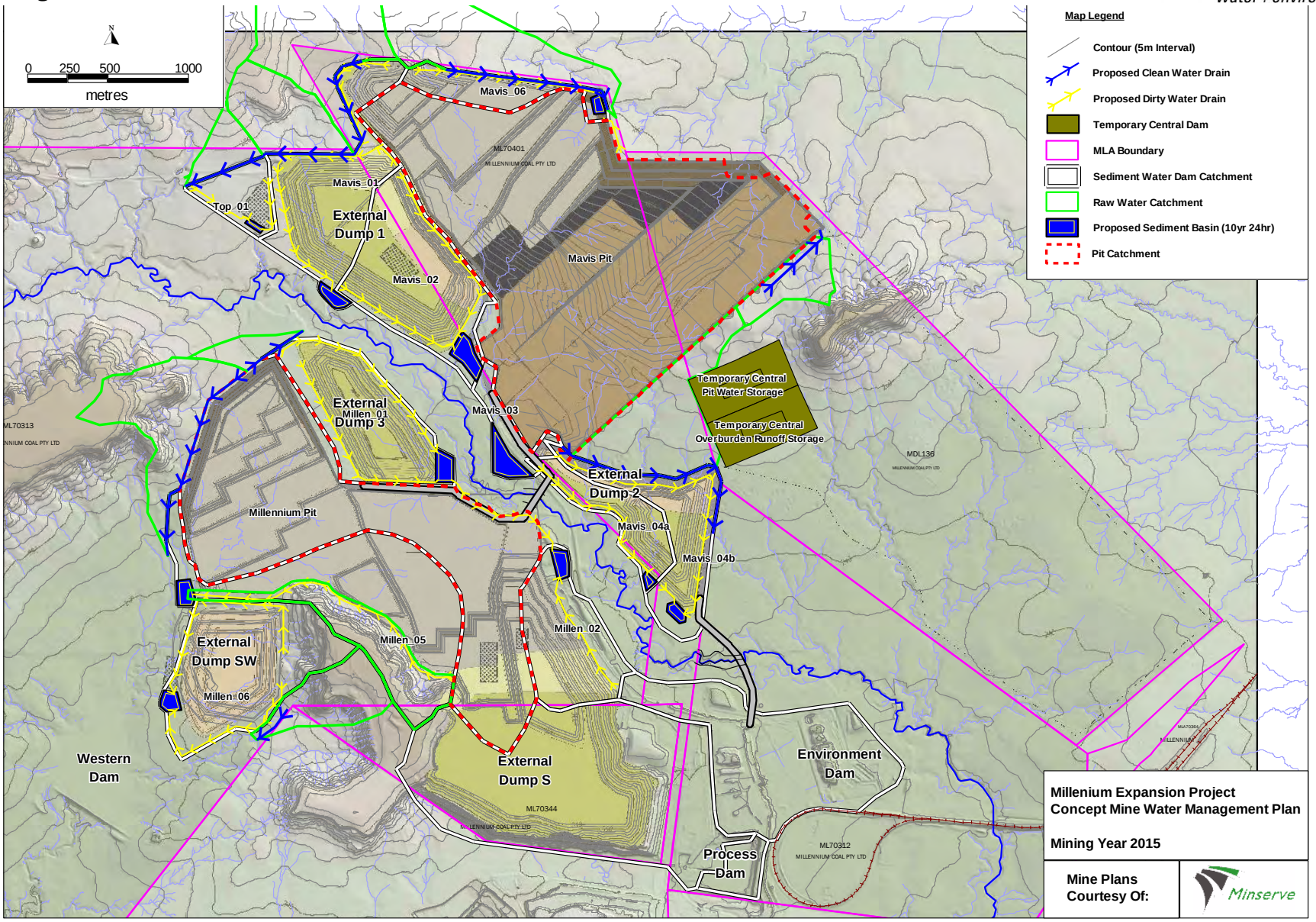

Figure A.2 2015 Water Management System Layout

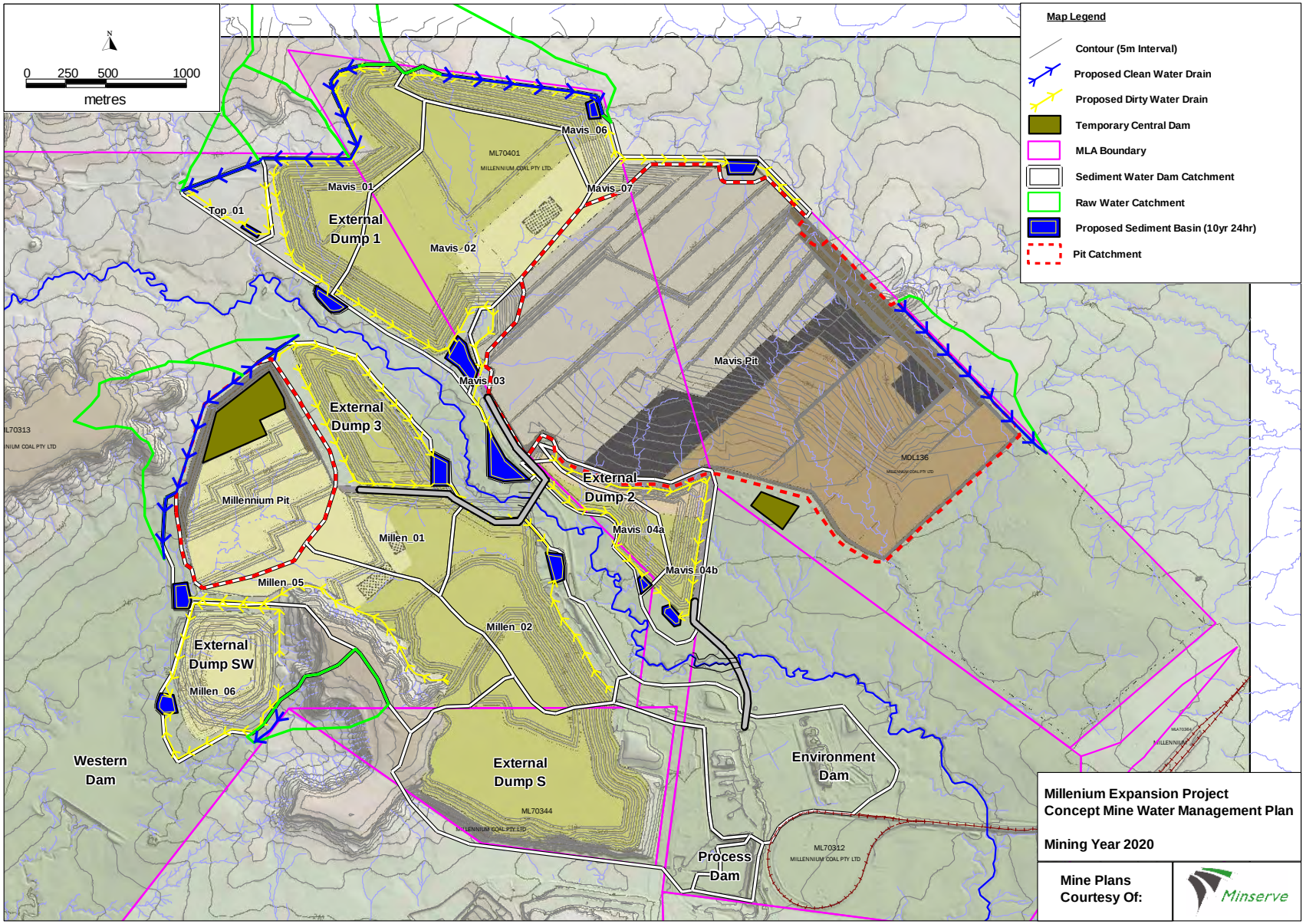

Figure A.3 2020 Water Management System Layout

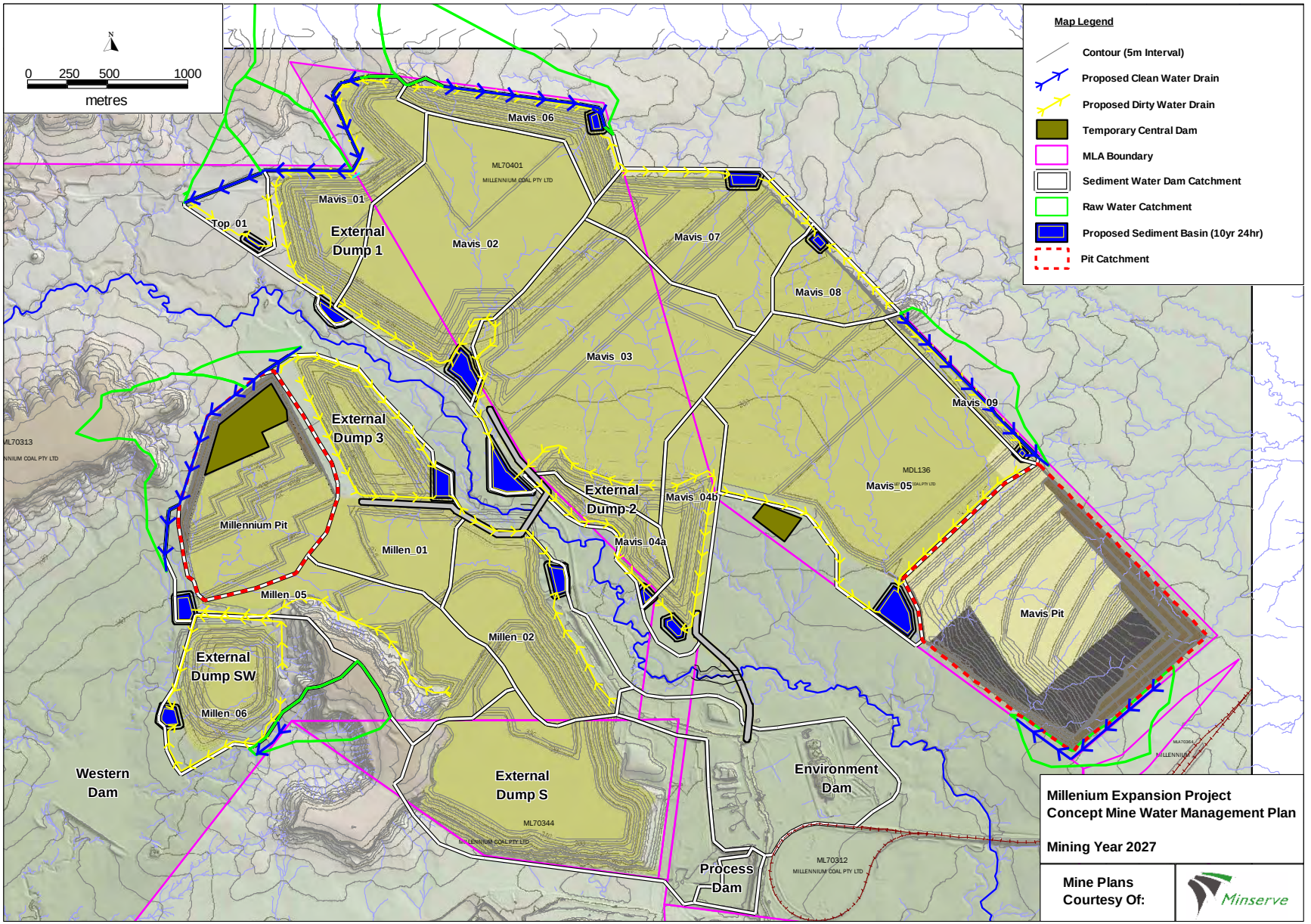

Figure A.4 2027 Water Management System Layout

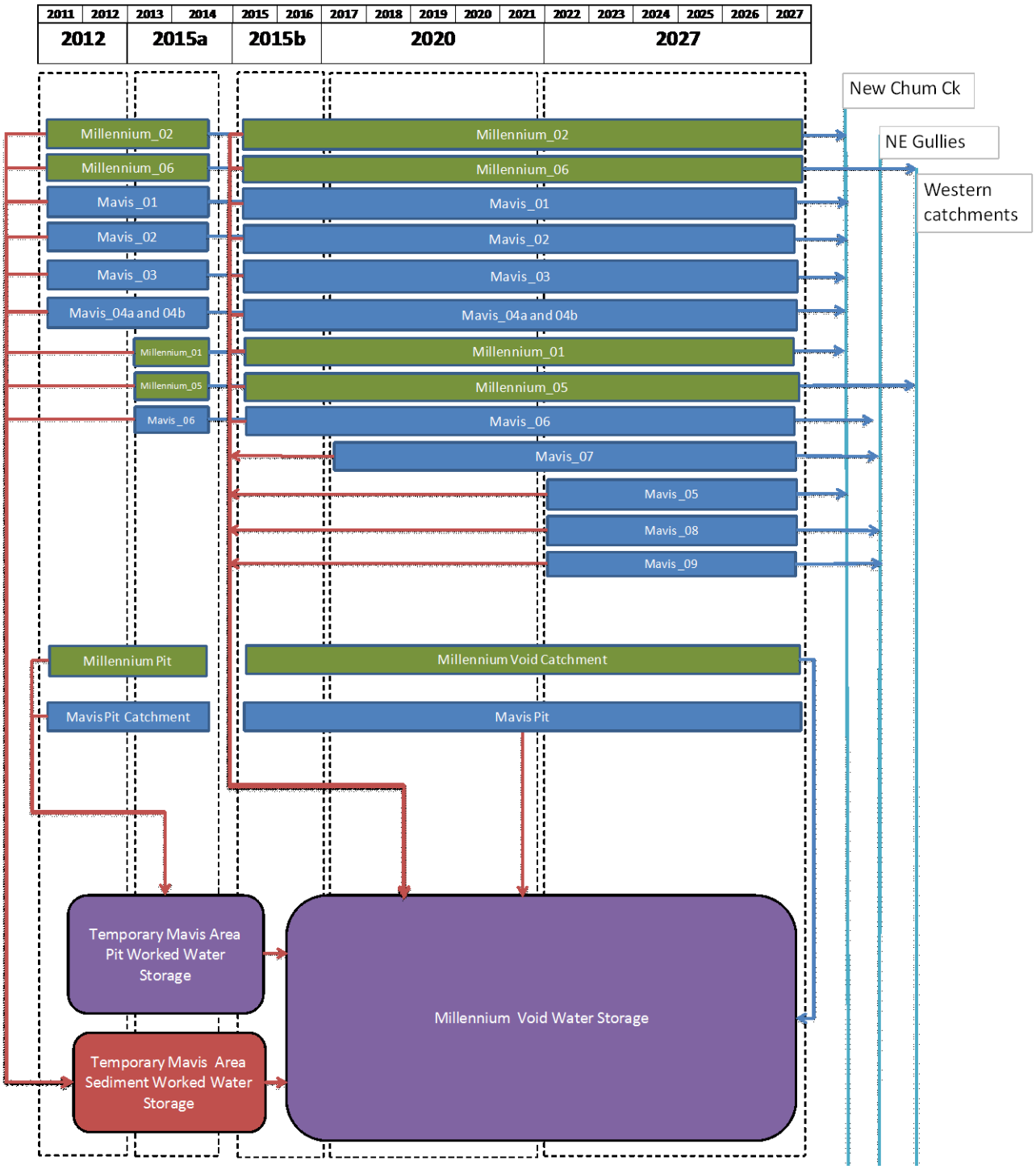

Figure A.5 MEP Water Management System – Schematic Diagram

A.3 OPSIM MODEL HYDROLOGICAL INPUTS

A.3.1 Input Climate Data

The rainfall and pan evaporation data obtained from DERM's Data Drill service (as described in Section 2.3.2) was used in the analysis.

A.3.2 Catchment Runoff

OPSIM incorporates the widely used Australian Water Balance Model (AWBM) (Boughton, 2003). The AWBM uses a group of connected conceptual storages (three surface water storages and one ground water storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evaporation. Simulated surface runoff occurs when the storages fill and overflow. The model parameters define the storage depths, the proportion of the catchment draining to each of the storages, and the rate of flux between them.

For the purposes of the conceptual WMS design and impact assessment, AWBM parameters were selected so that the catchment runoff estimates would be conservatively high. Parameters were selected based on experience with calibrated models at other sites and comparison with the nearby DERM streamflow gauge records for natural catchments. As shown in Table A.2, when these parameters are adopted, the mean annual runoff for the modelled catchments over the simulation period (1889 to 2009) ranged between 14.4% and 24.8% of mean annual rainfall. Gauged natural catchments in the region typically have mean annual runoff to rainfall ratios in the range 3% to 10%.

Table A.2 Adopted (High runoff) AWBM Parameters

Parameter	Undisturbed Areas	Unrehabilitated Waste Rock	Pit Floor/ Prestrip Areas/ Highwall
A1	0.10	0.10	0.10
A2	0.40	0.90	0.90
BFI	0.75	0.90	0.0
C1	5	12	12
C2	25	21	38
C3	120	0	0
K_{base}	0.8	0.7	1.0
Mean Annual Runoff/Rainfall	14.4%	24.8%	17.5%

The sensitivity of the water balance to changes in catchment runoff parameters was also tested. The results of the sensitivity analysis are presented in Section A.5.

A.3.3 Pit Groundwater Inflows

Groundwater inflows to the open cut pits were adopted in accordance with the estimates made in the groundwater assessment report (Met Serve, 2010). The modelled inflows are summarised in the table below.

Table A.3 Adopted Groundwater Inflow to Pits (kL/d)

Stage	Stage	Millennium Pit	Mavis Pit	Total
2012	2011-2012	70	110	**180**
2015a	2013-2014	70	110	**180**
2015b	2015-2016	70	110	**180**
2020	2017-2021	-	140	**140**
2027	2022-2027	-	80	**80**

A.4 SITE WATER DEMANDS

Water demands are assumed to be supplied in the following priority (see Figure A.5):

1. The CHPP is supplied first:
    a. Supplies are drawn from the Central Worked Water Storages if available. Water is drawn at a 50-50 spilt between the Temporary Pit Water Storage and the Temporary Overburden Runoff Storage in the first two stages. If one storage is empty – all supplies come from the other;
    b. If there are no supplies available from the Central Worked Water Storages, all supplies are drawn from the Western Dam;
    c. If the Western Dam cannot supply the full demand, the shortfall is drawn from the Burdekin Pipeline.

2. Dust suppression is supplied second:
    a. Supplies are drawn from the Central Worked Water Storages if available. Water is drawn at a 50-50 spilt between the Temporary Pit Water Storage and the Temporary Overburden Runoff Storage in the first two stages. If one storage is empty – all supplies come from the other;
    b. If there are no supplies available from the Central Worked Water Storages, all supplies are drawn via the Western Dam;
    c. If the Western Dam cannot supply the full demand, the shortfall is drawn from the Burdekin Pipeline.

3. Vehicle washdown is supplied third:
    a. Supplies are drawn from the Central Worked Water Storages if available. Water is drawn at a 50-50 spilt between the Temporary Pit Water Storage and the Temporary Overburden Runoff Storage in the first two stages. If one storage is empty – all supplies come from the other;
    b. If there are no supplies available from the Central Worked Water storage, all supplies are drawn from the Western Dam.

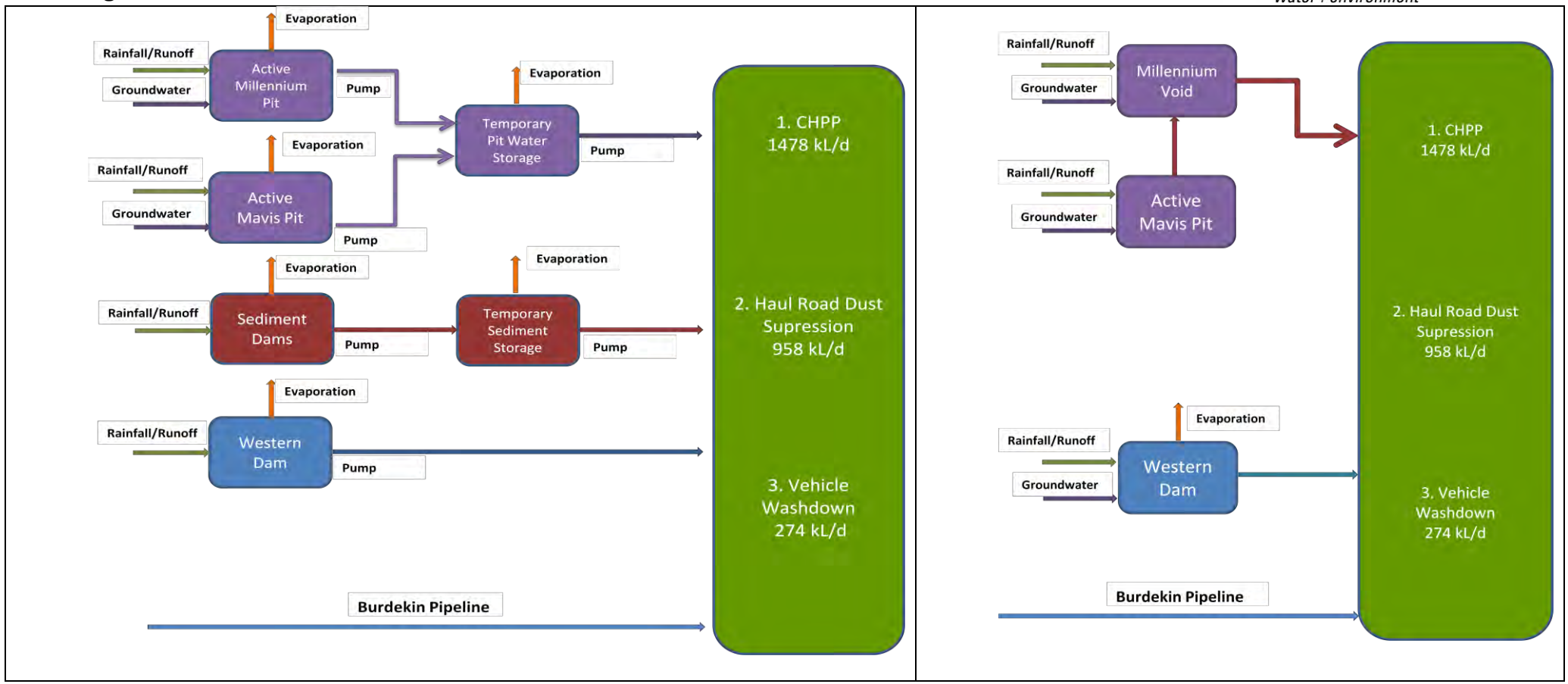

Figure A.6 MEP Water Management System Supplies and Demands

A.5 SENSITIVITY ANALYSES

A.5.1 Runoff Parameters

The water balance model results reported as the base case for this analysis were chosen to give conservatively high runoff volumes for the purposes of dams sizing and impact assessment. The analysis was repeated with the set of parameters listed in Table A.5, which generate lower runoff volumes. Note that for the MEP system, unrehabilitated waste rock makes up the majority of catchment types reporting to the water management system.

Table A.5 Adopted AWBM Parameters – low runoff

Parameter	Undisturbed	Unrehabilitated Waste Rock	Pit Floor/ Prestrip Areas/ Highwall
A1	0.10	0.02	0.10
A2	0.40	0.195	0.90
BFI	0.75	0	0.0
C1	5	10	12
C2	25	40	38
C3	120	420	0
K_{base}	0.8	0	1.0
Mean Annual Runoff/Rainfall	14.4%	3.6%	17.5%

Table A.6 Summary Average Annual Water Balance (Low Runoff)

	2012 (2 yrs)	2015a (2 yrs)	2015b (2 yrs)	2020 (5 yrs)	2027 (6 yrs)
Inflows (ML/a)					
Groundwater Millennium	25.6	25.6	25.6	0.0	0.0
Groundwater Mavis	40.2	40.2	40.2	51.1	29.2
Catchment Inflow	515.8	547.0	560.1	580.4	487.7
Burdekin Pipeline	443.2	498.7	482.3	471.1	544.1
Sum of Inflows (ML/a)	**1,025**	**1,111**	**1,108**	**1,103**	**1,061**
Outflow (ML/a)					
CHPP	540.0	540.0	540.0	540.0	540.0
Haul Rd Dust Suppression	350.0	350.0	350.0	350.0	350.0
Vehicle Washdown	100.1	100.1	100.1	100.1	100.1
Evaporation	115.3	101.7	101.1	103.2	80.7
Spills					
New Chum Ck	0.0	0.0	0.0	0.0	0.0
North Creek	0.0	0.0	0.0	0.0	0.0
West Creek	11.4	3.0	4.7	4.3	1.6
Sum of Outflows (ML/a)	**1,117**	**1,095**	**1,096**	**1,098**	**1,072**
Change in volume stored in WMS	-91.9	16.6	12.3	5.0	-11.4

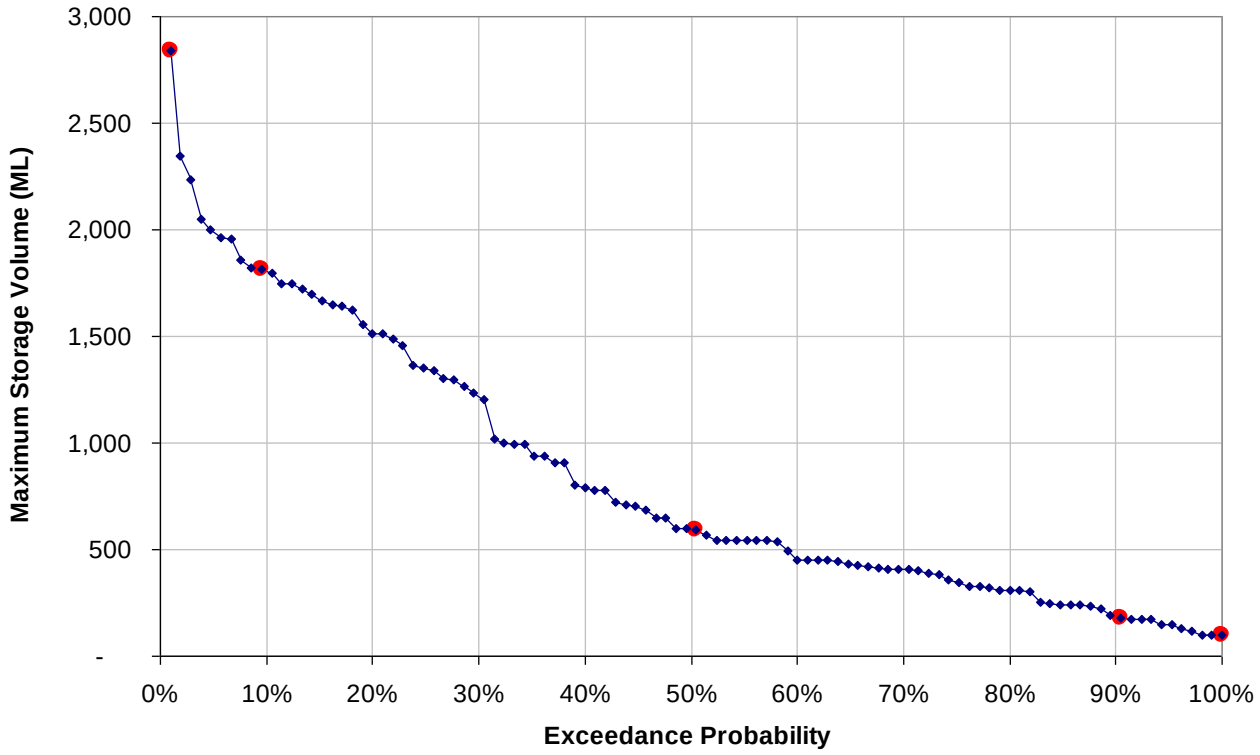

Figure A.7 Low Runoff Analysis - Temporary Pit Worked Water Storage – Exceedance Probability of Max Volume

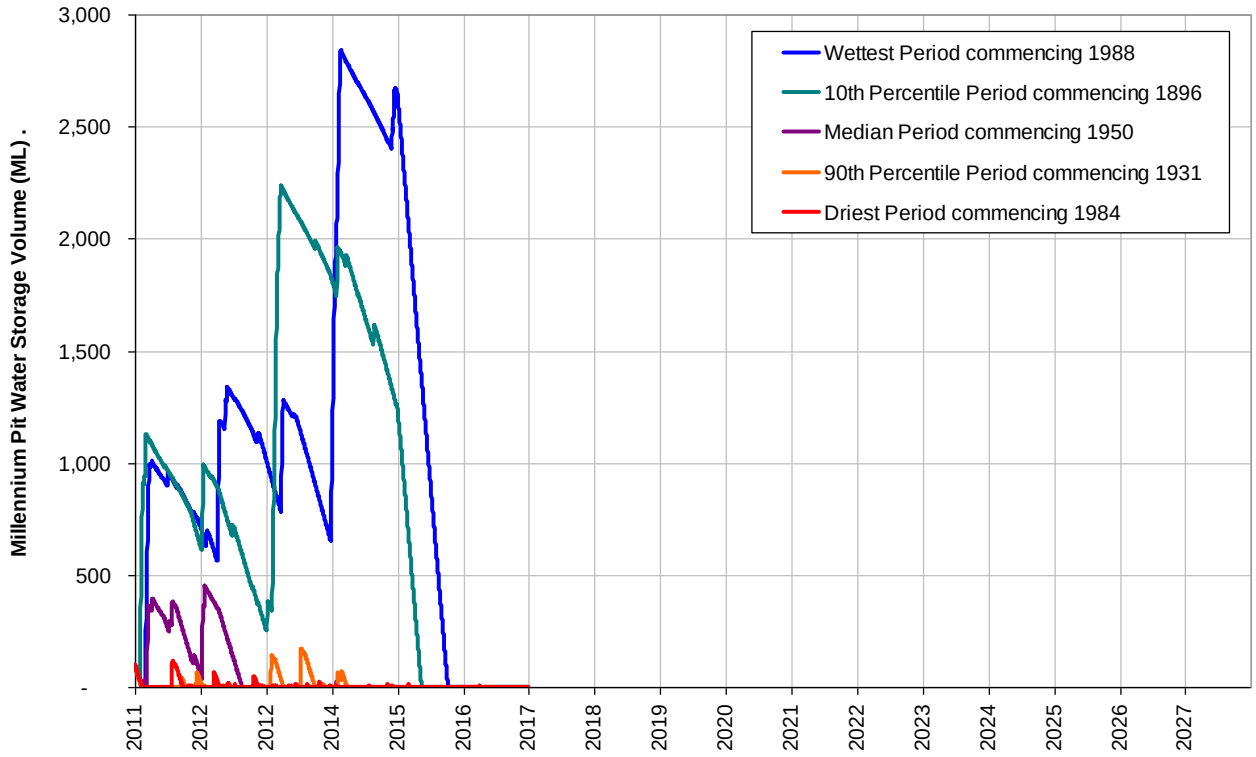

Figure A.8 Low Runoff Analysis - Temporary Pit Worked Water Storage – Simulated Behaviour

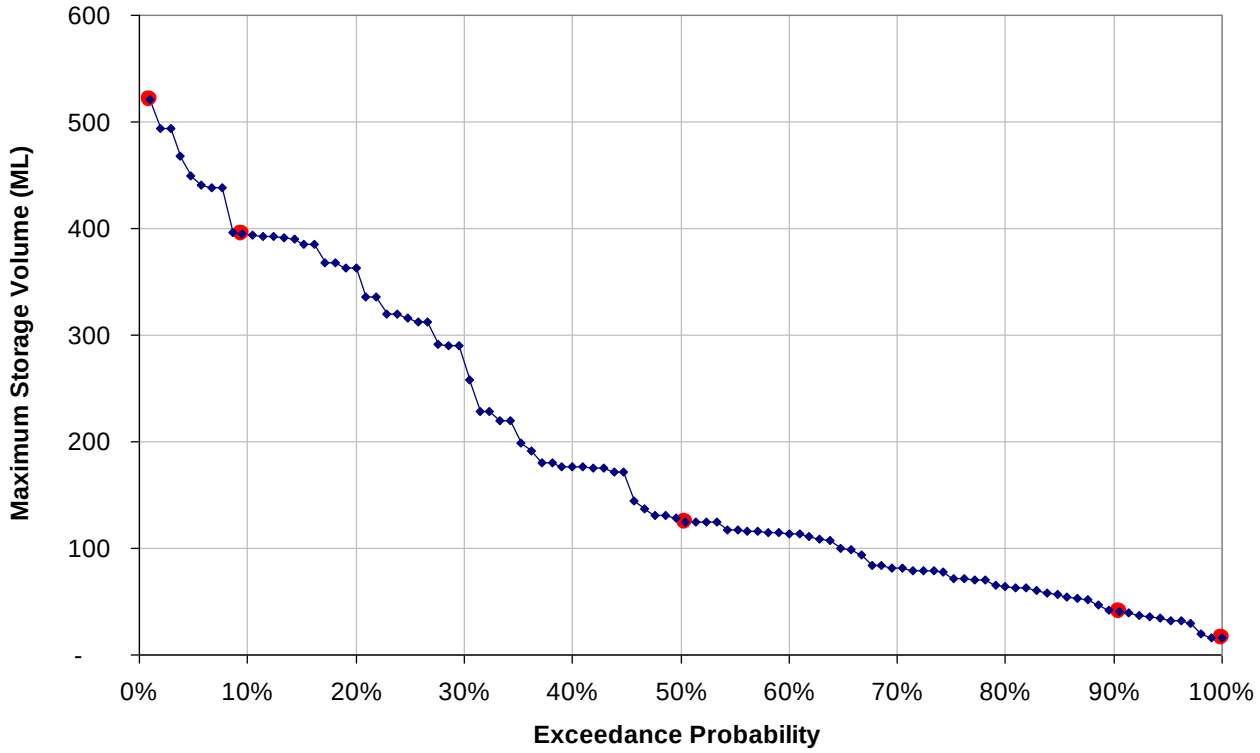

Figure A.9 Low Runoff Analysis - Temporary Sediment Worked Water Storage – Exceedance Probability

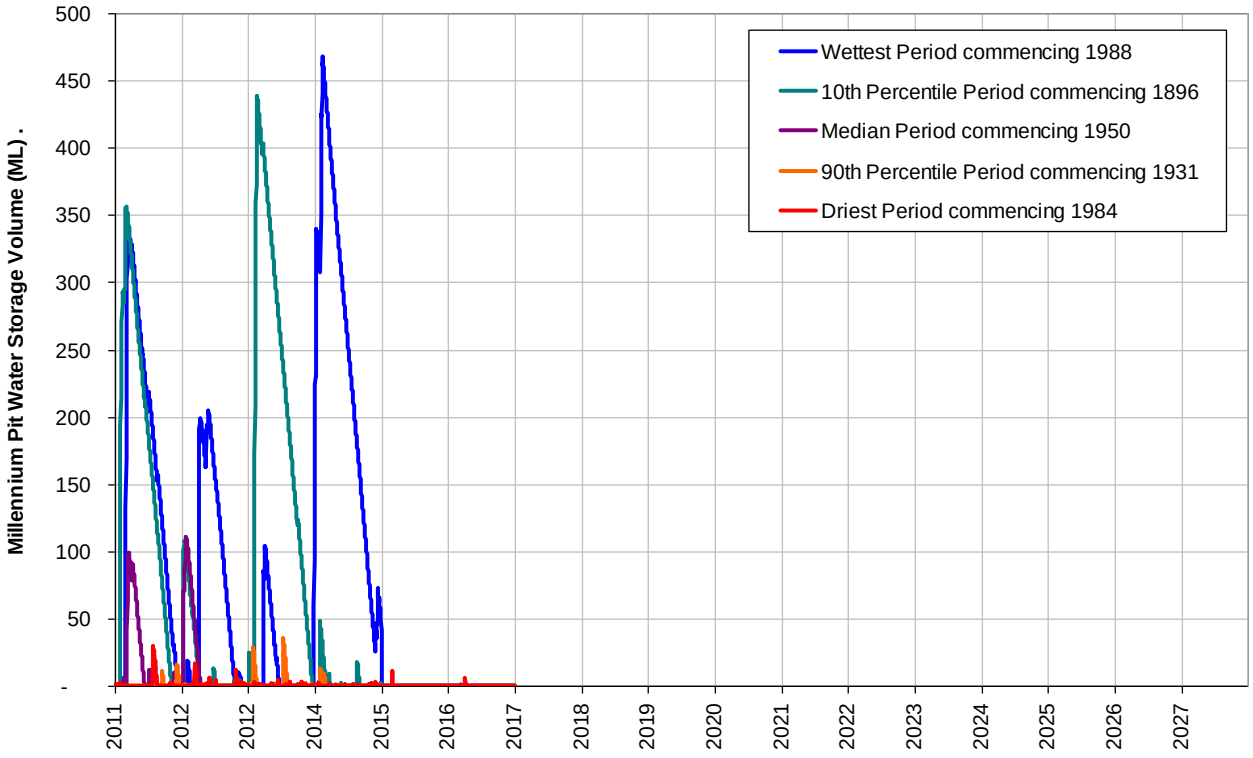

Figure A.10 Low Runoff Analysis - Temporary Sediment Worked Water Storage – Simulated Behaviour

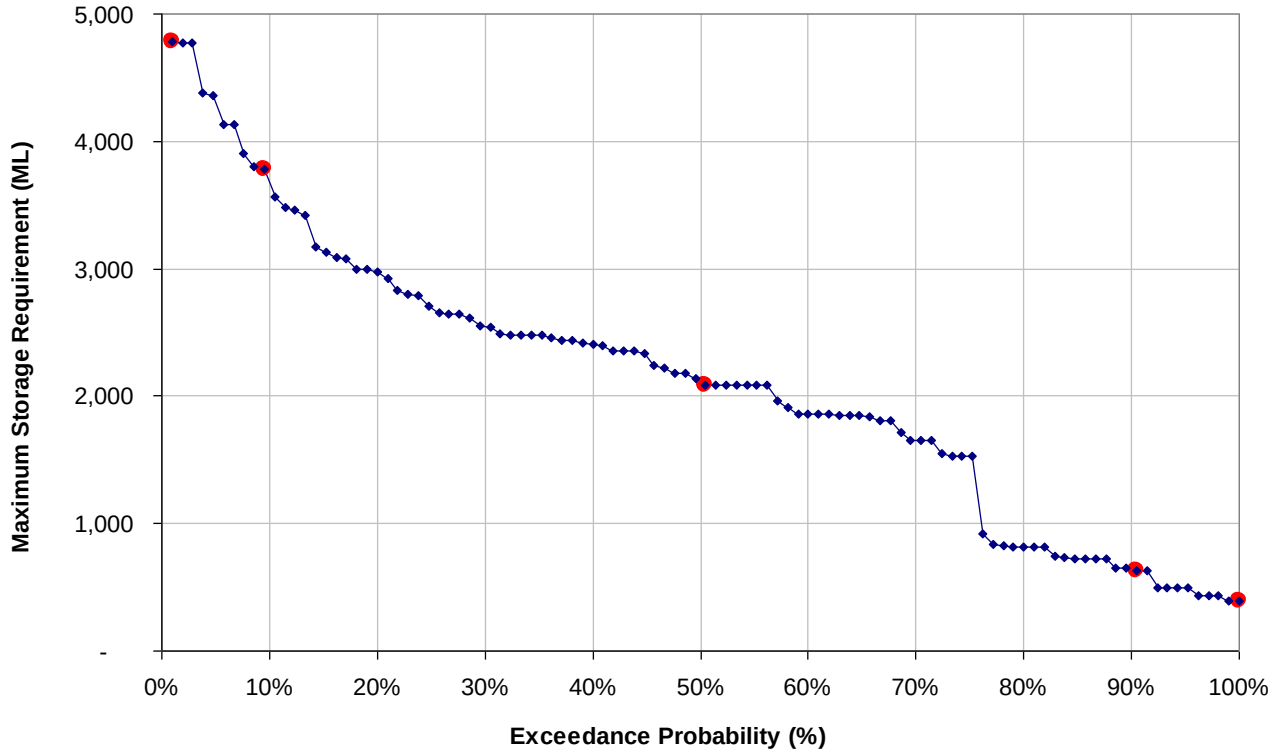

Figure A.11 Low Runoff Analysis - Millennium Void Combined Worked Water Storage - Exceedance Probability of Maximum Volume

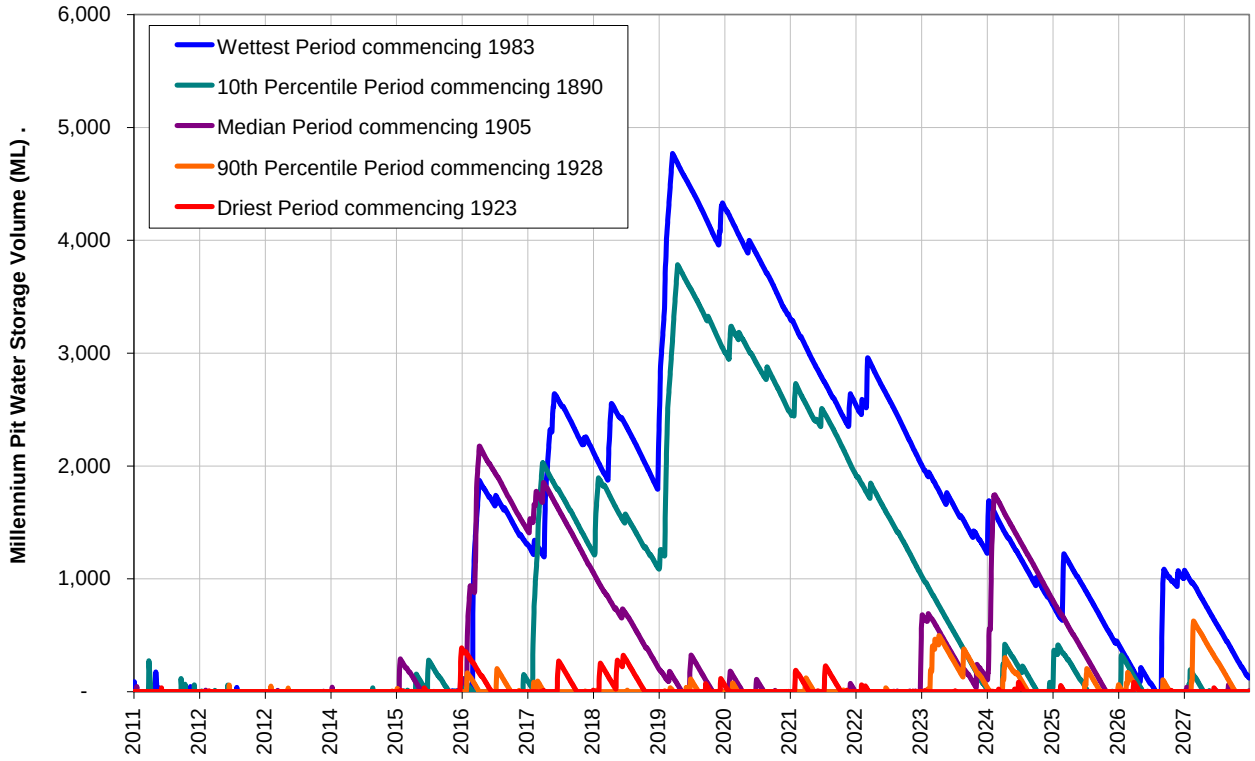

Figure A.12 Low Runoff Analysis - Millennium Void Combined Worked Water Storage – Simulated Behaviour

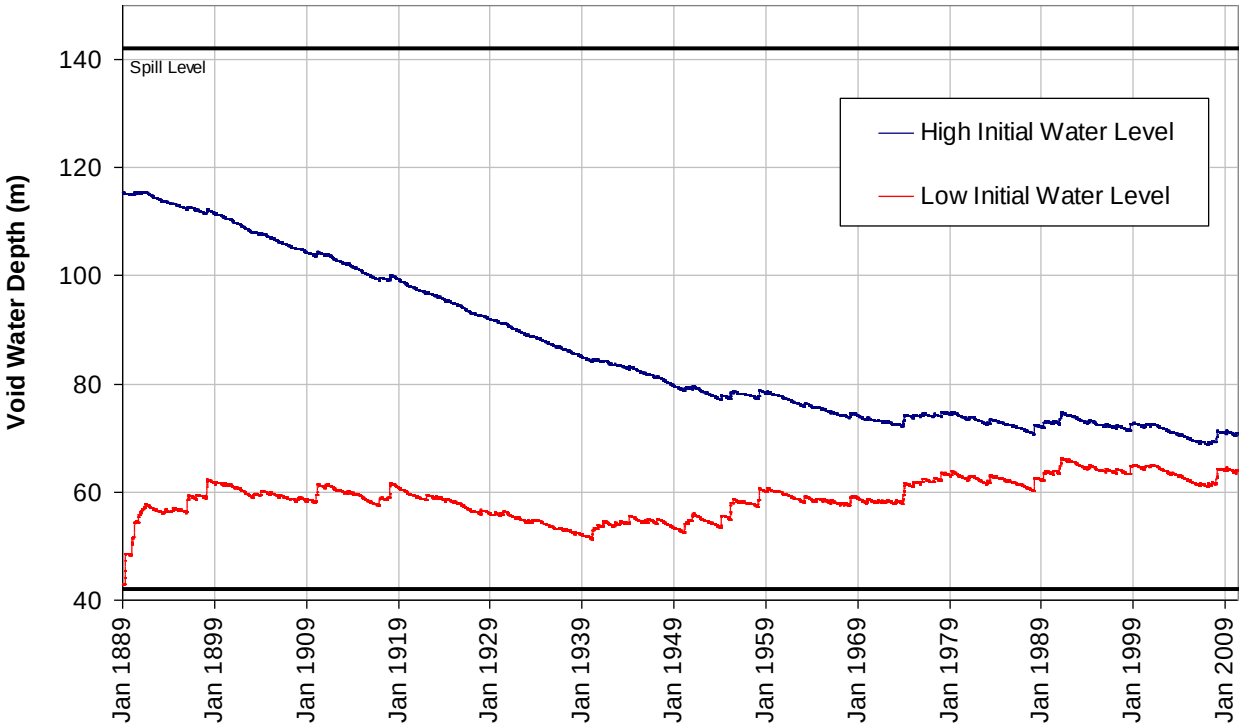

Figure A.13 Low Runoff Analysis – Mavis Pit Final Void Behaviour

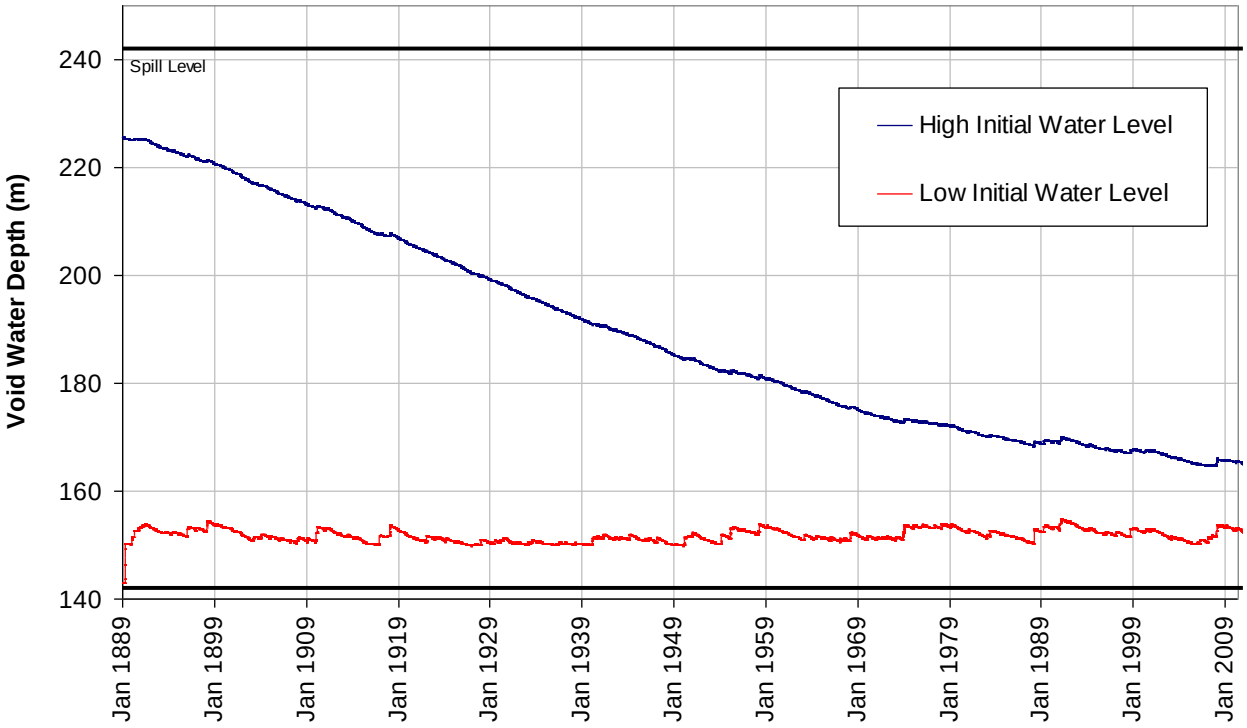

Figure A.14 Low Runoff Analysis – Millennium Pit Final Void Behaviour

B APPENDIX

HYDROLOGIC AND HYDRAULIC FLOOD MODEL DEVELOPMENT

FLOOD HYDROLOGY

The flood investigations detailed in the following sections have been prepared for the purpose of impact assessment. The results should not be used for any other purpose without seeking advice from WRM Water & Environment regarding its applicability.

B.1 METHODOLOGY – NEW CHUM CREEK HYDROLOGY

The RAFTS runoff-routing model (RAFTS, 2002) was used to estimate design flood discharges throughout the New Chum Creek catchment based on design rainfall intensity-frequency-duration data from ARR (1998). The model parameters were chosen to match the peak 100 year ARI discharges (estimated using the Rational Method) at the upstream and downstream extents of the mine workings.

Design flood discharge hydrographs were output for a range of ARIs up to the PMF, and a range of durations up to 9 hours (6 hours for the PMF).

Design rainfall intensities were derived in accordance with ARR (1998), and probable maximum precipitation (PMP) design rainfall depths were estimated using the Generalised Short-Duration Method (GSDM) for durations up to 6 hours (BoM, 2003a).

B.2 NEW CHUM CREEK RAFTS MODEL CONFIGURATION

Figure B.1 shows the configuration of the New Chum Creek RAFTS model. The model covers the New Chum Creek catchment to about 800 m south of the Millennium ML (a total catchment area of 31.9 km^2). The model consists of ten sub-catchments. Table B.1 shows the areas for each sub-catchment used in the model. The value of B_x adopted to match the Rational Method flows was 1.4. The adopted initial and continuing loss for the RAFTS model is 15 mm and 2.5mm/hr, respectively.

Table B.1 New Chum Creek RAFTS Model Sub-Catchment Areas

Sub-Catchment ID	Area (ha)	Catchment Slope (%)	Imperviousness (%)	PERN 'n'
Cat_01	514	3.5	0	0.055
Cat_02	540	2.5	0	0.055
Cat_03	310	0.5	0	0.055
Cat_04	278	0.5	0	0.055
Cat_05	140	0.5	0	0.055
Cat_06	189	0.5	0	0.055
Cat_07	473	0.5	0	0.055
Cat_08	363	0.5	0	0.055
Cat_09	184	0.5	0	0.055
Cat_10	203	0.5	0	0.055

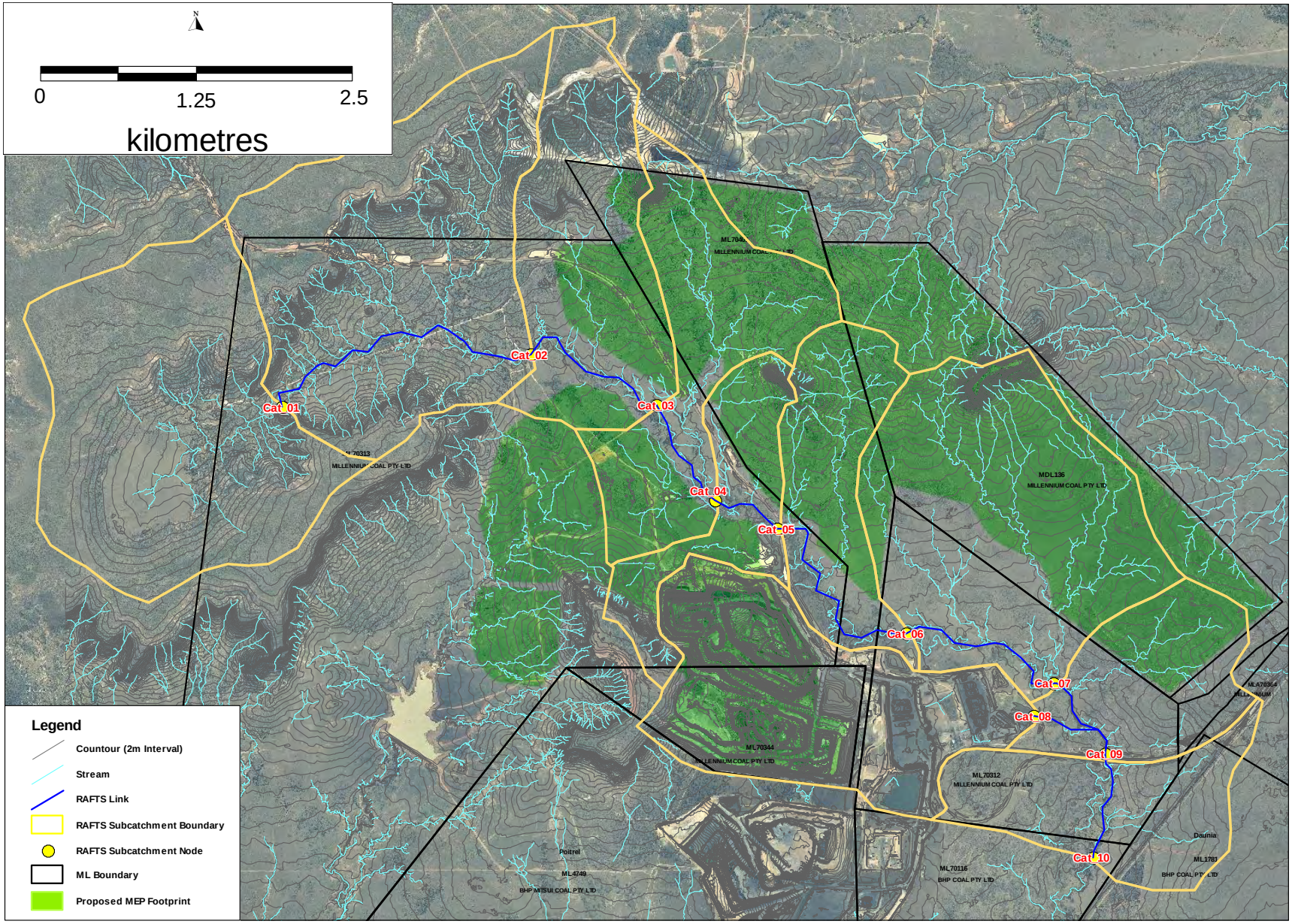

Figure B.1 New Chum Creek RAFTS Model Configuration

B.3 DESIGN PROBABLE MAXIMUM PRECIPITATION

PMP rainfall patterns and intensities for the area were determined using the procedures given in the GSDM (BoM, 2003). The GSDM (BOM, 2003) is suitable for application to small catchments (up to 1,000km²) for short durations (up to 6 hours).

Figure B.2 shows the rainfall spatial distribution based on the orientation of the ellipses over the New Chum Creek catchment. Table B.2 shows the estimated PMP rainfall depths for each ellipse for durations up to 6 hours.

Table B.2 PMP Average Rainfall Intensity between Ellipses, New Chum Creek

Ellipse	Area (km²)	PMP Rainfall Intensity (mm/hr)										
		0.25hr	0.5hr	0.75hr	1hr	1.5hr	2hr	2.5hr	3hr	4hr	5hr	6hr
A	2.6	854	618	521	454	345	289	246	216	177	153	135
B-A	12.7	756	561	470	406	306	262	220	192	160	137	122
C-B	14.9	624	496	404	377	288	239	210	178	149	132	115
D-C	1.7	699	188	442	396	301	253	148	187	113	102	120

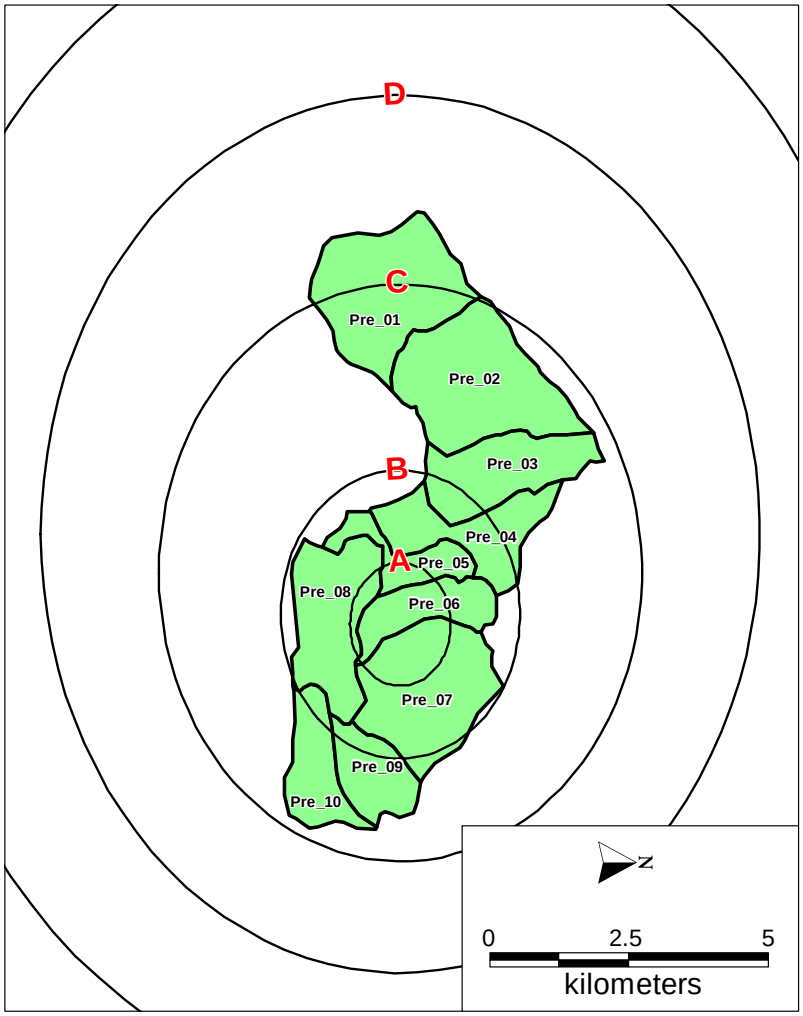

Figure B.2 GSDM Design Spatial Distribution of PMP, New Chum Creek Catchment

B.4 RATIONAL METHOD DESIGN DISCHARGES

Table B.3 shows the estimated Rational Method peak design discharges to the upstream and downstream boundaries of the MEP. The time of concentration is based on the modified Friend's equation (DNRW, 2008):

$$t_c = \frac{91 \times Length(km)}{Area(ha)^{0.1} \times \left(\frac{Slope(\%)}{100000}\right)^{0.2}}$$

Table B.3 New Chum Creek Rational Method 100 year ARI Discharge Calculations, Upstream and Downstream Boundaries of the MEP

Location	Catchment Area (km^2)	Channel Length (km)	Slope (%)	Time of Concentration, t_c (minutes)	100 yr ARI Rainfall Intensity (mm/hr)	50 yr ARI Runoff Coeff.	100 yr ARI Peak Discharge (m^3/s)
Upstream Boundary	10.5	6.5	0.56	210	37.3	0.6	69.4
Downstream Boundary	29.9	14.0	0.39	435	23.0	0.6	121.3

B.5 DESIGN DISCHARGES

Table B.4 shows the New Chum Creek peak 100 year ARI and PMP flood discharges calculated using the RAFTS model at each node within the MEP boundary. The New Chum Creek RAFTS model and Rational Method 100 year ARI discharges are in good agreement at the upstream and downstream boundaries. The RAFTS model discharges have been adopted for this study.

Note that the critical storm durations for the 100 year ARI and PMP flood events at the downstream boundary were 9 hours and 5 hours, respectively.

Table B.4 New Chum Creek RAFTS Model 100 year ARI and PMP Design Discharges

RAFTS Subcatchment ID	Design Discharge (m^3/s)	
	100 year ARI	Probable Maximum Precipitation
Cat_02 (US Bdy)	69	553
Cat_03	76	629
Cat_04	84	707
Cat_05	90	746
Cat_06	95	761
Cat_07	108	850
Cat_09 (DS Bdy)	126	964

FLOOD HYDRAULICS

B.6 AVAILABLE DATA

Topographic aerial survey data for the study area was provided by Met Serve Pty Ltd. The following is of note:

- The survey supplied by Met Serve Pty Ltd was performed in May/June 2008 and covers an area of some 90km^2. This survey was undertaken after the construction of the Millennium mine pit.
- Additional cross-section survey of New Chum Creek in the location of the HEC RAS model was supplied by Lambert and Rehbein Pty Ltd.
- The surveyed points were supplied as a digital elevation model (DEM) spaced at 5m intervals. The survey included 3D break lines on the top and bottom of banks along watercourses, dams, roads and ridgelines.

B.7 MODELLING OVERVIEW – NEW CHUM CREEK HYDRAULICS

The HEC-RAS model (USACE, 2009), was used to estimate the 100 year ARI and PMP design flood levels along New Chum Creek around the proposed mine lease area for pre- and post-mine conditions. The discharges estimated using the RAFTS runoff-routing model (see Section B.5) were adopted as inflows to the HEC-RAS model.

B.8 HEC RAS MODEL CONFIGURATION – NEW CHUM CREEK EXISTING CONDITIONS

B.8.1 Model Configuration

Figure B.3 shows the locations of the HEC RAS cross-sections and hydraulic structures for existing conditions. The 10km modelled reach comprises 22 cross sections.

B.8.2 Adopted Manning's 'n' Values

The HEC-RAS model uses Manning's 'n' value to represent hydraulic resistance (notionally channel or floodplain roughness). In the absence of suitable calibration data for the hydraulic model, Manning's 'n' values were selected based on typical published values (for example, those of Chow, 1959). The adopted Manning's n values were:

- Overbank Areas: 'n' = 0.10
- Creek Channel: 'n' = 0.05

The adopted overbank n value is somewhat higher than would be indicated by typical vegetation on the floodplain. This slightly higher value was adopted because flow across the floodplain is expected to be relatively shallow, resulting in a higher hydraulic resistance.

B.8.3 Tailwater Conditions

The downstream boundary condition is normal depth with a flood slope of 0.0025, which is typical of the bed slope at this location. The model results in the area of interest are insensitive to the downstream boundary condition; changing the flood slope at the boundary by 0.001 changed flood levels upstream of the railway culverts by less than 0.01 m.

B.9 HEC RAS MODEL CONFIGURATION – NEW CHUM CREEK OPERATIONAL CONDITIONS

The haul road crossings of New Chum creek were designed as low flood immunity level crossings. The deck surface is assumed parabolic in shape across the floodplain and a minimum of 1 m cover was provided over the obvert of the culverts. Erosion protection will be required on the downstream side of the road embankment and culvert outlets. The culverts will be mitred to match the profile road embankment on both the upstream and downstream side of the haul road.

The northern haul road crossing (chainage 6780 m) was configured as follows:

- 2 x 1.8 m diameter corrugated pipes
- Pipe length = 40 m
- Upstream Invert = 241.2 m AHD
- Downstream Invert = 241.0 m AHD
- Minimum deck level = 244.0 m AHD

The southern haul road crossing (chainage 3896 m) was configured as follows:

- 2 x 1.8 m diameter corrugated pipes
- Pipe length = 40 m
- Upstream Invert = 232.0 m AHD
- Downstream Invert = 231.8 m AHD
- Minimum deck level = 234.8 m AHD

B.10 HEC RAS MODEL RESULTS

Figure B.3 shows the existing 100 year ARI and PMP flood levels along New Chum Creek. The results are tabulated in the tables in the following sections.

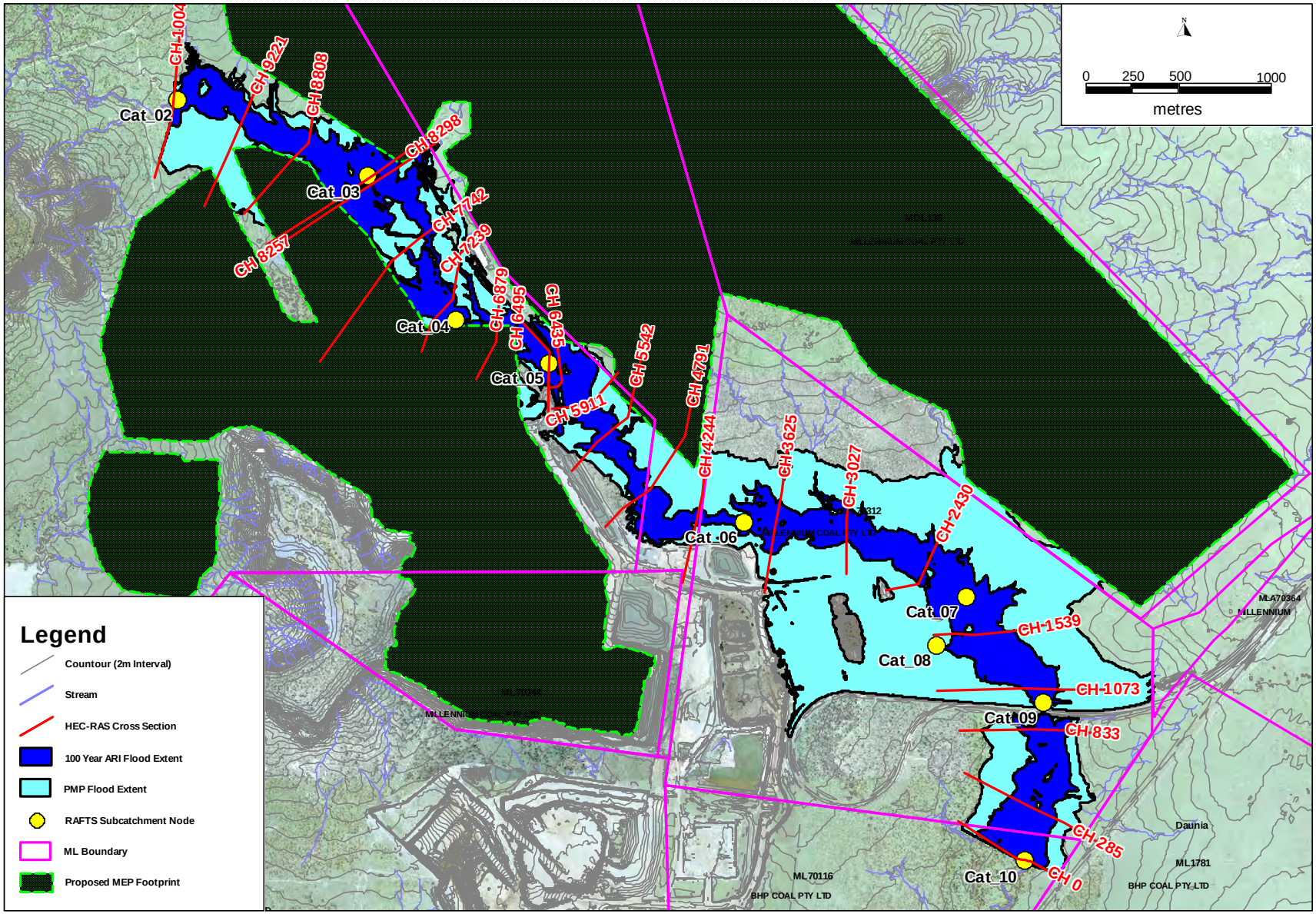

Figure B.3 New Chum Creek Survey and HEC-RAS Model Extent

B.10.1 New Chum Creek Water Levels

River Station	10y ARI Flood Level (m AHD)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	259.5	259.5	259.5	0.0
9220.9	256.0	256.0	256.0	0.0
8808.0	254.3	254.3	254.3	0.0
8298.0	251.6	251.6	251.6	0.0
8276.0	Access Track			
8257.3	251.5	251.5	251.6	0.1
7742.0	248.6	248.6	248.9	0.3
7238.7	245.6	245.6	245.6	0.0
6878.9	244.2	244.2	244.5	0.2
6806.0	243.9	243.9	244.4	0.5
6780.0	Proposed North Haul Road			
6753.0	243.7	243.7	243.7	0.0
6495.4	243.5	243.5	243.5	0.0
6455.0	Existing Road			
6434.7	242.4	242.4	242.4	0.0
5911.1	240.7	240.7	240.7	0.0
5542.4	239.3	239.3	239.3	0.0
4791.1	237.2	237.2	237.2	0.0
4244.4	235.5	235.5	235.7	0.1
3923.0	234.6	234.6	235.2	0.6
3896.0	Proposed South Haul Road			
3866.0	234.5	234.5	234.4	-0.1
3624.8	233.7	233.7	233.7	0.0
3026.9	231.5	231.5	231.5	0.0
2430.5	229.4	229.4	229.4	0.0
1539.5	226.6	226.6	226.6	0.0
1073.7	225.2	224.6	224.6	0.0
1000.0	#N/A	224.7	224.7	0.0
965.0	Railway			
930.0	#N/A	224.4	224.4	0.0
832.2	224.2	224.2	224.2	0.0
285.2	222.4	222.4	222.4	0.0
0.0	221.1	221.1	221.1	0.0

River Station	100y ARI Flood Level (m AHD)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	259.8	259.8	259.8	0.0
9220.9	256.3	256.3	256.3	0.0
8808.0	254.5	254.5	254.5	0.0
8298.0	251.8	251.8	251.8	0.0
8276.0	Access Track			
8257.3	251.6	251.6	251.8	0.1
7742.0	248.8	248.8	249.3	0.5
7238.7	246.0	246.0	246.0	0.0
6878.9	244.6	244.6	244.7	0.1
6806.0	244.2	244.2	244.6	0.4
6780.0	Proposed North Haul Road			
6753.0	244.0	244.0	244.0	0.0
6495.4	243.6	243.6	243.6	0.0
6455.0	Existing Road			
6434.7	242.7	242.7	242.7	0.0
5911.1	241.0	241.0	241.0	0.0
5542.4	239.7	239.7	239.7	0.0
4791.1	237.8	237.8	237.8	0.0
4244.4	236.0	236.0	236.1	0.1
3923.0	234.9	234.9	235.4	0.5
3896.0	Proposed South Haul Road			
3866.0	234.7	234.7	235.1	0.4
3624.8	234.1	234.1	234.1	0.0
3026.9	231.8	231.8	231.8	0.0
2430.5	229.8	229.8	229.8	0.0
1539.5	227.2	227.2	227.2	0.0
1073.7	225.7	225.7	225.7	0.0
1000.0	#N/A	225.5	225.5	0.0
965.0	Railway			
930.0	#N/A	224.7	224.7	0.0
832.2	224.5	224.5	224.5	0.0
285.2	222.6	222.6	222.6	0.0
0.0	221.4	221.4	221.4	0.0

River Station	1000y ARI Flood Level (m AHD)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	260.2	260.2	260.2	0.0
9220.9	256.8	256.8	256.8	0.0
8808.0	254.8	254.8	254.9	0.0
8298.0	252.0	252.0	252.1	0.1
8276.0	Access Track			
8257.3	251.8	251.8	252.1	0.2
7742.0	249.1	249.1	249.6	0.5
7238.7	246.6	246.6	246.6	0.0
6878.9	245.0	245.0	245.1	0.1
6806.0	244.7	244.7	244.9	0.2
6780.0	Proposed North Haul Road			
6753.0	244.5	244.5	244.5	0.0
6495.4	243.7	243.7	243.7	0.0
6455.0	Existing Road			
6434.7	243.1	243.1	243.4	0.3
5911.1	241.3	241.3	241.3	0.0
5542.4	240.3	240.3	240.3	0.0
4791.1	238.6	238.6	238.5	0.0
4244.4	236.6	236.6	236.7	0.1
3923.0	235.2	235.2	235.4	0.2
3896.0	Proposed South Haul Road			
3866.0	235.1	235.1	235.3	0.2
3624.8	234.4	234.4	234.4	0.0
3026.9	232.3	232.3	232.3	0.0
2430.5	230.3	230.3	230.3	0.0
1539.5	227.8	227.9	227.9	0.0
1073.7	226.1	227.5	227.5	0.0
1000.0	#N/A	227.1	227.1	0.0
965.0	Railway			
930.0	#N/A	224.9	224.9	0.0
832.2	225.0	225.0	225.0	0.0
285.2	223.0	223.0	223.0	0.0
0.0	221.8	221.8	221.8	0.0

River Station	PMF Flood Level (m AHD)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	261.3	261.3	261.3	0.0
9220.9	258.1	258.1	258.5	0.4
8808.0	255.9	255.9	256.2	0.4
8298.0	252.7	252.7	253.3	0.6
8276.0	Access Track			
8257.3	252.6	252.6	253.3	0.7
7742.0	249.6	249.6	250.7	1.1
7238.7	247.9	247.9	248.1	0.2
6878.9	246.6	246.6	246.5	-0.1
6806.0	246.3	246.3	246.1	-0.3
6780.0	Proposed North Haul Road			
6753.0	246.0	246.0	246.0	0.0
6495.4	244.6	244.6	244.6	0.0
6455.0	Existing Road			
6434.7	244.3	244.3	244.4	0.1
5911.1	242.8	242.8	242.8	0.0
5542.4	241.8	241.8	241.8	0.0
4791.1	239.8	239.8	240.1	0.3
4244.4	237.9	237.9	238.0	0.0
3923.0	236.3	236.3	236.2	-0.1
3896.0	Proposed South Haul Road			
3866.0	236.2	236.2	236.3	0.1
3624.8	235.5	235.5	235.5	0.0
3026.9	233.7	234.3	234.3	0.0
2430.5	231.6	234.1	234.1	0.0
1539.5	229.1	234.0	234.0	0.0
1073.7	227.6	234.0	234.0	0.0
1000.0	#N/A	234.0	234.0	0.0
965.0	Railway			
930.0	#N/A	231.3	231.3	0.0
832.2	226.4	226.4	226.4	0.0
285.2	224.2	224.2	224.2	0.0
0.0	223.2	223.2	223.2	0.0

B.10.2 HEC RAS model Results – New Chum Creek Velocity

River Station	10 year ARI Velocity (m/s)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	1.4	1.4	1.4	0.0
9220.9	1.1	1.1	1.0	0.0
8808.0	0.7	0.7	0.7	0.1
8298.0	0.6	0.6	1.1	0.5
8276.0	Access Track			
8257.3	0.3	0.3	0.4	0.0
7742.0	0.3	0.3	0.5	0.2
7238.7	1.5	1.5	1.5	0.0
6878.9	1.7	1.7	1.3	-0.4
6806.0	1.6	1.6	0.8	-0.8
6780.0	Proposed North Haul Road			
6753.0	1.4	1.4	2.9	1.6
6495.4	0.9	0.9	0.9	0.0
6455.0	Existing Road			
6434.7	1.6	1.6	1.6	0.0
5911.1	1.4	1.4	1.4	0.0
5542.4	0.7	0.7	0.7	0.0
4791.1	1.5	1.5	1.5	0.0
4244.4	1.4	1.4	1.3	-0.2
3923.0	1.1	1.1	1.1	0.0
3896.0	Proposed South Haul Road			
3866.0	1.2	1.2	3.9	2.7
3624.8	1.5	1.5	1.5	0.0
3026.9	1.3	1.3	1.3	0.0
2430.5	1.3	1.3	1.3	0.0
1539.5	1.4	1.4	1.4	0.0
1073.7	1.7	3.3	3.3	0.0
1000.0	#N/A	1.4	1.4	0.0
965.0	Railway			
930.0	#N/A	1.5	1.5	0.0
832.2	1.5	1.5	1.5	0.0
285.2	1.0	1.0	1.0	0.0
0.0	1.0	1.0	1.0	0.0

River Station	100y ARI Velocity (m/s)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	1.7	1.7	1.7	0.0
9220.9	1.3	1.3	1.3	0.0
8808.0	0.8	0.8	0.9	0.1
8298.0	0.6	0.6	0.9	0.4
8276.0	Access Track			
8257.3	0.4	0.4	0.5	0.1
7742.0	0.4	0.4	0.6	0.2
7238.7	1.8	1.8	1.8	0.0
6878.9	2.2	2.2	1.9	-0.3
6806.0	1.9	1.9	1.2	-0.6
6780.0	Proposed North Haul Road			
6753.0	1.7	1.7	1.7	0.1
6495.4	1.4	1.4	1.4	0.0
6455.0	Existing Road			
6434.7	2.4	2.4	2.4	0.0
5911.1	2.0	2.0	2.0	0.0
5542.4	0.9	0.9	0.9	0.0
4791.1	1.7	1.7	1.7	0.0
4244.4	1.8	1.8	1.6	-0.1
3923.0	1.5	1.5	1.6	0.1
3896.0	Proposed South Haul Road			
3866.0	1.4	1.4	2.2	0.8
3624.8	1.5	1.5	1.5	0.0
3026.9	1.5	1.5	1.5	0.0
2430.5	1.6	1.6	1.6	0.0
1539.5	1.8	1.8	1.8	0.0
1073.7	2.2	2.0	2.0	0.0
1000.0	#N/A	2.0	2.0	0.0
965.0	Railway			
930.0	#N/A	2.5	2.5	0.0
832.2	1.8	1.8	1.8	0.0
285.2	1.3	1.3	1.3	0.0
0.0	1.1	1.1	1.1	0.0

River Station	1000y ARI Velocity (m/s)			
	Exist no Rail	Exist	Proposed	Impact
10047.2	2.0	2.0	2.0	0.0
9220.9	1.6	1.6	1.6	0.0
8808.0	1.0	1.0	1.2	0.1
8298.0	0.6	0.6	0.8	0.3
8276.0	Access Track			
8257.3	0.5	0.5	0.6	0.1
7742.0	0.5	0.5	0.8	0.3
7238.7	2.1	2.1	2.1	0.0
6878.9	2.7	2.7	2.5	-0.2
6806.0	2.2	2.2	1.9	-0.3
6780.0	Proposed North Haul Road			
6753.0	2.1	2.1	2.1	0.1
6495.4	2.6	2.6	2.5	-0.1
6455.0	Existing Road			
6434.7	3.9	3.9	2.8	-1.0
5911.1	2.6	2.6	2.6	0.0
5542.4	1.1	1.1	1.1	0.0
4791.1	2.2	2.2	2.3	0.1
4244.4	2.2	2.2	2.1	-0.1
3923.0	2.1	2.1	2.9	0.8
3896.0	Proposed South Haul Road			
3866.0	1.6	1.6	2.6	0.9
3624.8	1.8	1.8	1.8	0.0
3026.9	1.8	1.8	1.8	0.0
2430.5	1.9	1.9	1.9	0.0
1539.5	2.0	1.8	1.8	0.0
1073.7	2.9	1.0	1.0	0.0
1000.0	#N/A	2.6	2.6	0.0
965.0	Railway			
930.0	#N/A	4.6	4.6	0.0
832.2	2.0	2.0	2.0	0.0
285.2	1.8	1.8	1.8	0.0
0.0	1.3	1.3	1.3	0.0

C APPENDIX

GEOMPORPHOLOGICAL DESCRIPTION OF STREAMS

Millennium Mine Creek Photos

Location No	AGD 84 Coordinates		Location Description	Field Notes	
	S	E			
L1	631,879	7,562,552	New Chum Creek u/s of railway crossing	- Channel is 4-5 m wide and 1.5-2.0 m high - Unshaded waterhole within creek channel - Channel has steep sides (nearly vertical) - bank erosion is evident - banks are grassed with some trees	
L2			West Creek ~50 d/s of dam	- Channel is 4-5 m wide and 2-3 m high - Fine silty/clay soil creek bed - flat side slopes About 1(V):4(H) - banks are grassed with some trees	
L3			WC u/s of dam - backwater affected reach	- Channel is 4-5 m wide and 2 m high - Steep banks - Submerged by West Dam - Some trees are located on the bank and within overbank areas	
L4	627,100	7,564,242	WC u/s of dam - & d/s of road	- Channel is 2-3 m wide and 1 m high - Dry creek bed consisting of fine gravel - Some small trees located along the bank - Course bed material is located downstream of this location	
L5	628,115	7,565,288	NCC u/s of proposed road crossing	- Channel is 4-5 m wide and up to 1 m high - sandy creek bed - flat side slopes About 1(V):4(H) - banks are grassed with some trees - floodplain is grassed with a scatter of trees - floodplain is flat	

L6	627,152	7,565,661	NCC at u/s road crossing	- Channel is variable - looking upstream: defined channel about 4 m wide and 2-4 m high. Gradual, grassed side slopes and trees within creek banks - looking downstream: divided channel around trees. Sandy gravel bed and eroded bend with steep slopes. Channel height at bend is 2-4 m high. - immediately downstream: some shaded and unshaded waterholes and bends. Sandy/gravely creek bed. erosion evident at the bends. Stable straight section.	
L7	627,461	7,566,643	Culverts on NCC tributary across access rd	- 4 x 1050 mm diameter culverts through access road. - Grassed channel. Bed of channel not visible	
L8			NCC at Main Rd crossing	- Channel is 4-5 m wide and 3-4 m high - Side slopes about 1:1 to 1(V):2(H) - Waterholes present - Creek bed is littered with tree branches and root debris - Some trees located along the bank -evidence of bed and some bank erosion - grassed banks with trees - disturbed by road crossing. There is evidence of erosion an the channels is generally degraded.	
L9	630,027	7,563,477	NCC at lease boundary to the north of the office	- Channel is 4-5 m wide and 3-4 m high - Steep side slopes - Sandy Creek bed. Littered with tree branches, roots and woody debris. A number of trees/obstructions within the channel - Some trees located along the bank -evidence of bed and some bank erosion - grassed banks and overbanks with medium density of trees - evidence of bed erosion.	

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F4:

GROUNDWATER

Peabody

Groundwater Impact Assessment

for

Millennium Expansion Project EIS

May 2010

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TABLE OF CONTENTS

GLOSSARY OF TERMS I
EXECUTIVE SUMMARY 1
1 INTRODUCTION 2
1.1 PROJECT OVERVIEW 2
2 SCOPE OF WORK 4
2.1 PROJECT TERMS OF REFERENCE 4
2.2 STUDY COMPONENTS 4
3 QUEENSLAND LEGISLATION RELEVANT TO GROUNDWATER 5
4 EXISTING ENVIRONMENT 6
4.1 TOPOGRAPHY AND DRAINAGE 6
4.2 LAND USE 6
4.3 CLIMATE 6
4.4 GEOLOGY 6
4.5 GROUNDWATER OCCURRENCE 9
4.5.1 Quaternary Alluvial Aquifer 9
4.5.2 Permian Rangal Coal Measures Aquifer 9
4.6 GROUNDWATER USE 10
4.6.1 Impacts of Current Pumping 10
4.7 EXISTING GROUNDWATER MONITORING 13
4.8 GROUNDWATER QUALITY AND ENVIRONMENTAL VALUE 13
4.8.1 Permian Rangal Coal Measures Aquifer 16
4.8.2 Quaternary Alluvial Aquifer 16
5 IMPACT OF OPEN CUT AND UNDERGROUND MINING ON GROUNDWATER 18
5.1 OPEN CUT PITS 18
5.2 UNDERGROUND PITS 18
5.3 POTENTIAL IMPACTS 18
6 NUMERICAL GROUNDWATER MODELLING 19
6.1 MODELLING OBJECTIVES 19
6.2 CONCEPTUAL MODEL 19
6.3 MODEL DEVELOPMENT 22
6.3.1 Model Code Selection 22
6.3.2 Model Geometry 22
6.3.3 Boundary Conditions 24
6.3.3.1 General Head Boundaries 24
6.3.3.2 No Flow Boundaries 24
6.3.3.3 Recharge and Discharge 24
6.3.3.4 Surface Groundwater Interaction 25

6.3.4 Aquifer Parameters 29
6.3.4.1 Hydraulic Conductivity 29
6.3.4.2 Storativity and Specific Yield 29
6.3.4.3 Vertical Leakance 30
6.3.5 Modelled Timeframe 32
6.4 STEADY STATE CALIBRATION 32
6.4.1 Calibration Targets 32
6.4.2 Calibration Results 32
7 MODEL PREDICTIONS 34
7.1 MODELLING SCENARIO 34
7.2 PIT INFLOW RATES 34
7.3 GROUNDWATER LEVELS 36
7.4 GROUNDWATER RECOVERY 36
7.5 SENSITIVITY ANALYSIS 43
8 POTENTIAL GROUNDWATER IMPACTS 44
8.1 IMPACTS ON GROUNDWATER LEVELS 44
8.1.1 Impacts on Surrounding Groundwater Users 44
8.2 IMPACTS ON GROUNDWATER QUALITY 45
8.2.1 Impact on Environmental Values 45
8.3 POST MINING IMPACTS 45
9 PROPOSED GROUNDWATER MONITORING AND MITIGATION 47
10 REFERENCES 50

APPENDIX

Appendix A Mass Balance ..... A

FIGURES

Figure 1-1 Regional project location 3
Figure 4-1 Surface geology 8
Figure 4-2 Surrounding groundwater user and monitoring bore locations 12
Figure 6-1 Conceptual model 21
Figure 6-2 Model geometry 23
Figure 6-3 Boundary conditions and general head boundaries 26
Figure 6-4 Recharge zones 27
Figure 6-5 River cells (Isaac River) 28
Figure 6-6 Horizontal hydraulic conductivity and vertical leakance zones 31
Figure 6-7 Scattergram – calibrated versus observed groundwater levels 33
Figure 7-1 Simulated Millennium Mine and the MEP pit inflows 35

Figure 7-2 Groundwater drawdown Year 5 (2013) – Rangal Coal Measures 37
Figure 7-3 Groundwater drawdown Year 10 (2018) – Rangal Coal Measures 38
Figure 7-4 Groundwater drawdown Year 15 (2023) – Rangal Coal Measures 39
Figure 7-5 Groundwater drawdown Year 19 (2027) – Rangal Coal Measures 40
Figure 7-6 Hydrograph of predicted groundwater drawdown in surrounding bores 41
Figure 7-7 Groundwater level recovery post-mining activities 42
Figure 9-1 Proposed groundwater monitoring bore locations 49

TABLES

Table 4-1 Summary of stratigraphic sequence 7
Table 4-2 Surrounding registered, landholder and monitoring bore details 11
Table 4-3 Groundwater levels within surrounding Permian registered, landholder and monitoring bores 13
Table 4-4 Rangal Coal Measures aquifer electrical conductivity and pH on site 14
Table 4-5 Rangal Coal Measures aquifer groundwater quality compared with adopted guidelines . 15
Table 4-6 Environment values of the Rangal Coal Measures aquifer resource 16
Table 6-1 Model aquifer parameters 30
Table 6-2 Calibration targets and simulated standing water levels 33
Table 7-1 Mining timeline 34
Table 7-2 Groundwater inflow rates into MEP pits 35
Table 7-3 Sensitivity analysis compared to modelled values 43
Table 8-1 Predicted groundwater drawdown in the Rangal Coal Measures 44
Table 9-1 Proposed groundwater monitoring program 48

GLOSSARY OF TERMS

mAHD	Metres above Australian Height Datum (approximately Mean Sea Level).
Aquifer	A water bearing rock or sediment in a formation, group of formations, or part of a formation that is capable of yielding sufficient water to satisfy a particular demand.
Aquitard	A layer that is much less permeable than the aquifers themselves, but not impermeable.
BOM	Australian Bureau of Meteorology.
Bore	A bore is a hole drilled into the ground to enable the extraction of groundwater from an aquifer. The term 'well' is commonly used in the oil and gas industry and also in the water industry in some other countries to define the same type of facility. In Australia, the term 'well' normally applies to a large diameter bore. For the purposes of this report, the terms 'well' and 'bore' are synonymous.
Cone of depression	A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a bore, or any facility, from which groundwater is being withdrawn. The cone of depression defines the area of influence of a bore.
Drawdown	The distance that the water level in a bore is lowered from the standing water level when influenced by pumping.
DERM	Queensland Department of Environment and Resource Management.
Ephemeral	Lasting a very short time, i.e. hours to days.
Flow boundary	Any geologic, geomorphic or hydrologic feature which impedes the normal groundwater flow regime. An impermeable rock mass, such as bedrock, a feature which hinders flow across it, such as a fault, or drawdowns resulting from other pumping bores constitute impermeable boundaries and result in an increase in the rate of drawdown. A surface body of water, such as a lake or stream, which intersects the aquifer constitutes a recharge boundary and results in a reduction in the rate of drawdown.
Groundwater	The water contained within the joints, vesicles, fractures or interconnected pores of an aquifer.
Groundwater flow	The movement of water through openings in sediment and rock; occurs in the zone of saturation.
Groundwater head	Refer 'hydraulic head'.
Hydraulic head	The specified measurement of water pressure above a particular datum level, i.e. mAHD.
Hydraulic Conductivity	Hydraulic Conductivity (*K*) is an aquifer parameter. It is the rate at which water can be transmitted through a unit area of an aquifer, normal to the direction of flow, under a unit gradient. Units are length/time, e.g. m/day.
Kilolitre (kL)	1,000 litres.
L/s	Litres per second.
L/d	Litres per day.
Megalitre (ML)	1,000,000 litres.
m/day	Metres per day.
mAHD	Australian Height Datum (metres).

mbgl	Metres below groundwater level.
mtpa	Million tonnes per annum.
MODFLOW	Industry standard numerical groundwater modelling computer software. The numerical model allows groundwater flows within the aquifer to be predicted and described by numerical equations, with specified values for boundary conditions that are solved on a personal computer.
Monitoring bore	A non-pumping bore used to monitor water properties such as water levels or water quality. A monitoring bore is generally of small diameter and is typically screened or slotted throughout the thickness of the aquifer.
Piezometer	A small diameter observation well used to measure the hydraulic head of groundwater in aquifers.
Potentiometric level	An imaginary surface that represents the level to which water could rise in a bore. The water table is a particular potentiometric surface for an unconfined aquifer.
Recovery	A rise of the water level in a bore or an aquifer after the pumping rate has been reduced or the pump has been shut off or when mining has ceased.
Registered bores	Groundwater bores that have their details included within the DERM database. Some of these bores may also be attached to water licences.
Sandstone (SS)	Lithified accumulation of sand-sized grains (0.063 to 2 mm in diameter).
Screen	A tubular device with slots, holes, gauze, or continuous-wire wrap; used at the end of a bore casing to allow entry of water while withholding aquifer material.
Shale (SHL)	Group of fine-grained, laminated sedimentary rocks consisting of silt- and clay-sized particles.
Siltstone (SLT)	Hardened sedimentary rock that is composed primarily of angular silt-sized particles (0.0039 to 0.063 mm in diameter).
Specific Yield	Specific Yield (*Sy*) is the volume of water that will drain under gravity from a unit volume of aquifer; commonly referred to as the Storage Coefficient of an unconfined aquifer.
Standing water level	The depth from ground level (or other stated reference point) to the water level in a bore which is not influenced by pumping.
Storage Coefficient	Storage Coefficient (*S*) is an aquifer parameter. It is the volume of water that a saturated aquifer releases from or takes into storage per unit surface area per unit change of head. It is related to the elastic properties of the water and the soil matrix.
Subartesian	Groundwater rising naturally in a well above that of the surrounding water table but not flowing out of the well.
Throughflow	The movement of groundwater horizontally beneath the land surface.

EXECUTIVE SUMMARY

Peabody Energy Australia Pty Limited is planning to expand the operation of its existing open cut Millennium Coal Mine, in the Bowen Basin, Central Queensland.

Currently, 1.9 million tonnes of coal is produced at the Millennium Mine per annum. The Millennium Mine Expansion Project (MEP) involves the expansion of the current Millennium Mine, as well as the creation of a new open cut pit (Mavis pit), located immediately northeast of the current mining operation. Production is set to increase to 5 million tonnes per annum over a 18 year mine life (2006 – 2027) once relevant approvals are received.

The Bowen Basin is made up of a number of coal bearing sandstone and siltstone units that carry varied amounts of water through the various compartmentalised aquifer systems within. During exploration drilling at Millennium, groundwater has been encountered within the Rangal Coal Measures in the various target coal seams and associated interburden. It is expected that minor quantities of water will enter the open cut pits as the mine progresses. It is possible that dewatering of the pits to allow for dry mining will have regional impacts on groundwater users. These impacts may include the drawdown of groundwater in the Rangal Coal Measures aquifer and the reduction of landholder bore yields.

In order to better understand the potential impacts of the proposed mine on the groundwater regime, a groundwater flow model for the aquifers in the area of the MEP and surrounding mines was constructed. The main objectives of the groundwater model were to understand the hydrogeological environment; estimate the groundwater drawdowns in the Rangal Coal Measures aquifer and design groundwater monitoring programs.

Key Findings

- the maximum drawdown of groundwater levels within the Rangal Coal Measures aquifer in the project area is expected to be in the order of 175 m;
- landholder bores screened in affected aquifers which are located within the predicted radius of influence of 9 km from the MEP pits may experience a level of reduced groundwater heads;
- it is anticipated that two registered and three unregistered bores, which are installed within the Rangal Coal Measures, may be impacted by MEP and surrounding mine dewatering;
- the dewatering of the Rangal Coal Measures aquifer will have a negligible impact on other aquifers in the area, due to hydraulic disconnection of the aquifers;
- groundwater inflow rates to the Mavis and Millennium pits are likely to be of the order of 1.16 L/s on average; and
- groundwater quality data suggests that groundwater in the Rangal Coal Measures aquifer is brackish to saline, its use is limited stock watering. There is no potential for groundwater quality to be degraded further due to the MEP; the available information indicates the assigned environmental values will be maintained.

Recommendations/Mitigation Measures

Groundwater monitoring should be undertaken during, and post, extraction. The aim of the monitoring would be to assess the impact mine dewatering has on the surrounding groundwater environment, both in radial extent and in the magnitude of the drawdown. Monitoring would provide early warning of any variation of the groundwater system from that predicted. This would enable the undertaking of mitigation measures to minimise impact on surrounding groundwater users.

Should groundwater users be assessed as being unduly impacted, proposed mitigation measures including the allocation of alternative water supplies.

1 INTRODUCTION

The Millennium Mine is an existing open cut coal operation located in Central Queensland, approximately 22 km east of the township of Moranbah and 150 km southwest of Mackay (refer to **Figure 1-1**). The mine is a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (Peabody). The mine has been in operation since May 2006 at an average rate of 1.5 million tonnes per annum (mtpa). Peabody is proposing to increase the rate up to 5 mtpa run of mine (ROM) and extend the area of mining, via the Millennium Expansion Project (MEP).

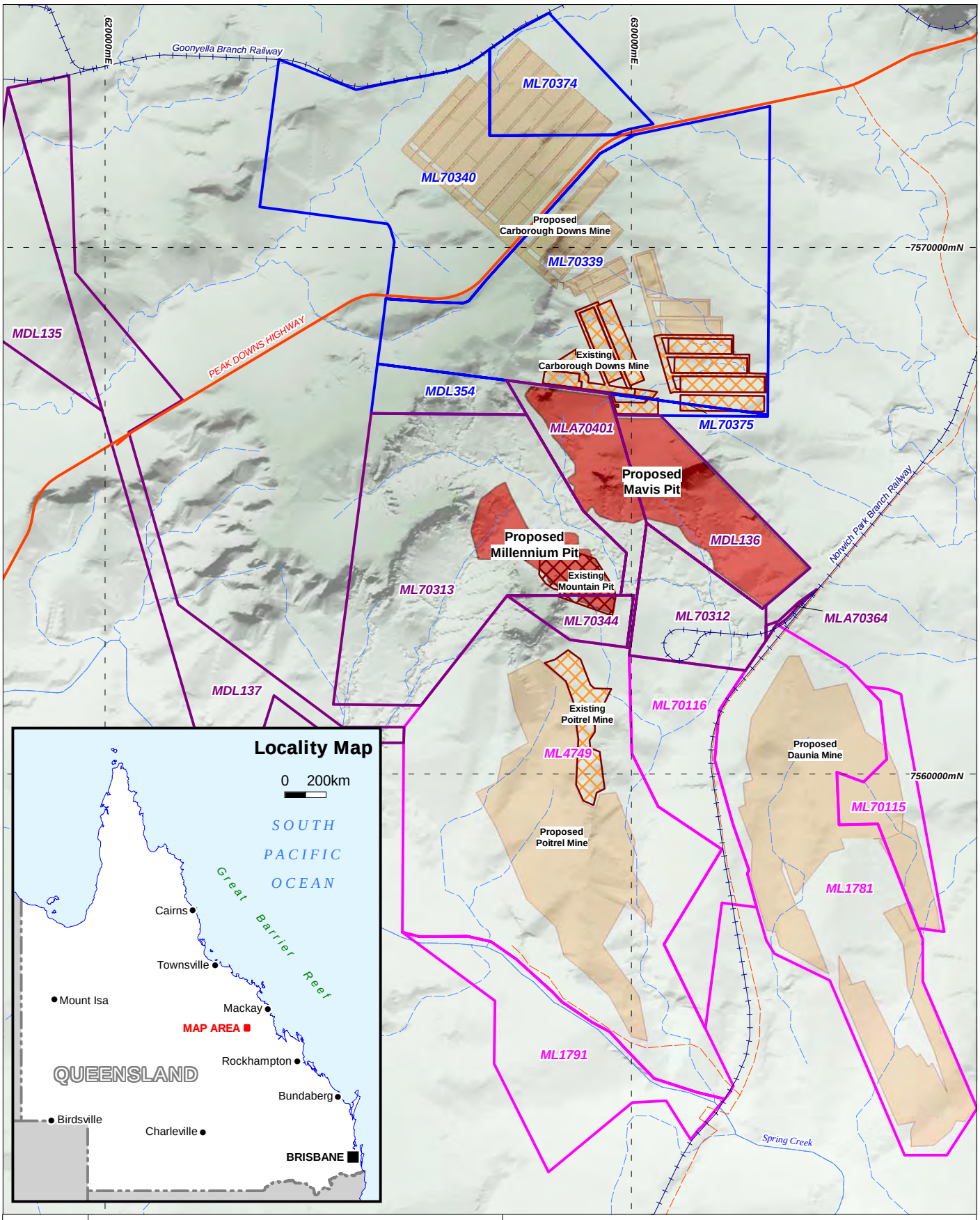
The proposed increase in mining footprint and coal production rates has triggered the requirement for an Environmental Impact Statement (EIS). This report provides an assessment of groundwater impacts associated with the proposed expansion of the Millennium Mine and the open cut pits adjacent. The report was prepared by Matrixplus on behalf of Peabody.

1.1 PROJECT OVERVIEW

The existing Millennium Mine is contained within two mining leases ML70313 and ML70344. It is proposed to extend mining operations within the existing mine lease ML 70313, and expand into MLA70401 and MDL136. The expansion areas are shown in **Figure 1-1**.

The current truck and excavation mining method will be utilised in the expansion although electric shovels, larger trucks and a dragline may be considered.

The MEP ROM coal will be processed at the existing Coal Handling and Preparation Plant (CHPP) on ML70312. The product coal will be transported to the Dalrymple Bay Coal Terminal via the existing rail network.



LEGEND

- Highway
- Road
- Track
- Highway
- River
- Watercourse
- Peabody tenement
- BMA tenement
- Vale tenement

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Regional location plan

0 2 4

Kilometres

Scale: 1:100,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 1-1

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2 SCOPE OF WORK

2.1 PROJECT TERMS OF REFERENCE

The scope of work for the groundwater investigation was based on the final Terms of Reference (TOR) for the project as approved by the Department of Environment and Resource Management (DERM).

2.2 STUDY COMPONENTS

The objective of the project is to assess the impact of the MEP on the hydrogeological regime, and if necessary, identify measures for monitoring and/or mitigation of impacts as specified in the TOR. To achieve this objective, the scope of work includes:

- a review of geological data, including exploration reports held in the Department of Environment and Resources Management (DERM) library and maps published by the Geological Survey of Queensland;
- a review of exploration data provided by Peabody;
- a review of hydrogeological data held on the DERM database for existing groundwater bores and previous studies in the area;
- an assessment and analysis of all available hydrogeological data through the use of numerical modelling; and
- preparation of a report detailing the impacts of the proposed development on the groundwater regime.

3 QUEENSLAND LEGISLATION RELEVANT TO GROUNDWATER

Under the *Water Act 2000*, the DERM is planning to advance the sustainable management and allocation of groundwater within the Fitzroy Basin to provide secure supplies for both water users and the environment. When the Water Resource (Fitzroy Basin) Plan (WRP) was finalised in 1999, no provision was made for management of the basin's groundwater resources.

The Water Resource (Fitzroy Basin) Plan 1999 will expire on 1st September 2010. During December 2008, the Minister for DERM (previously, Natural Resources and Water) advertised the intention to prepare a new Fitzroy Basin Draft Water Resource Plan (WRP) to replace the expiring WRP. The new plan will now include the management of groundwater across the whole basin, which includes the groundwater resources of the Isaac-Connors catchment. The new WRP (once released) will provide for the sustainable use of the groundwater resource, effective water sharing arrangements, improved definition and security of water entitlements, a framework for tradable water entitlements, water for the environment, salinity management and monitoring and reporting.

The MEP is also located within the declared Highlands Subartesian Area. The taking of water from an aquifer under land within the area is regulated by the Queensland *Water Act 2000* and Queensland *Water Regulation 2002*. Where operations such as coal mining activities intersect aquifers, the DERM assesses the need for licensing of groundwater inflow to coal mine pit voids. In cases where groundwater inflow to a mine pit void is sourced from an identified aquifer, and/or where this resource is utilised by others, a licence to take water may be required.

The Water Licence is required to facilitate the management of the resource in terms of monitoring and mitigation requirements. In addition, the Water Licence will also provide security, via make good clauses, to other parties potentially affected by the removal of groundwater from the specified aquifers by mining activities.

A moratorium on the allocation of additional entitlements currently exists for the Isaac River and Connors River Catchment. The existing moratoria intend to ensure the water entitlement status quo remains while the draft WRP is being developed. This moratorium is expected to apply until the new WRP for the Fitzroy Basin has been finalised. The moratorium applies to all subartesian water in the alluvial aquifers in the unconsolidated Quaternary deposits in the area associated with the Isaac River, the Connors River and all tributaries of those Rivers.

4 EXISTING ENVIRONMENT

4.1 TOPOGRAPHY AND DRAINAGE

The MEP topography is undulating with an overall gradient to the south, towards the Isaac River. The MEP is located in the upper catchments of New Chum Creek and West Creek, both tributaries of the Isaac River. All of the drainage lines, including the Isaac River, are ephemeral.

4.2 LAND USE

The MEP is surrounded by a mixture of cattle grazing properties and coal mining operations. Poitrel open cut mine (BMA), the proposed Daunia open cut mine (BMA) and the Carborough Downs underground mine (Vale Australia) are adjacent to the Millennium Mine and MEP (refer to **Figure 1-1**).

Mining at Millennium commenced in May 2006 and at the Poitrel Mine in October 2006. Both mines will continue to operate for approximately 20 years. Carborough Downs commenced development in 2006 with longwall production commencing in September 2009. Daunia Mine is due to begin operation in 2010.

4.3 CLIMATE

Climate data obtained from the closest Bureau of Meteorology Station (#034038 located at the Moranbah Water Treatment Plant) suggests the MEP area is subtropical, with humid, wet summers and cool, dry winters. The mean maximum temperatures range from 23.6°C in July to 34.0°C in December.

The annual average rainfall for the area is 592.4 mm (1972 - 2009) of which the majority falls in the warmer months of the year (November to February). The annual average rate of evaporation is 2,372.5 mm, greatly exceeding the annual rainfall and has implications on the availability of rainfall to recharge aquifers.

4.4 GEOLOGY

The MEP is located in the Bowen Basin on the western margins of the Taroom Trough within a heavily faulted and folded Permian subcrop. The MEP geology typically comprises of Triassic sediments unconformably overlying Permian coal measures (Queensland Department of Mines and Energy, 2006). The target resource is contained within the Rangal Coal Measures, approximately 70 m thick. The Leichhardt, Millennium and the Vermont seams, occurring within the Rangal Coal Measures and will be targeted for mining. The coal seams are interbedded with fine-grained and low-permeability sediments (e.g. siltstones, shales and mudstones) and sandstones. The average seam thickness is 3.6 m with the interburden thickness ranging between 18 - 36 m.

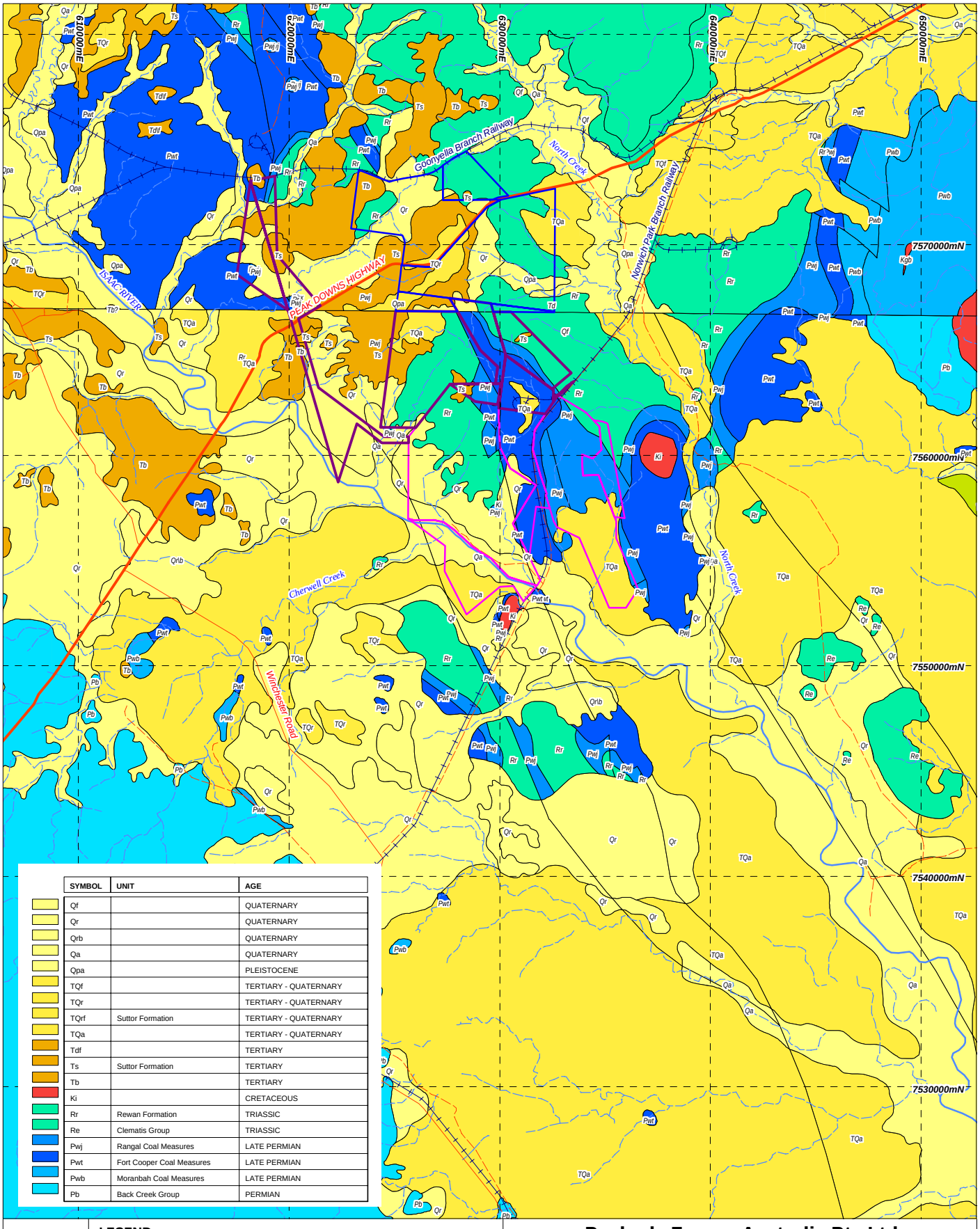
The Rangal Coal Measures are underlain by the Permian Fort Cooper Coal Measures and is overlain by the Triassic Rewan Group. A series of northwest aligned faults displaying throws of up to 80 m disjoint the assemblage, with the Fort Cooper and Rangal Coal Measures outcropping in the centre of the MEP area.

The majority of the MEP area is covered with a veneer of Triassic Rewan sediments. In the south towards BMA's operation, Quaternary aged alluvium associated with the Isaac River overlies the Triassic - Permian sequence. Tertiary sediments are known to occur in isolation east and west of the MEP, forming topographic features.

Table 4-1 shows a generalised stratigraphic section of the MEP area including a brief lithologic description of each unit. **Figure 4-1** illustrates the regional geology.

Table 4-1 Summary of stratigraphic sequence

Age	Unit	Lithology	Thickness (m)
Quaternary	Recent Alluvial	Clay, silt, sand and gravel	0 – 20
Tertiary	Suttor Formation	Sandstone, mudstone, conglomerate and minor basalt	0 – 50
	Duaringa Formation	Mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt	0 – 50
Triassic	Rewan Group	Sandstone, mudstone and minor conglomerate (at base)	5 – 70
Permian	Rangal Coal Measures	Sandstone, siltstone, mudstone, and coal including: • Leichardt seam (4–10 m) • Millennium seam (1 m) • Vermont seam (4-10 m)	20 – 70
	Fort Cooper Coal Measures	Sandstone, conglomerate, mudstone, tuff and coal	30 – 60



SYMBOL	UNIT	AGE
Qf		QUATERNARY
Qr		QUATERNARY
Qrb		QUATERNARY
Qa		QUATERNARY
Qpa		PLEISTOCENE
TQf		TERTIARY - QUATERNARY
TQr		TERTIARY - QUATERNARY
TQrf	Suttor Formation	TERTIARY - QUATERNARY
TQa		TERTIARY - QUATERNARY
Tdf		TERTIARY
Ts	Suttor Formation	TERTIARY
Tb		TERTIARY
Ki		CRETACEOUS
Rr	Rewan Formation	TRIASSIC
Re	Clematis Group	TRIASSIC
Pwj	Rangal Coal Measures	LATE PERMIAN
Pwt	Fort Cooper Coal Measures	LATE PERMIAN
Pwb	Moranbah Coal Measures	LATE PERMIAN
Pb	Back Creek Group	PERMIAN

LEGEND

- Peabody tenement
- BMA tenement
- Vale tenement
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse

Data Source:
Geology (100k) - EEDI. Topography (250k) - Geoscience Australia. Tenement - Minserve.

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matrixplus

Peabody

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Surface geology

0 5 10

Kilometres

Scale: 1:250,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 4-1

4.5 GROUNDWATER OCCURRENCE

Published and anecdotal evidence suggests that four different hydrogeological systems occur in the region; the Quaternary, Tertiary, Triassic and Permian aquifers. Lithological data collected during the MEP exploration drilling suggests that the Tertiary and Triassic aquifers are geological isolated and hydraulically disconnected, and are unlikely to be affected by proposed mining at the MEP. For the purpose of this investigation only aquifers proximal to the MEP were considered. A description of the Quaternary alluvial and Permian Rangal Coal Measures aquifers is provided below.

4.5.1 Quaternary Alluvial Aquifer

The Quaternary alluvium aquifer unit consists of clay, silt, sand and gravel and occurs to the south of the MEP in association with the Isaac River. The unit is generally less than 20 m in thickness.

There is limited information on this aquifer, although it is likely that this unit represents an unconfined, perched aquifer system separated from the underlying Rangal Coal Measures by low permeable Rewan sediments. The aquifer may, however, be hydraulically connected to the underlying Permian aquifer where the Isaac River is incised into the Rangal Coal Measures and may contribute to net recharge of the Permian aquifer.

Recharge to the alluvial aquifer will occur in areas of thin soil cover or along creek beds where surface water can readily permeate into the aquifer during and following rainfall events.

Available bore yield data sampled from this unit suggest flows are variable and can range as high as 4 L/sec. However prolonged groundwater extraction from this aquifer at high rates, while possible for a short duration, is not envisaged to be sustainable. Groundwater salinity is marginal to brackish, ranging from 1,500 to 3,000 mg/L total dissolved solids (TDS) (SKM, 2005).

4.5.2 Permian Rangal Coal Measures Aquifer

The Permian Rangal Coal Measures unit consists of interbedded siltstone, sandstone, mudstone and coal. The unit occurs across the majority of the MEP as a regular sedimentary sequence, on the eastern and western blocks of a faulted anticline assemblage. In general, the formation does not yield significant volumes of groundwater. The Rangal Coal Measures aquifer unit can be classified as fractured porous media with water stored and transmitted via both primary and secondary porosity. Groundwater flows through pore spaces of interburden sandstone, cleated coal and fractured sandstone. Higher yields (1 – 4 L/s) are intersected within coal seams while lower yields (0.1 – 1 L/s) are recorded within fractured sandstone.

Background groundwater levels reveal that groundwater levels within the coal seams and the interburden (i.e. sandstone) units are similar at proximal locations. This suggests that there may be a degree of interaction between the various water bearing units throughout the aquifer.

There is no information on the range of hydraulic properties of the aquifer proximal to the MEP and therefore parameter values have been determined from pumping tests undertaken on similar units in the region and standard textbook values.

The quality of the groundwater is varies from poor to fair and generally suitable only for stock purposes. The groundwater salinity associated with these deposits is anticipated to range in between 1,000 and 10,000 mg/L TDS (SKM, 2005). The regional groundwater flow within the Rangal Coal Measures aquifer is to the south southeast.

Recharge to the Rangal Coal Measures predominantly occurs via direct rainwater infiltration in areas where the formation outcrops or sub crops. Recharge may also occur from the alluvial aquifer to the south of the MEP, where the Isaac River is incised into the Rangal Coal Measures.

4.6 GROUNDWATER USE

The MEP area is located within the Highlands Declared Subartesian Area and under the *Water Act 2000* bores drilled in the area must be approved. The DERM maintain a database of all registered groundwater bores in Queensland. A search of the groundwater database indicates that there are 36 registered bores within a 10 km radius of the MEP that could potentially be impacted.

A review of available construction details reveals that 26 of the registered bores were drilled for coal and gas exploration purposes and not groundwater extraction or monitoring. These exploration holes may have been incorrectly entered into the groundwater database because they were drilled by drillers with water boring licences. Subsequently these holes are excluded from background data compiled for this investigation. Hydrogeologic details for the 10 remaining registered bores is summarised in **Table 4-2**.

Additional landholder bores, which have not been registered with the Department, may exist. A bore census undertaken as part of the Poitrel EIS (SKM, 2005) identified 12 bores within the vicinity of BMA's operations and Millennium Mine (including the MEP). Bore construction detail is limited, with screened lithologies based on anecdotal evidence and geological interpretations. Bore details collected as a part of the census, along with data from the DERM database search, are provided in **Table 4-2** and their locations are shown in **Figure 4-2**.

Compiled data suggests that groundwater usage surrounding the MEP is minimal to non-existent. Surrounding landholders source water for domestic consumption from rainfall, while stock water is predominantly supplied from surface water (i.e. dams) and in small volumes from the Quaternary alluvial and Rangal Coal Measures aquifers.

Millennium Mine and surrounding operations currently extract groundwater discharging into the open cuts. No water licence has been required to undertake extraction.

4.6.1 Impacts of Current Pumping

The rate at which groundwater can be extracted from a bore is dependant upon the extraction capacity of the pump, bore construction and the hydraulic properties of the aquifer, which determines the rate at which groundwater moves into the bore column. Similarly, the impact that extracting groundwater from a bore has on the surrounding groundwater resource is related to the quantity of water removed, and the aquifer parameters which govern its ability to store and transmit water.

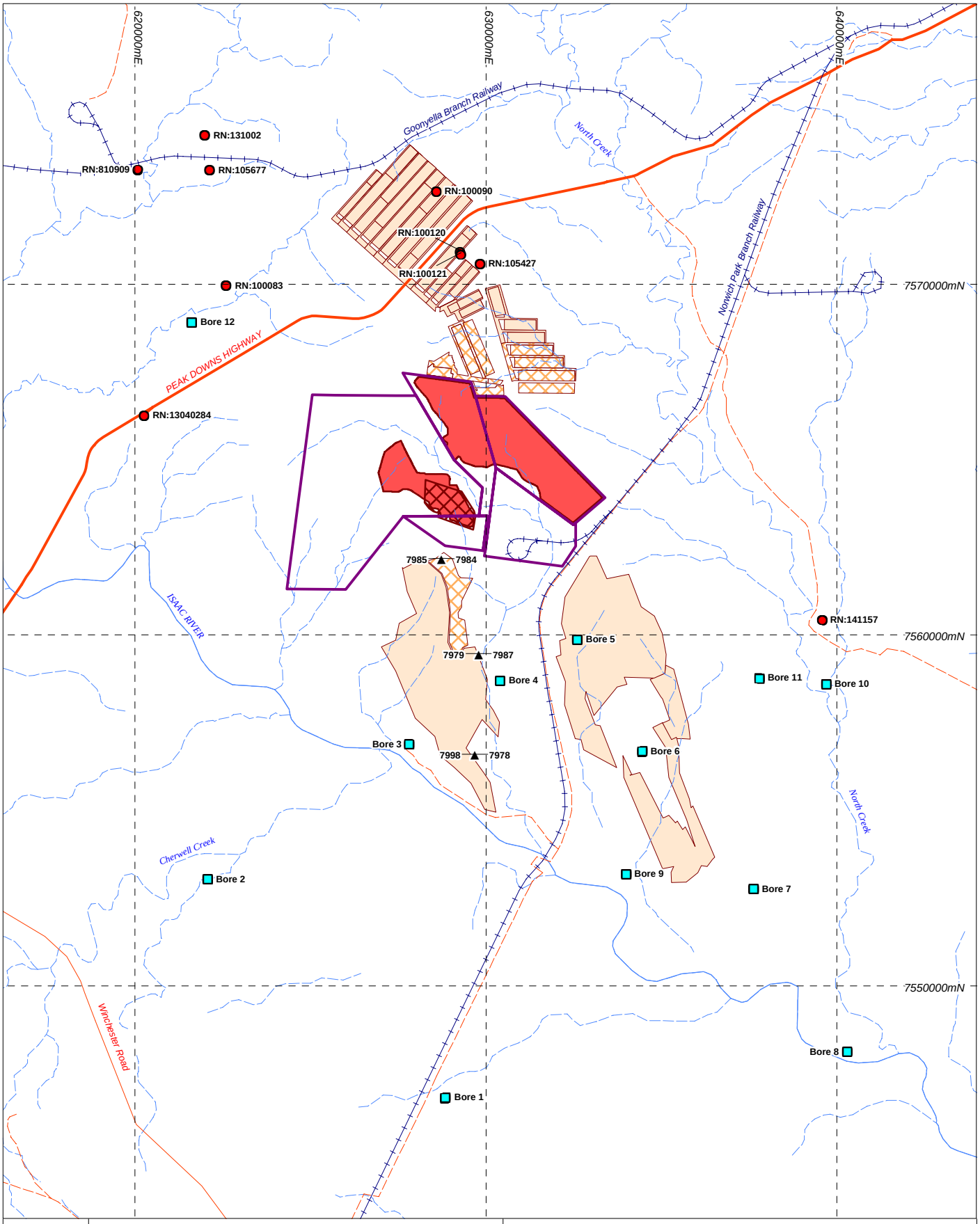
It is likely that the majority of landholder bores are equipped with submersible pumps and set to extract groundwater rates of less than 5 L/s for a few hours each day. On the basis of the dispersed location of the bores and the low extraction rates, the impact to the regional groundwater resource by current landholder pumping is likely to be negligible, in both the Quaternary alluvium and Permian Rangal Coal Measures aquifer.

At low rates and frequency of pumping, drawdown within the aquifer is likely to be limited to the immediate vicinity of the landholder bore, and would typically vary from minimal up to 10 metres depending upon the characteristics of the aquifer immediately surrounding the bore.

Table 4-2 Surrounding registered, landholder and monitoring bore details

Reg No	Date drilled	mE (GDA94)	mN (GDA94)	Total depth (m)	Screened aquifer	Yield (L/s)	Water quality (µS/cm)
DERM registered bores							
81909	17/12/1994	620090	7573318	60	Rewan Formation	5.3	5,670
100083	25/9/1992	622605	7570006	-	unknown	-	-
100090	16/10/1992	628593	7572696	-	unknown	-	-
100120	11/8/1993	629268	7570968	-	unknown	-	-
100121	10/6/1994	629296	7570906	-	unknown	-	-
105427	22/4/2004	629841	7570637	100	Rewan Formation	3.8	-
13040284	2/9/2004	620264	7566309	19	Rangal Coal Measures	3.6	14,310
105677	13/6/2005	622136	7573306	67.7	Tertiary basalt	7.3	1,055
131002	18/11/2005	621997	7574302	63	Tertiary basalt	6	1,022
141157	27/4/2007	639587	7560479	66	Rangal Coal Measures	1.3	-
Unregistered landholder bores							
Bore 1	unknown	628740	7546688	-	Rangal Coal Measures	-	-
Bore 2	unknown	621970	7552907	-	Rangal Coal Measures	0.3	-
Bore 3	unknown	627714	7556752	-	Quaternary alluvium	-	-
Bore 4	unknown	630297	7558574	-	Rangal Coal Measures	-	-
Bore 5	unknown	632495	7559750	-	Rangal Coal Measures	-	-
Bore 6	unknown	634350	7556563	-	Rangal Coal Measures	-	-
Bore 7	unknown	637519	7552624	-	Rangal Coal Measures	-	-
Bore 8	unknown	640189	7547989	-	Quaternary alluvium	-	-
Bore 9	unknown	633898	7553055	-	Quaternary alluvium	2-4	-
Bore 10	unknown	639594	7558477	-	Rangal Coal Measures	2	-
Bore 11	unknown	637684	7558650	-	Fort Cooper Coal Measures	-	-
Bore 12	unknown	621511	7568791	-	Rangal Coal Measures	-	-
Poitrel Mine monitoring bores							
7984	2004	628626	7562006	-	Rangal Coal Measures	-	-
7985	2004	628626	7562006	-	Rangal Coal Measures	-	-
7987	2004	629690	7559289	-	Rangal Coal Measures	-	-
7979	2004	629689	7559294	-	Rangal Coal Measures	-	-
7978	2004	629578	7556426	-	Rangal Coal Measures	-	-
7998	2004	629578	7556426	-	Rangal Coal Measures	-	-

- = No information



LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse
- DERM registered bore
- Landholder unregistered bore
- Poitrel monitoring bore
- MEP tenement
- Existing Mountain Pit
- Proposed MEP mine
- Other existing mine
- Other proposed mine

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Surrounding groundwater user and monitoring bore locations

0 3 6

Kilometres

Scale: 1:150,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 4-2

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4.7 EXISTING GROUNDWATER MONITORING

The Millennium Mine does not hold any water licences, which in accordance with the provisions of the *Water Act 2000*, would require groundwater monitoring. Nor have past environmental impact assessments from previous Millennium operations stipulated groundwater monitoring requirements. In addition, Millennium's Environmental Authority (EA) MIN100344305 has recently been revised and now stipulates that the holder must develop and implement a groundwater monitoring program which must be able to detect significant changes to groundwater levels and quality. The installation of Millennium Mine's groundwater monitoring program has been postponed until the outcome of the MEP is known as its potential approval will alter the required number and locations of groundwater monitoring bores surrounding the operations.

Approximately 5 km south of the MEP, six monitoring bores surrounding BMA's Poitrel Mine are installed within the Rangal Coal Measures. Bore details are provided in **Table 4-2**, the location of these bores is shown in **Figure 4-2**. Where available, groundwater levels from these bores, along with DERM registered monitoring bores and unregistered landholder bores are provided below in **Table 4-3**.

Table 4-3 Groundwater levels within surrounding Permian registered, landholder and monitoring bores

Bore ID	Standing water level (mAHD)	Monitoring date
13040284	233.73	21/11/2007
141157	185.00	27/04/2007
Bore 1	190.30	2004
Bore 2	195.00	2004
Bore 4	190.00	2004
Bore 5	184.00	2004
Bore 8	174.00	2004
Bore 10	187.00	2004
Bore 12	237.50	2004
7987	186.26	20/07/2004
7979	186.13	20/07/2004
7978	182.02	21/07/2004
7998	182.00	22/07/2004

4.8 GROUNDWATER QUALITY AND ENVIRONMENTAL VALUE

An assessment was made of the MEP's groundwater quality in terms of the relevant Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) criteria and environmental values identified in the *Environmental Protection (Water) Policy 1997*:

- aquatic ecosystems;
- suitability for recreational use;
- suitability for minimal treatment before supplying as drinking water;
- suitability for agricultural use; and
- suitability for industrial use.

Limited groundwater quality data exists for the MEP. To characterise the MEP groundwater quality, data was compiled from exploration drilling, the DERM registered bore database and the surrounding BMA's operation's groundwater monitoring.

Rangal Coal Measures groundwater quality data from field measurements taken during the MEP exploration drilling and measurements recorded within the DERM registered bore database are presented in **Table 4-4**.

Groundwater sample results from the neighbouring Poitrel Mine's Rangal Coal Measures aquifer monitoring bores collected in July 2004 are shown and compared to ANZECC (2000) and Australian Drinking Water Guidelines (NHMRC, 2004) in **Table 4-5**.

Table 4-4 Rangal Coal Measures aquifer electrical conductivity and pH on site

Bore ID	Electrical conductivity (µS/cm)	pH
13040284	14,310	8.10
R112	12,370	6.55
M018	14,200	12.72
R588	6,861	7.53
R596	17,830	7.30
R612	2,074	7.87
Median	**14,200**	**7.70**

Table 4-5 Rangal Coal Measures aquifer groundwater quality compared with adopted guidelines

Parameter	Units	ANZECC guidelines (1)			Drinking water guidelines (2,4)	Bore			
		Aquatic ecosystem (3)	Irrigation	Stock water		7987	7979	7978	7998
Alkalinity	mg/L	N/a	N/a	N/a	N/a	746	758	860	769
TDS	mg/L	150	highly dependent on crop type and soils	4,000 (beef), 2,500 (dairy), **5,000** (sheep), 4,000 horses), 4,000 (pigs), 2,000 (poultry)	500	**8,190**	**8,000**	4,880	4,360
pH	-	N/a	N/a	N/a	**6.5 to 8.5**	6.5	6.5	6.7	6.6
Sulphate	mg/L	N/a	N/a	**1000**	250	174	201	89	122
Sulphide	mg/L	N/a	N/a	N/a	N/a	<0.1	<0.1	<0.1	<0.1
Chloride	mg/L	N/a	175 (sensitive crops) to >**700** (tolerant crops)	N/a	250	**4,020**	**3,880**	**1,730**	**1,700**
Calcium	mg/L	N/a	N/a	**1,000**	N/a	237	208	116	128
Magnesium	mg/L	N/a	N/a	**2,000**	N/a	433	377	169	163
Sodium	mg/L	N/a	115 (sensitive crops) to >460 (tolerant crops)	N/a	**180**	1,610	1,690	1,090	908
Iron	mg/L	ID	**0.2**	not sufficiently toxic	**0.3**	**1.35**	0.05	0.02	**1.47**
Arsenic	mg/L	0.001 (As 3), 0.0008 (As 5)	0.1	**0.5 to 5**	0.007	0.004	0.005	0.001	<0.001
Cadmium	mg/L	0.00006	0.01	**0.01**	0.002	0.0002	<0.0001	<0.0001	0.0001
Chromium	mg/L	0.00001 (Cr5)	0.1	**1**	0.05	0.006	0.006	<0.001	0.002
Copper	mg/L	0.001	0.2	**0.4 to 5**	1	0.007	0.016	<0.001	0.003
Lead	mg/L	0.001	2	**0.1**	0.01	0.003	0.003	0.002	<0.001
Zinc	mg/L	0.0024	**2**	**20**	3	0.013	0.035	0.007	0.007
Mercury	mg/L	0.00006	0.002	**0.002**	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	mg/L	1.2	**0.2**	not sufficiently toxic	0.1	**0.901**	**0.821**	0.163	**0.468**

Notes:

(1) Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand(ARMCANZ). 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. National Water Quality Management Strategy.

(2) National Health and Medical Research Council (NHMRC) 2004, Australian drinking water guidelines

(3) The aquatic ecosystem guideline represents 99 % species level of protection.

(4) Both Health and Aesthetic guidelines are provided for drinking water. The value adopted was the lower of the two.

ID = Insufficient data

Values represented in **bold** indicates levels exceeding the corresponding ANZECC Guideline.

4.8.1 Permian Rangal Coal Measures Aquifer

The monitoring data indicates that groundwater in the Rangal Coal Measures aquifer on site is typically neutral to slightly alkaline with an median pH of 7.70. Electrical conductivity (EC) ranges between 2,074 µS/cm and 17,830 µS/cm (refer to **Table 4-4**). This observed wide range of EC levels is expected due to the distribution of sample location across the Permian unit. Groundwater bores proximal to recharge areas will exhibit fresher characteristics while bores screened at a greater depth will show high salinities owing to reduced permeabilities. Comparatively low readings for EC observed in bores R588 and R612 (2,074 – 6,861 µS/cm) could be explained the location of the recharge zone where the unit sub-crops, suggesting that the water is replenished by rainfall recharge near the Millennium pit sub-crop. With a median EC of 14,200 µS/cm, the Rangal Coal Measures aquifer groundwater can be classified as saline.

Acidity values are generally consistent, although anomalously low values of 12.72 have been recorded. This reading is most likely to be the result of a data measurement error or possible contamination of drilling fluids within the borehole.

Compared with the aquatic ecosystem guideline levels, salinity, arsenic, chromium, copper, manganese and zinc are elevated in the majority of the groundwater samples at Poitrel Mine.

Similarly, the salinity of the groundwater would generally limit its use for stock watering. The elevated salinity of the groundwater (up to 8,100 mg/L TDS) would preclude its use for drinking water, for which the Australian salinity guideline is less than 500 mg/L TDS.

Based on the description of the groundwater usage surrounding the MEP and current knowledge of groundwater quality within the Rangal Coal Measures aquifer, the environmental value of the resource has been assessed against *Environmental Protection (Water) Policy 1997*. A summary is provided in **Table 4-6**.

Given the general low yield and poor quality of the groundwater in the Rangal Coal Measures, the environmental value has been classified as "primary industry" with the main potential use being for stock watering. In some bores the groundwater is too saline for the more salt sensitive stock.

Table 4-6 Environment values of the Rangal Coal Measures aquifer resource

***Environmental Protection (Water) Policy 1997* Environmental Values**	**Interpretation**
Aquatic ecosystems	Groundwater dependent aquatic ecosystems are not known to exist within the MEP
Suitability for recreational use	There are no known recreational uses of groundwater in the MEP areas
Stygofauna and troglofauna	No stygofauna and troglofauna are expected to exist with the MEP areas
Suitability for minimal treatment before supplying as drinking water	The high levels of salinity of much of the groundwater in the MEP area indicates that the resource is unsuitable for human consumption and would require substantial treatment to meet drinking water standards
Suitability for agricultural use	Some bores surrounding the MEP area are utilised for agricultural use
Suitability for industrial use	Surrounding BMA coal operations (Poitrel) intersect groundwater within the Rangal Coal Measures however these operations are not actively extracting water from the resource for industrial purposes

4.8.2 Quaternary Alluvial Aquifer

Little data is available on groundwater quality of the alluvial aquifer along the Isaac River. Anecdotal evidence suggests that the alluvial groundwater is brackish to saline, an assessment supported by the DERM registered bore database which indicates that there are few landholder bores that draw water from the alluvium surrounding the MEP. This is consistent with all rivers in the Bowen Basin, with the river alluvial systems containing little groundwater except for a few metres at the base of the alluvium which is generally saline.

Given the general poor quality of the groundwater in the alluvial aquifer, the environmental value has been classified as "primary industry" with the main potential use being for stock watering. In some bores the groundwater may even be too saline for the more salt sensitive stock.

5 IMPACT OF OPEN CUT AND UNDERGROUND MINING ON GROUNDWATER

As mining progresses to depths beneath the pre-mining standing water levels of aquifers in the MEP area, groundwater will inflow into the MEP pits causing groundwater levels to drawdown around the excavations. The extent of drawdown (i.e. radius and magnitude of influence) is site-specific and is dependent on the intensity of production, aquifer hydraulic parameters, duration of mining and geological conditions.

The MEP is located adjacent to the Poitrel Mine, Daunia Project, and the Carborough Downs Mine. Given the close proximity of three existing and one proposed coal mines, this assessment considers the cumulative impact of all four mines on the regional groundwater levels. The Moorvale Coal Mine and proposed Olive Downs open cut, further east of the project and modelled area, have also been considered in this study.

Isaac Plains, Peak Downs Mine, south and southwest of the project area, mine coal from seams located in the Moranbah Coal Measures, and are therefore exempt from this groundwater study.

5.1 OPEN CUT PITS

Dewatering of the Poitrel and Daunia pits will be undertaken through the use of sump pumps with pit progression. Drawdown contours are expected to have a minimal impact on pit inflow rates of the Millennium and Mavis pits. There will however be an amalgamation of drawdown contours which may effectively contribute to reduction of bore yields for groundwater users sourcing water from the Rangal Coal Measures.

5.2 UNDERGROUND PITS

Dewatering of the Carborough Downs underground mine will be undertaken via gas vent pumps during longwall mining procedures. Dewatering of this Rangal Coal Measures will have minimal impacts on groundwater users sourcing groundwater directly from the Rangal Coal measure due to disconnection of the mine and potential bores as a result of New Chum Fault displacements.

The Carborough Downs underground mine is situated within relatively impermeable Rangal Coal Measures. As stipulated in Section 6.3.4.1, coal measure permeability decreases exponentially with depth and therefore groundwater drawdown extracted from this unit will be relatively restricted and drawdowns in the immediate vicinity of the mining area will have a steep, restricted drawdown cone. Due to coal compressibility and sandstone diagenesis, storativity and yield attributes are expected to be exponentially lower. Groundwater flow will preferentially flow along the more permeable units of the Rangal Coal Measures, i.e. up-dip and proximal to the New Chum Fault. Longwall mining dewatering has been modelled in order to the see what impact dewatering of a neighbouring mine has on predicted groundwater inflows into the MEP.

The Moorvale Coal Mine open cut and proposed underground, east of the modelled and project area, will have zero impact on groundwater inflow. This is due to the hydraulic disconnection of the coal mine to the aquifer systems relevant to the MEP, again due to various major faults to the east of the project area, distance from the project site, as well as the impermeable nature and lack of water in the coal measures at this locality.

5.3 POTENTIAL IMPACTS

Potential impacts on the groundwater resources in and surrounding the MEP include:

- alteration to groundwater levels due to dewatering of all intersected aquifers in the open cut pits;
- alteration to groundwater flow patterns due to dewatering; and
- lowering of groundwater levels and subsequent reduced yields in surrounding bores within the affected aquifers.

6 NUMERICAL GROUNDWATER MODELLING

6.1 MODELLING OBJECTIVES

In order to assess the potential impact of the MEP on the surrounding groundwater environment, conceptual and numerical models of groundwater flow were developed following accepted industry standard guidelines (ASTM, 1194; Middlemis, 2000).

The objectives of modelling were to:

- assess the impact of open cut mining on groundwater levels in the Rangal Coal Measures aquifer;
- assess regional impacts on groundwater levels as a result of cumulative mine dewatering; and
- predicted times for the recovery of regional groundwater equilibrium conditions.

6.2 CONCEPTUAL MODEL

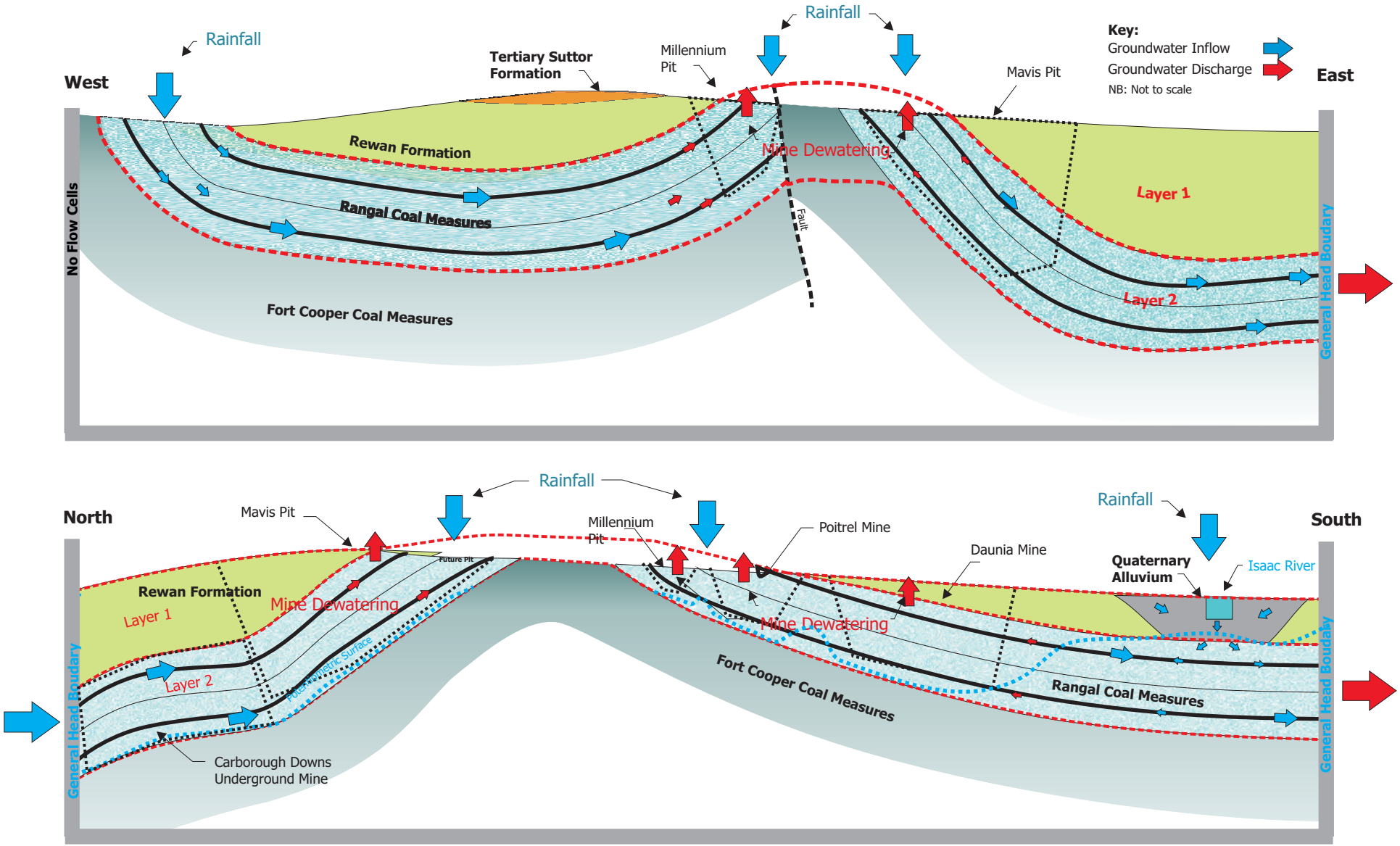
The key to successfully modelling the potential impact mining may have on the surrounding groundwater environment is to adequately conceptualise the aquifer systems. The conceptual model forms the foundation of the numerical groundwater model. A conceptual model is a simplified representation of the essential features of the physical hydrogeological system, and its hydraulic behaviour.

The conceptual model was developed based on site specific geological data, published regional geological maps, Millennium Mine's digital terrain model and adjacent mines (i.e. Carborough Downs, Poitrel and Daunia) hydrogeological data, groundwater models and reports. The conceptual model encompasses a 15 km radius surrounding the MEP and has been presented in **Figure 6-1** as cross-sectional lines N-S and E-W through the project area.

The following are key features of the conceptual model:

- the model includes the Quaternary alluvial and Permian Rangal Coal Measures aquifers;
- the Quaternary alluvium does not occur across the MEP, but is associated with the Isaac River to the south of the MEP. The alluvial aquifer's hydraulic connection to the underlying Permian aquifer is limited to where the Isaac River incises the Rangal Coal Measures and is considered to contribute to the net recharge of the Permian aquifer;
- the alluvial aquifer is not modelled separately but is included within the Tertiary and Triassic units, this layer is modelled as the upper unit over the whole of the model area;
- a Tertiary aquifer is known to occur regionally, however the Tertiary unit will not be extensively intersected by the MEP pits and the aquifer is not known to be hydraulically connected to the Rangal Coal Measures. As such the inclusion of the Tertiary aquifer within the model is not warranted;
- while the Rewan Formation directly overlies the Rangal Coal Measures the unit is unlikely to be impacted by mining as the Rewan Formation is considered to be an aquitard;
- the Permian unit outcrops in several regions of the MEP and surrounds due to faulting and antiformal structures;
- the underlying Fort Cooper Coal Measures outcrops in the centre of the MEP, but as it is hydraulically disconnected from the Rangal Coal Measures it has been excluded from the groundwater simulation;
- recharge of the Rangal Coal Measures will occur only where the unit subcrops, due to the impermeable characteristics the overlying Rewan sediments, primarily as a result of rainfall, and to a lesser extent from seepage loss from the base of creeks where they cross the seams;

- regional groundwater flow within the Rangal Coal Measures aquifer is to the south southeast;
- the hydraulic conductivity of the Rangal Coal Measures is considered to decline with depth; and
- significant groundwater usage surrounding the MEP is minimal to non-existent with the exception of dewatering associated with proximal coal mines (i.e. Carborough Downs, Poitrel and Daunia).



matrixplus

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Groundwater Impact Assessment

Conceptual groundwater model - Figure 6-1

6.3 MODEL DEVELOPMENT

6.3.1 Model Code Selection

The model was developed using the United States Geological Survey three-dimensional, finite-difference, modular, groundwater flow model MODFLOW (McDonald and Harbaugh, 1984), with the Processing Modflow Professional (PMWIN) graphical user interface (Chiang and Kinzelbach, 1996). The MODFLOW code is the most widely used code for groundwater modelling and is presently considered an industry standard.

The advantages of using MODFLOW include:

- MODFLOW block model configuration is applicable for relatively shallow dipping strata;
- the modelling code enables easy adaptation of the model to relatively orthogonal pit/strip advance rates;
- the modelling code is acceptable for confined/unconfined groundwater systems;
- the modelling environment is not subject to deformation of strata (e.g. underground mining); and
- the modelling code is able to model transient and steady state scenarios.

6.3.2 Model Geometry

The spatial extent of the MEP groundwater model was selected to incorporate the potential drawdown zones from cumulative dewatering of the MEP and surrounding mines (Millennium, Daunia and Poitrel). This extent was estimated from the predicted drawdowns from previous modelling of the proposed Daunia Mine, as well as simple radial distance drawdown calculations (SKM, 2008).

The model coordinate system is UTM Zone 55, AGD84 datum. The results of the model and all other geographic information were then converted to GDA94 for presentation in the maps and figures of this report.

The model domain covers the area of 615,000 mE, 7,543,000 mN to 645,000 mE, 7,578,000 mN. This is a spatial extent of 30 km east-west by 35 km north-south.

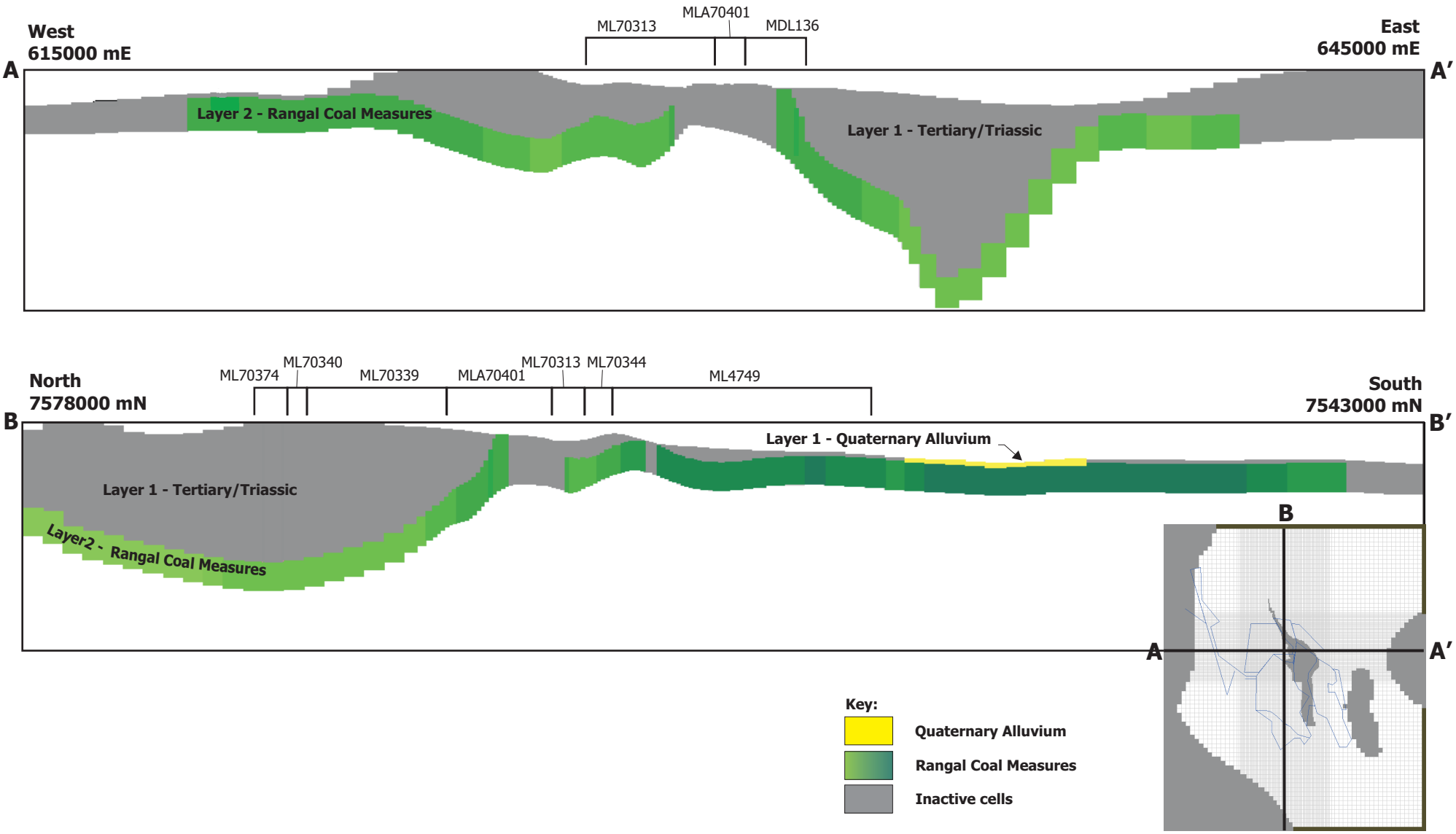
The model is split into a cell grid of 144 rows, 134 columns and two layers representing 38,592 cells. Grid cells vary both in width and length from 100 by 100 m in the vicinity of the Millennium and MEP pits to 500 m by 500 m at the boundaries of the model.

In agreement with the conceptual model of the area, the numerical model geometry consists of two aquifer systems (refer to **Figure 6-2**). Layer 1 represents a combination of the Quaternary alluvial, Tertiary Duaringa Formation and Triassic Rewan Formation. In the north of the modelled area this layer is considered hydraulically disconnected from the Rangal Coal Measures and as a result, the majority of this layer has been classified as inactive. The Quaternary alluvial deposits associated with the Isaac River have been made active and represent a hydraulic connection between the alluvial aquifer and the Rangal Coal Measures.

Layer 2 represents the Permian Rangal Coal Measures aquifer unit of coal seams, siltstone, mudstone and sandstone, grouped into one 70 m thick layer. EIS studies at Daunia Mine modelled individual coal seams and interburden within the Rangal Coal Measures separately. However, due to the thin nature of the coal seams in the MEP area and evidence from groundwater levels suggesting that there is very little difference in hydraulic heads within the Leichardt and Vermont seams, the Rangal Coal Measures unit can be modelled as one interconnected uniform layer.

The Rangal Coal Measures are extensively faulted across the MEP, displaying throws of up to 80 m. Layer 2 has been assigned inactive cells, or no flow zones, where the unit outcrops and/or is disconnected by faulting (refer to **Figure 6-2**).

The Rangal Coal Measures dips steeply to the northeast from the project area, reaching depths of up to 760 m below the surface. To improve model stability and produce representative results, the steeply dipping nature of the unit towards the extent of the model has been levelled at 350 m below the surface. To compensate for this, the increasing depth of this unit has been represented hydraulically.



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Model geometry - Figure 6-2

6.3.3 Boundary Conditions

Water entering or leaving the model domain is simulated through the actions of boundary conditions. The specific boundary flows and their representation in the model are discussed below.

6.3.3.1 General Head Boundaries

The model incorporates general head boundaries for all layers. These have been used to represent regional groundwater flow conditions within the model extent. Groundwater gradients in the MEP and surrounds are of the order of 0.001 and flow in a south southeast direction. These general head values will mimic the inflow and outflow of the model domain in order to recreate observed hydraulic gradients.

Layer 1 has been assigned two general head boundaries on the west and east boundaries of the model in order to simulate groundwater flow through the Isaac River alluvium. Layer 2 has been assigned general head boundaries in the north, south and east boundaries of the model.

6.3.3.2 No Flow Boundaries

No flow cells have been used extensively in Layer 1 in order to represent the hydraulic disconnection between the overlying Tertiary/Triassic units and the Rangal Coal Measures. The extent of the active cells (Quaternary alluvium) and location of no flow boundaries in Layer 1 is presented in **Figure 6-3**.

The Rangal Coal Measures outcrops and is eroded along the western boundary, as well as sections of the northern and the southern boundaries. The unit is absent in the centre of the MEP between the Millennium and Mavis pits. This disconnection extends approximately 1.5 km in length north/south and represents the faulted and subsequently eroded segment of the Rangal Coal Measures. This area has been represented by inactive or 'no flow' cells at the point of approximated disconnection. The extent of the inactive cells used in the Rangal Coal Measures is illustrated as **Figure 6-3**.

6.3.3.3 Recharge and Discharge

Rainfall and evaporation records were obtained from the Bureau of Meteorology. Recharge was applied across the model domain as a percentage of average rainfall. Recharge zones were applied with respect to geological units and their approximated zones of influence. An average net recharge of 1.3×10^{-5} L/day (0.01 mm/day) was applied along the alluvial deposit and 3.2×10^{-6} L/day (0.003 mm/day) in areas where the Rangal Coal Measures outcrops. These values represent 0.8 % and 0.02 % of rainfall being applied as net recharge to the uppermost active layer of the model at any point in time. These values are low as they represent average rainfall infiltration rates into the geological unit, minus the effects of high evaporation rates in the region. Zones of recharge as used in the model are illustrated in **Figure 6-4**.

Groundwater flow into the base of the open cut pits, and the sequential removal of the accumulated water, will be represented by drain cells that will increase in extent as mine pit progression continues. Drain cell conductivities are entered as highly conductive cells with values of 1,000 m/day in order to nullify resistance and to represent the open pit. Drain elevations were assigned according to progressive pit and bench designs. Groundwater above the base of the pit and bench elevation at a specified point in time is effectively immediately discharged (pumped) from the groundwater simulation.

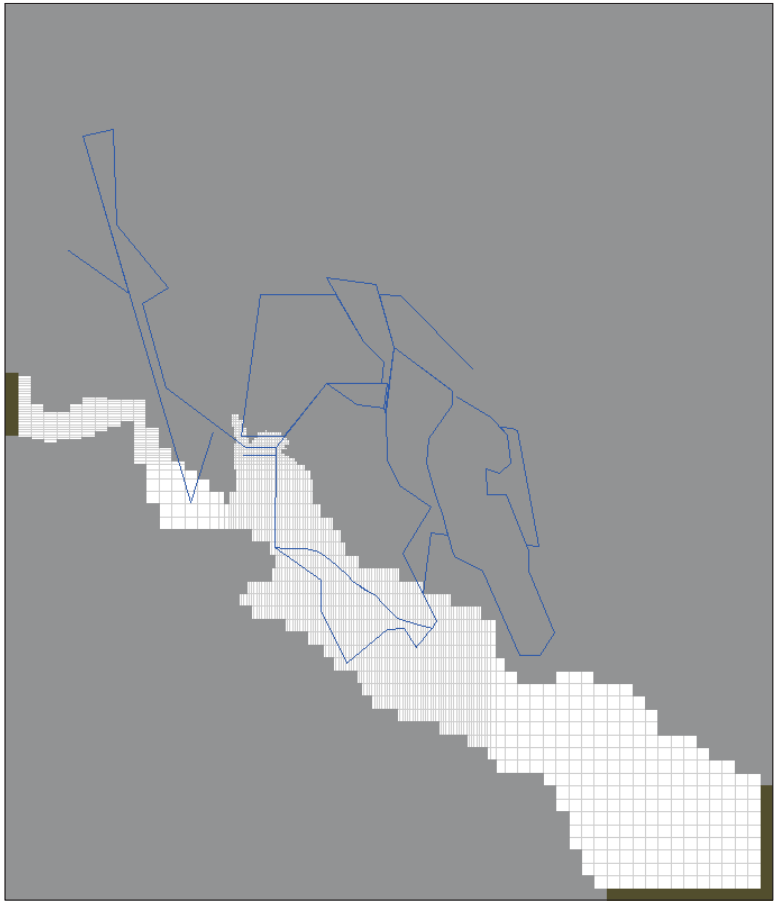
Waste rock from mining progression will result in increased recharge to the Rangal Coal Measures through direct infiltration. A value of 0.8 % of total rainfall has been applied to the mining waste rock within the MEP pits in order to simulate groundwater recovery in the post mining recovery model. Areas defined as waste rock are illustrated as **Figure 6-4** and are sequentially updated according to mine progress plans.

6.3.3.4 Surface Groundwater Interaction

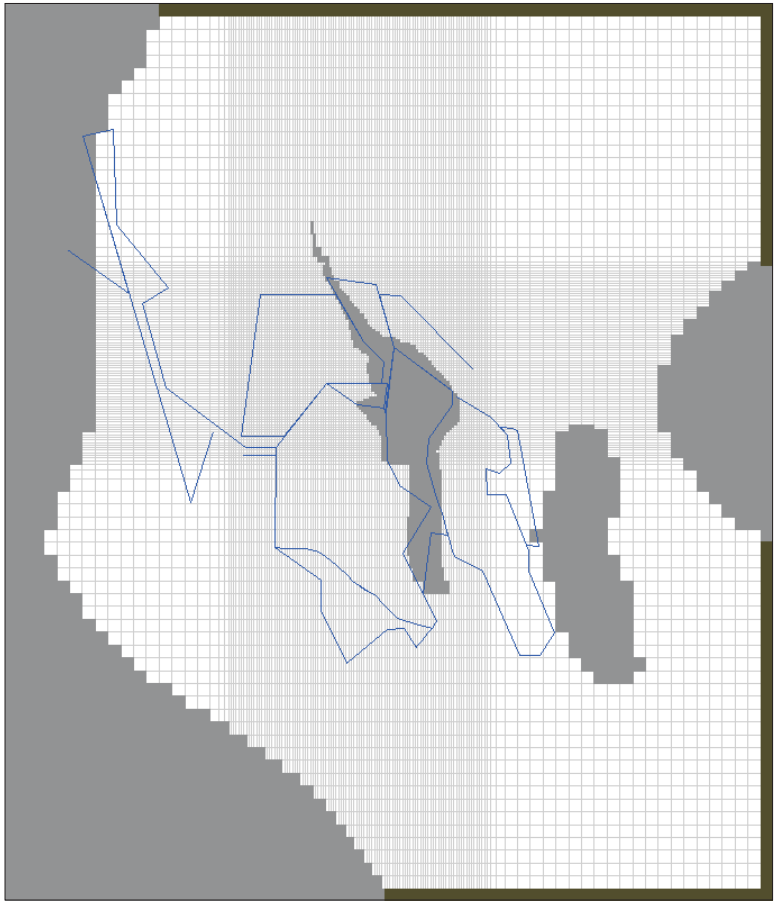
The Quaternary alluvial aquifer is an unconfined system and is therefore directly influenced by both rainfall and river recharge mechanisms associated with the Isaac River. The Isaac River has been represented as an ephemeral body with head values 3 m below the river bed.

Existing groundwater levels suggest that the hydraulic gradient decreases south towards the Isaac River. This suggests that there is likely to be seepage to the Quaternary alluvium from the Isaac River and ultimately to the Rangal Coal Measures through sub-cropping contacts beneath the Quaternary alluvium. This interaction between the Isaac River and its associated alluvium has been modelled through the use of river cells using MODFLOW's river package. Cells used to simulate the Isaac River system have been illustrated as **Figure 6-5**.

Minor drainage lines such as New Chum Creek are hydraulically disconnected to the Rangal Coal Measures aquifer. The tributaries associated with the Isaac River are ephemeral and as a result, these surface water features were not included in the model.



Layer 1



Layer 2

Key: Cell activity

- Active
- Inactive
- General head boundary
- Mine lease boundary

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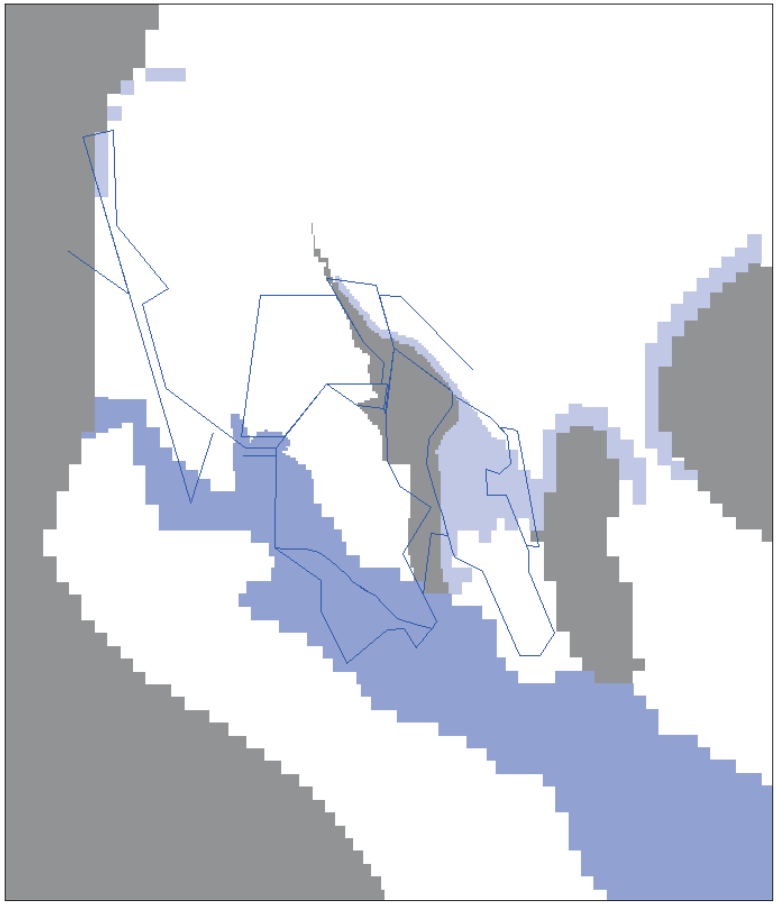
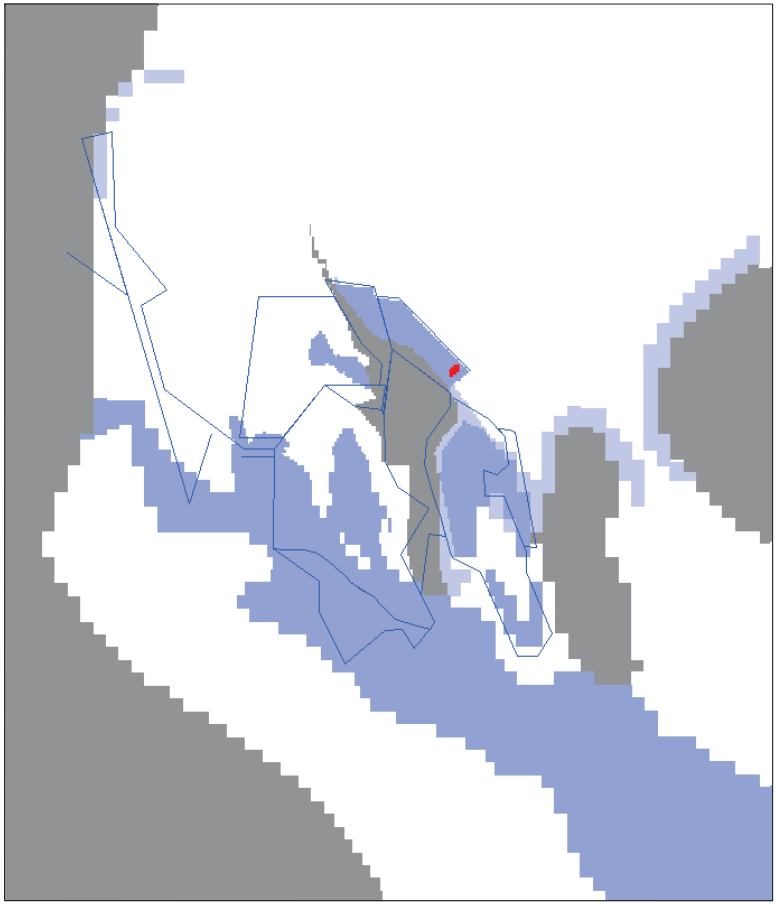
Boundary conditions and general head boundaries - Figure 6-3



Model (2004-2026)

Key: Recharge (L/day)

- 0.001
- 0.05
- Mine lease boundary



Recovery model (2026-2320)

Key: Recharge (L/day)

- 1.3E-06
- 5.6E-05
- -0.004
- Mine lease boundary

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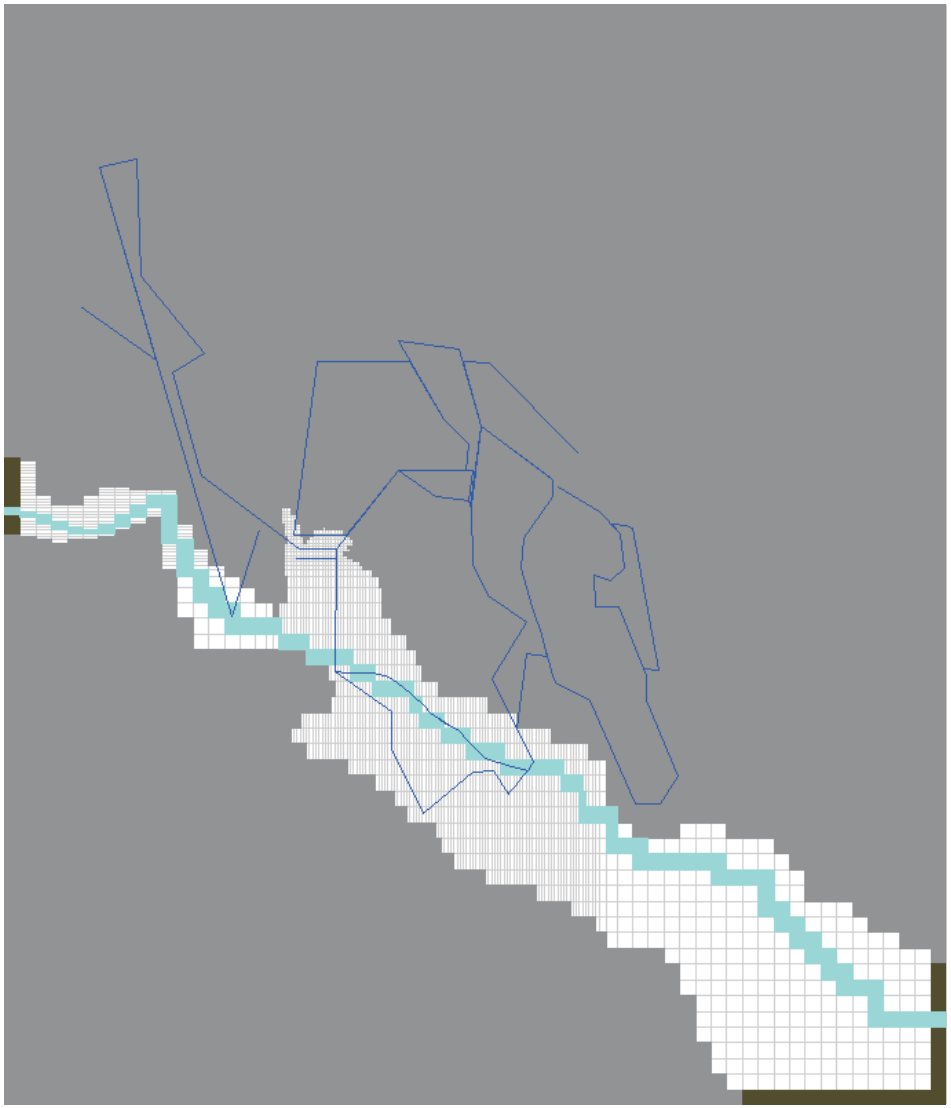
Recharge zones - Figure 6-4



River cells (Layer 1)

Key:

River cell (250 L^2/day)

Mine lease boundary

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River cells (Isaac River) - Figure 6-5

6.3.4 Aquifer Parameters

Values of aquifer parameters used within the model are tabulated in **Table 6-1**. Aquifer testing has not been conducted in the vicinity of the MEP; aquifer parameters for the Rangal Coal Measures were derived from pumping tests conducted on similar coal measures throughout the Bowen Basin. Where no field data existed, published values were applied. The process and justification for using these values will be explained in the following sections.

6.3.4.1 Hydraulic Conductivity

Hydraulic conductivity values are expected to vary within the 70 m thick Rangal Coal Measures owing to contrasting hydraulic characteristics. To take this into account the aquifer was divided into three different hydraulic units, the impermeable interburden (siltstone/mudstone), permeable interburden (sandstone) and permeable coal seams.

A representative hydraulic conductivity value of 1 m/day was assigned to the coal seams within the Rangal Coal Measures based on proximal field measurements. The combined average total thickness of the coal seams was assumed to be 10 m. As hydraulic properties of the interburden aquifers have not been tested, a value of 1 m/day was allocated to this unit, using an arbitrary thickness of 5 m. Typical yields from within this units are similar to the coal seam (0.5 – 3.6 L/s); suggesting hydraulic conductivity values would also be expected to have a range similar to the coal seams. A value of 0.01 m/day was adopted from text for the impermeable interburden, with an average unit thickness of 55 m (Freeze and Cherry, 1979).

In order to undertake modelling, a value of 0.2 m/day was initially assigned to the Rangal Coal Measures (Layer 2). This value was averaged from unit thicknesses and their hydraulic conductivity values (as described above).

Previous studies in the Bowen Basin indicate that hydraulic conductivity values of coal measure aquifer decrease exponentially down-dip. This relationship has been modelled using the following equation as derived from studies undertaken by Australian Groundwater Consultants Pty Limited (1984):

$$K = Ko * \exp(-0.046 * Z)$$

where: Ko = base hydraulic conductivity near surface (m/day), and

Z = depth of the coal seam (m)

Using this equation with starting values of K_h = 0.2, a correlation between depth and hydraulic conductivity allowed for true values to be distributed across the model domain. Hydraulic conductivity values ranging from 0.001 – 0.9 m/day were applied to the model, and their distribution according to depth of overburden and compartmentalisation from faulting is illustrated in **Figure 6-6**.

No hydraulic data was available for the alluvial unit. The range of hydraulic conductivity values for alluvial deposits of between 1 m/day and 90 m/day as reported by Freeze and Cherry (1979) has been adopted. For the purpose of this model, a value of 10 m/day has been assigned to Layer 1.

6.3.4.2 Storativity and Specific Yield

Specific Yield (*Sy*) values used in the model are tabulated in **Table 6-1**. Storage parameters for the Rangal Coal Measures aquifer were derived from proximal pumping tests. As a result, a representative *S* value of 10^{-4} and a *Sy* value of 0.08 were assigned to the model.

No pumping or yield testing data was available for the alluvial unit. The range of storativity values for a medium sand are between 0.15 and 0.26 as reported by Fetter (1994). For the purpose of this model a value of 0.2 has been assigned to Layer 1.

6.3.4.3 Vertical Leakance

Vertical leakance has been incorporated into the groundwater model in order to represent the interaction between the Quaternary aquifer and the Rangal Coal Measures. Layer 1 has been assigned vertical leakance values of 0.0027 in the areas where the Rangal Coal Measures is thought to be in direct contact with the Quaternary alluvium. Vertical leakance (*VCONT*) values were calculated using the following equation:

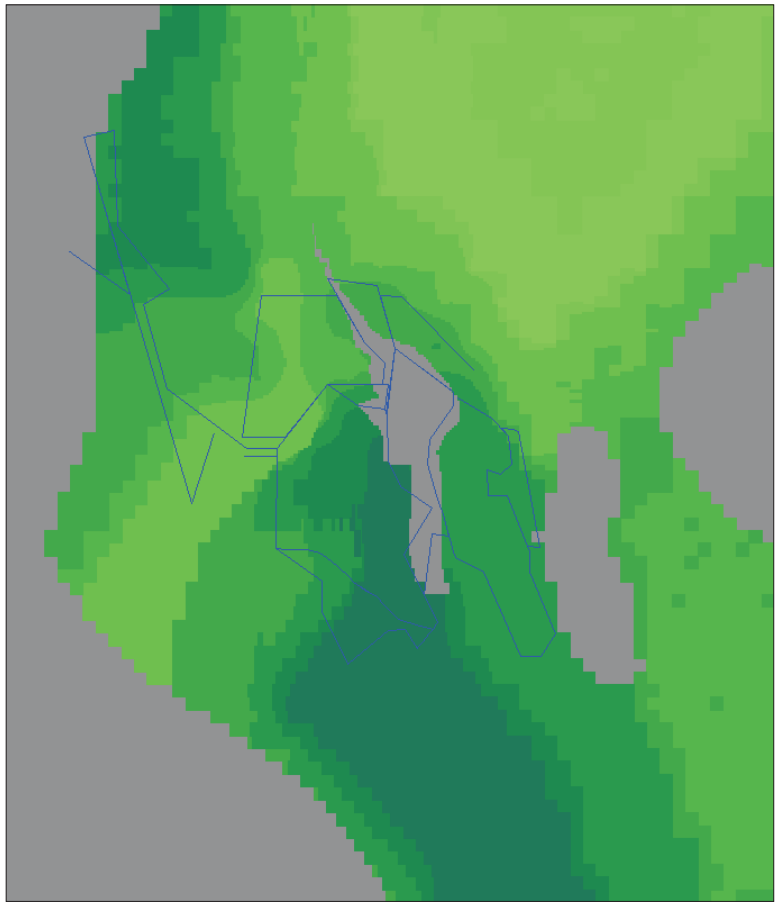
$$VCONT = \frac{2}{\frac{\Delta V_{k1}}{(K_z)_{k1,i,j}} + \frac{\Delta V_{k2}}{(K_z)_{k2,i,j}}}$$

Where ΔV represents layer thickness for the alluvium (*k1*) and the Rangal Coal Measures (*k2*). $(K_z)_{k,i,j}$ and $(K_z)_{k2,i,j}$ are the vertical hydraulic conductivity values of layers *k1* (Quaternary alluvium) and *k2* (Rangal Coal Measures), respectively.

The remainder of the Layer 1 is hydraulically disconnected to the Rangal Coal Measures and has therefore been assigned vertical leakance values of zero. Cells that were assigned to vertical leakance values are shown in **Figure 6-6**.

Table 6-1 Model aquifer parameters

Layer – active unit	Parameter	Value
Layer 1 Quaternary alluvium	Horizontal Hydraulic Conductivity (K_h) (m/day)	10
	Vertical Hydraulic Conductivity (K_v) (m/day)	1
	Storage Coefficient (*S*)	10^{-4}
	Specific Yield (*Sy*)	0.2
	Vertical Leakance (VCONT) (1/day)	0.0027
Layer 2 Rangal Coal Measures	Horizontal Hydraulic Conductivity (K_h) (m/day)	0.001 - 0.9
	Vertical Hydraulic Conductivity (K_v) (m/day)	n/a
	Storage Coefficient (*S*)	4×10^{-4}
	Specific Yield (*Sy*)	0.08
	Vertical Leakance (VCONT) (1/day)	n/a

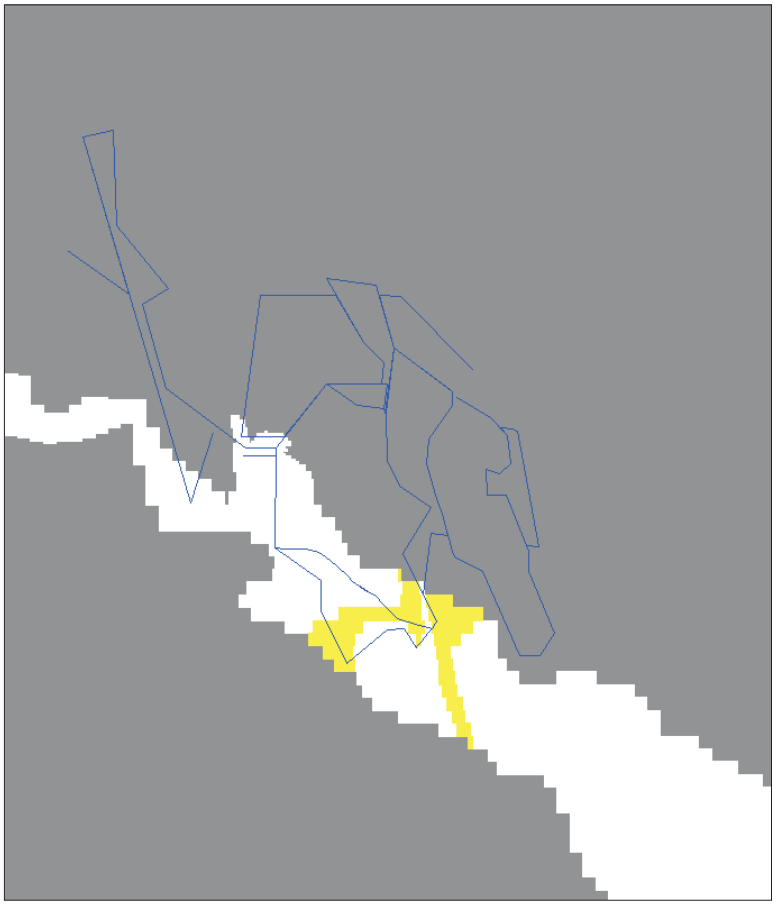


Horizontal hydraulic conductivity (Hk) (Layer 2)

Key: Hk (m/day)

- 0.001
- 0.05
- 0.1
- 0.3
- 0.5
- 0.9

Mine lease boundary



Vertical leakance cells (VCONT) (Layer 1)

Key:
Vertical leakance (1/L/day)

- 0
- 0.0027

Mine lease boundary

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Horizontal hydraulic conductivity and vertical leakance zones - Figure 6-6

6.3.5 Modelled Timeframe

Pre-mining groundwater levels are available from 2004 and therefore a start date of January 2004 was selected for the model in order to inversely calibrate aquifer parameters to match observed and simulated hydraulic heads. The predictive model progressed from 2004 with yearly stress periods for a total of 25 years. This incorporated cumulative mining operations from the Millenium Mine and surrounding mines (2006-2028) with the predictive period extended beyond 2028 to investigate post-mining groundwater recovery.

6.4 STEADY STATE CALIBRATION

The objective of model calibration was to match observed Rangal Coal Measures groundwater levels to simulated hydraulic heads in order to test the models ability to faithfully recreate the hydrogeologic regime.

Steady state calibration involved the continual adjustment of hydrogeological parameters including recharge, hydraulic conductivity and specific coefficient until the closest match between model predicted water levels and field measured water levels was reached.

6.4.1 Calibration Targets

Thirteen observation points were available for calibration including a combination of Poitrel monitoring bores, proximal DERM registered bores and surrounding landholder bores. Due to a lack of long-term monitoring data it was determined that water levels in these bores were representative of the long term average (steady state) groundwater levels.

Groundwater bores used in the calibration process are listed in **Table 6-2**. It should be noted that the landholder bore surface elevations in mAHD (Bores 1 - 12) were unavailable and were derived from surface topography digital elevation models available. As a result, these results should be considered to have an inherent error of ±5 m.

6.4.2 Calibration Results

Comparison of observed and simulated groundwater levels in the model area are given in **Table 6-2** and a scattergram with observed and calculated water levels is shown on **Figure 6-7**.

The predicted hydraulic heads closely match historic (i.e. pre-mining) groundwater levels observed within the model area, this is reflected with a correlation coefficient (r^2) of 0.92 (refer to **Figure 6-7**).

A recognised method to evaluate the calibration of the model is to examine the error between the modelled and observed (measured) water levels using the root mean square (RMS), expressed as:

$$RMS = [1/n \Sigma(h_o - h_s)_i^{\,2}]^{0.5}$$

where: n = number of measurements

h_o = observed water level

h_s = simulated water level

The RMS error of the calibrated model is 4.81 m. The maximum acceptable value for the calibration criterion depends on the magnitude of the change in heads over the model domain. If the ratio of the RMS error to the total head loss in the system is small, the errors are only a small part of the overall model response, (Anderson and Woessner, 1992). The total observed head loss within the model domain is 26.1 m, therefore the ratio of RMS to the total head loss is 18.4%. Taking into account the uncertainty associated with the calibration targets and assumptions made regarding aquifer parameters, this calibration error is considered to be acceptable.

Table 6-2 Calibration targets and simulated standing water levels

Bore ID	Observed standing water level (mAHD)	Simulated standing water level (mAHD)	Difference (m)
13040284	233.73	230.61	-3.12
141157	186.26	186.46	1.46
7987	186.13	190.51	4.25
7979	182.02	190.51	4.38
7978	182.00	188.31	6.29
7998	185.00	188.31	6.31
Bore 1	190.30	181.35	-8.95
Bore 2	195.00	190.5	-4.50
Bore 4	190.00	189.96	-0.04
Bore 5	184.00	189.1	5.10
Bore 8	174.00	173.95	-0.05
Bore 10	187.00	182.91	-4.09
Bore 12	237.50	232.13	-5.37

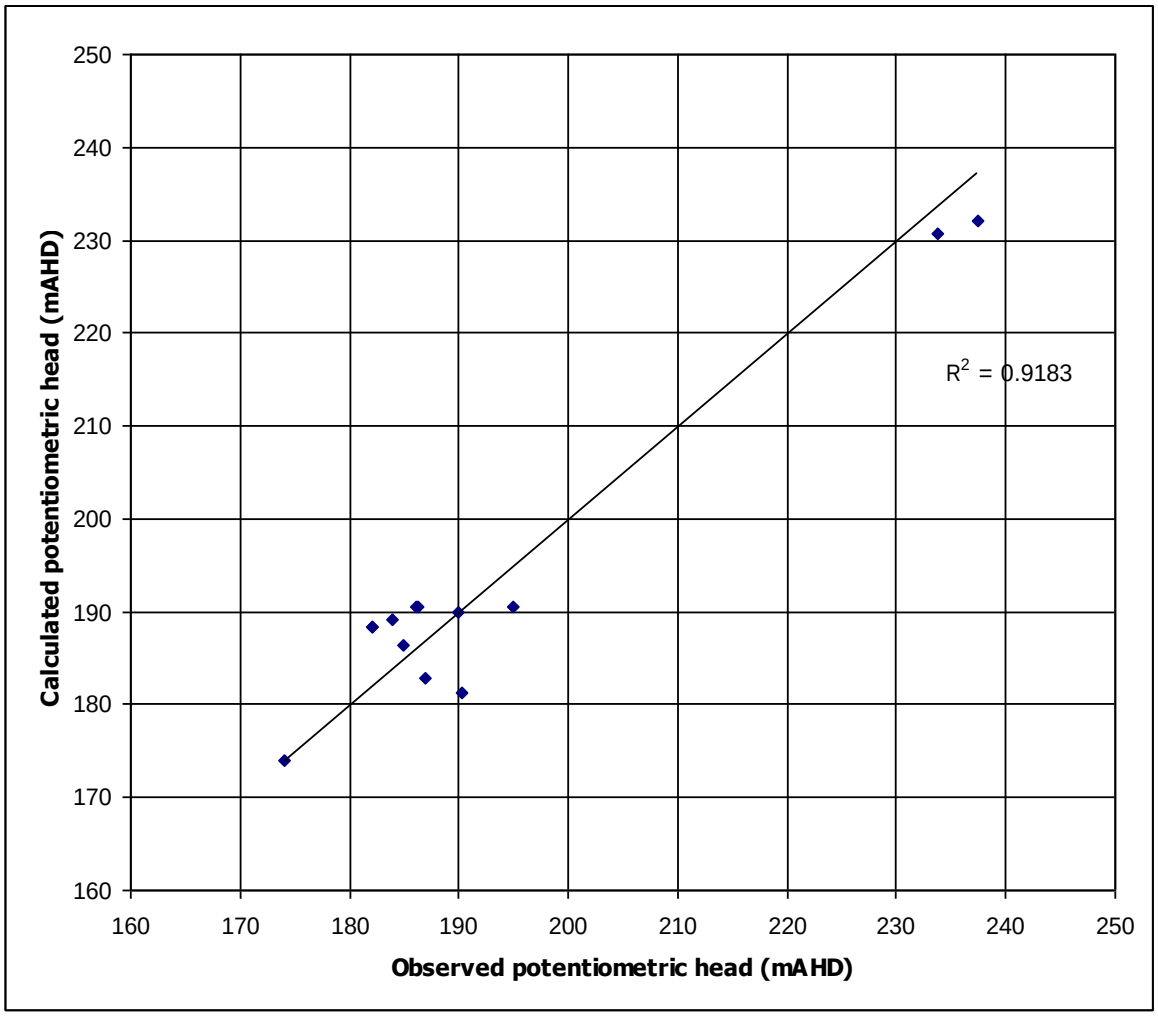


Figure 6-7 Scattergram – calibrated versus observed groundwater levels

7 MODEL PREDICTIONS

Based on the results of the calibration, a separate prediction model was developed. This model used the calibrated parameters and the simulated groundwater levels of the calibration model as initial hydraulic heads for the transient simulation.

7.1 MODELLING SCENARIO

The response of the groundwater system resulting from the cumulative dewatering of the MEP and surrounding operations was assessed by running the model from 2004 to 2028, a period of 25 years.

Progressive mining at the MEP and surrounding operations was simulated using drain cells. Drain cells allow water to be removed from the model domain by recreating dewatering. Drain cells were moved in yearly intervals across the operations in accordance with the proposed individual mine plans. **Table 7-1** shows the operational periods of individual mines and drain cell activation.

The model was used to predict drawdowns in the Rangal Coal Measures over a 23-year period (2006 – 2028). The predictive model produced outputs (drawdowns and mass balances) for 5 year intervals until the end of mining at the MEP in 2027. Mass balance results are presented in **Appendix A**.

Table 7-1 Mining timeline

Mine operation	Years of operation (drain cell activation)
Millennium pit (MEP)	2006 - 2014
Mavis pit (MEP)	2011 - 2027
Carborough Downs	2009 - 2027
Daunia pit	2009 - 2028
Poitrel pit	2006 - 2025

At the cessation of mining at the MEP and surrounding operations, groundwater levels previously drawn down by the mining operations will begin to recover (i.e. water levels will begin to rise). Recovery of groundwater levels will fill the pit (i.e. final voids), plus re-saturation of all aquifers (and layers) that have drained or partially drained during mine dewatering. The re-saturation of aquifers will rise over time to the elevation of the pre-mining water table. To simulate post mining conditions, the model was modified to predict the cessation of pumping and assess the rate of recovery. Nineteen stress periods were assigned to the model to simulate groundwater recovery for the next 340 years.

In order to simulate recovery conditions, drain cells were removed and waste rock was incorporated into the recovery model. Waste rock cells were assigned increased hydraulic conductivity (K_h = 5 m/day) and specific yield values (Sy = 0.1). A net recharge value of 0.8% of total rainfall was assigned to these cells in order to simulate direct infiltration to the aquifer system through the waste rock. Recharge values for the recovery model are presented in **Figure 6-4**.

7.2 PIT INFLOW RATES

Using the water budget extractor in PMWIN, pit inflow rates for the MEP pits were simulated. Predicted inflows to the pits over the mining period are presented in **Table 7-2** and **Figure 7-1**.

Table 7-2 Groundwater inflow rates into MEP pits

Pit	Units	Estimated groundwater inflow rates			
		Year 5	Year 10	Year 15	Year 18
Millennium Pit	ML/day	0.07	0.02		
	ML/Year	24.28	8.83		
	L/s	0.77	0.28		
Mavis Downs Pit	ML/day	0.11	0.14	0.17	0.09
	ML/Year	38.54	52.69	62.44	33.43
	L/s	1.22	1.67	1.98	1.06

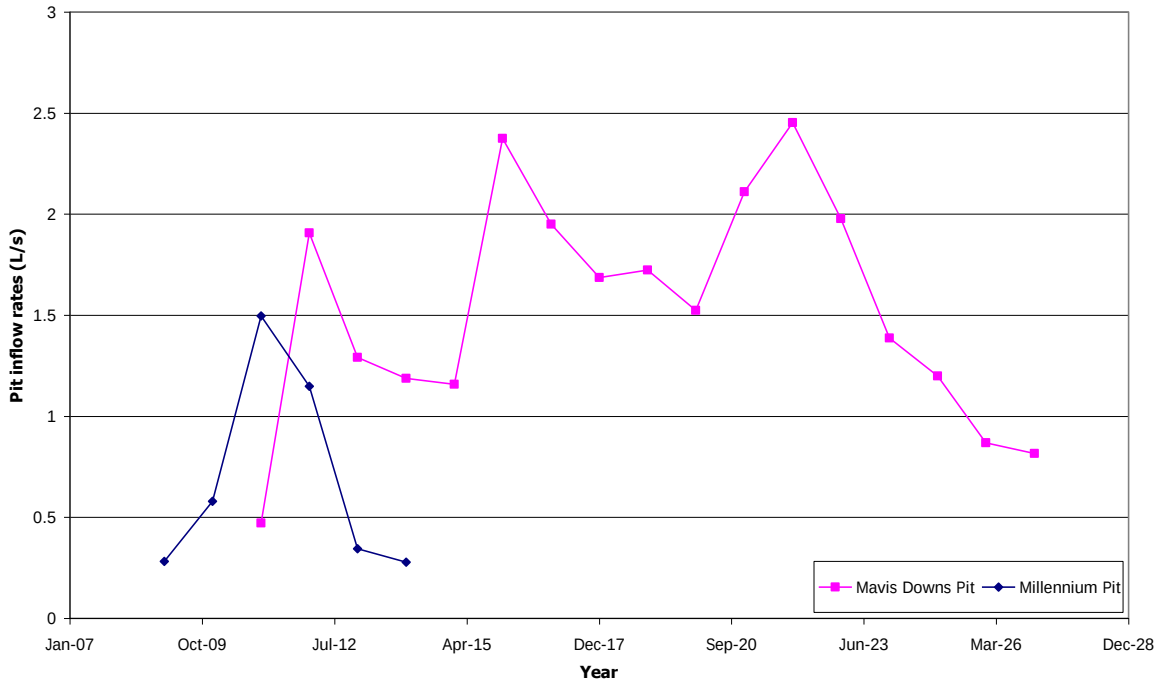


Figure 7-1 Simulated Millennium Mine and the MEP pit inflows

The MEP Mavis pit is expected to encounter higher inflow rates due to the greater depth and larger circumference of the pit compared to the Millennium pit (refer to **Table 7-2**).

Figure 7-1 indicates that groundwater inflow rates from the walls of the exposed Rangal Coal Measures are predicted to be relatively low at between 0.28 L/s to 1.98 L/s. This inflow will be distributed across the area of active mining, a portion of this inflow would be expected to evaporate with the remainder removed via dewatering sumps. It is also likely that groundwater flow through the Rangal coal measures waste rock makes up a significant proportion of this inflow. Modelling results indicate initial flows into the MEP Mavis Pit reduced from 1.2 to 0.5 L/s with the inclusion of dewatering of Carborough Downs. After this, comparative inflows using the inclusion/exclusion of Carborough Downs are similar, suggesting that dewatering activities associated with the Carborough Downs Mine have a minimal impact on MEP Mavis Pit inflows.

7.3 GROUNDWATER LEVELS

During the life of the MEP, the rate of groundwater extraction from the mine workings will exceed the rate that the Rangal Coal Measures can recharge. This will lead to drawdown of the potentiometric surface (i.e. groundwater levels) in the vicinity of the MEP when compared to pre-mining levels at this location.

The impact of mining related groundwater extraction on the Rangal Coal Measures aquifer has been simulated within a numerical groundwater flow model. The potential impact is illustrated via a series of groundwater drawdown contour maps at various stages through the MEP mine life (**Figure 7-2** to **Figure 7-5**). The 2 m contours represents the maximum radius of influence, groundwater level changes less than 2 m are not considered to be significant as this is within expected seasonal fluctuations experienced within the region.

Dewatering by the MEP and the neighbouring mines is predicted to create an amalgamated drawdown cone in the Rangal Coal Measures to the north, east and west of the MEP. The largest drawdowns are immediately surrounding the MEP pits, with large radial drawdowns observed propagating north of the MEP, a cumulative response to dewatering of both the Mavis Downs Pit and the Carborough Downs Underground Mine. Drawdowns to the southwest are constricted owing to the unit outcropping and continued recharge to the Rangal Coal Measures via the Isaac River. Predicted groundwater drawdown of 2 m within the Permian aquifer will reach approximately 9 km to the north and 6 km west of the MEP at the end of mining at the MEP. Drawdowns of up to 10 m will reach the eastern termination of the Rangel Coal Measures as a result of cumulative impacts from Carborough Downs.

Groundwater drawdown observed in the north east of the project may be exaggerated and misrepresented. Drawdown contours in this area of the project area may be influenced by the Carborough Downs mine, and therefore a level of error in the area immediately surrounding Bore 12 should be taken into consideration.

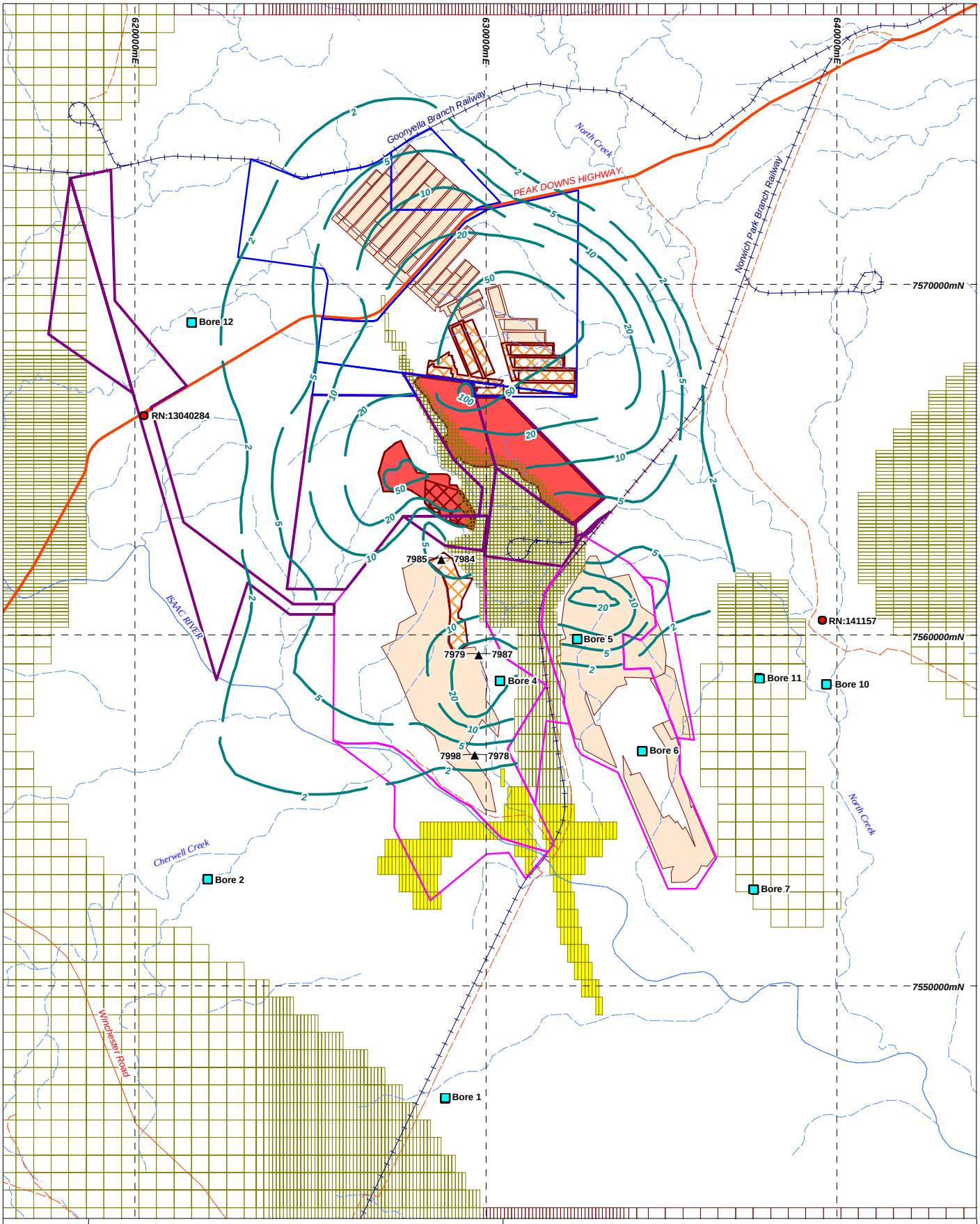
Figure 7-6 shows hydrographs of the predicted decline of groundwater levels in bores surrounding the MEP for the period of mining. The grey cells on the map represent areas where the Rangal Coal Measures outcrops and terminates. The largest drawdown predicted in the Rangal Coal Measures aquifer is 29.96 m in bore 7987. This is to be expected as this bore is located on the edge of the Poitrel Mine pit.

Drawdown impacts within the Quaternary alluvial aquifer have not been simulated as dewatering associated with the MEP is expected to have a minimal impact on groundwater levels within the aquifer. This is due to the hydraulic disconnection between the Quaternary and Permian aquifers.

7.4 GROUNDWATER RECOVERY

Following the cessation of mining, groundwater will continue to inflow into the final pit voids. Water levels within the pits and the surrounding aquifer will immediately begin to recover. Groundwater recovery post mining was also assessed by the model. The recovery in groundwater levels in the Rangal Coal Measures within pits and surrounding bores after completion of mining is shown in **Figure 7-7**.

Groundwater simulation results suggest that regional groundwater levels will reach equilibrium conditions after approximately 350 years. The majority of the pits will be filled with mine waste rock, which will act as a transmissive medium for groundwater levels to recover through. Groundwater levels immediately surrounding the Millennium pit recover quickly. This is due to the increased recharge through pit waste rock, resulting in elevated equilibrium groundwater levels in these areas, relative to surrounding areas. According to final pit designs, the only remaining MEP final void will be the south-eastern section of Mavis pit. Here, groundwater recovery rates will be slow due to the direct evaporation of the exposed pit lake water body.



LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse
- Drawdown contour (m)
- Permian DERM registered bore
- Permian landholder unregistered bore
- Peabody tenement
- BMA tenement
- Vale tenement
- Existing Mountain Pit
- Proposed MEP mine
- Other existing mine
- Other proposed mine
- Model boundary
- No flow zone
- Vertical leakance

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Groundwater drawdown year 5 (2013)
Rangal Coal Measures

0 3 6

Kilometres

Scale: 1:150,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 7-2

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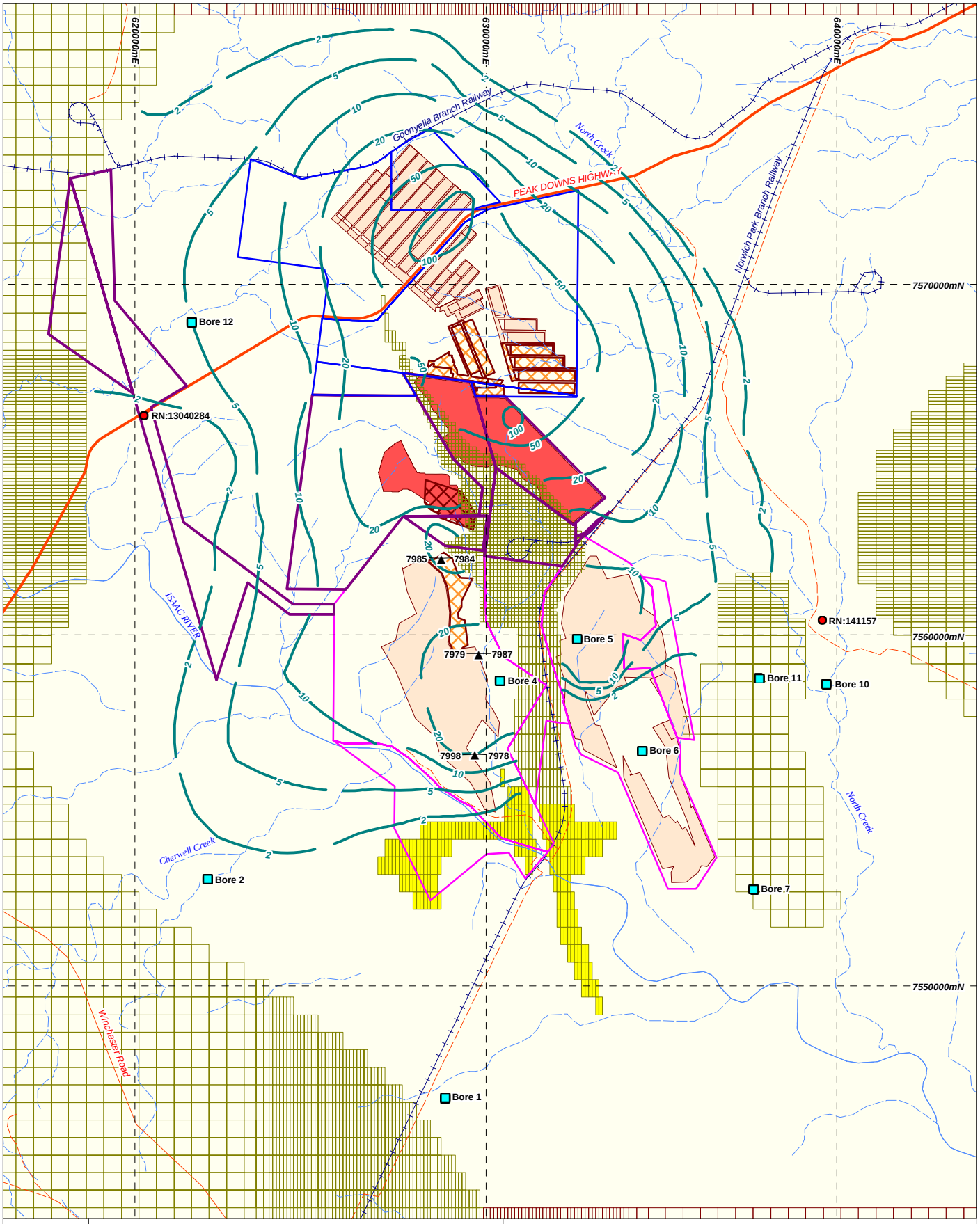
620000mE
630000mE
640000mE
7570000mN
7560000mN
7550000mN
Goonyella Branch Railway
North Creek
PEAK DOWNS HIGHWAY
Norwich Park Branch Railway
Bore 12
RN:13040284
7985
7984
7979
7987
7998
7978
Bore 5
Bore 4
Bore 6
Bore 11
Bore 10
RN:141157
Bore 7
Bore 2
Bore 1
ISAAC RIVER
Cherwell Creek
Winchester Road
LEGEND
Principal road
Road (sealed)
Road (unsealed)
Railway
River
Watercourse
Drawdown contour (m)
Permian DERM registered bore
Permian landholder unregistered bore
Peabody tenement
BMA tenement
Vale tenement
Existing Mountain Pit
Proposed MEP mine
Other existing mine
Other proposed mine
Model boundary
No flow zone
Vertical leakance
Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.
Peabody Energy Australia Pty Ltd
Millennium Expansion Project
Groundwater drawdown year 10 (2018)
Rangal Coal Measures
0
3
6
Kilometres
Scale: 1:150,000 (A4)
12/05/2010
Datum: GDA94
Projection: MGA55
FIGURE 7-3
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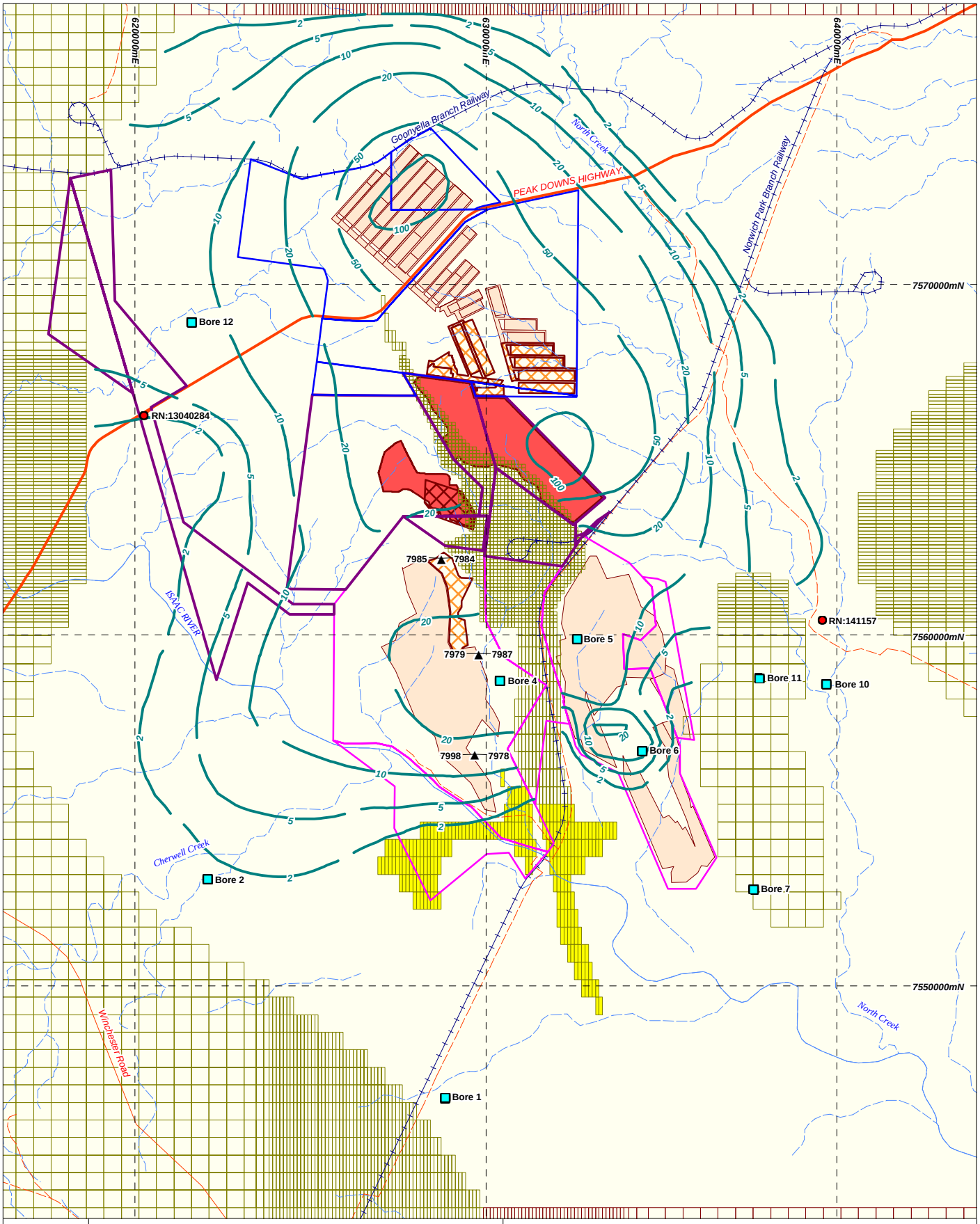

LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse
- Drawdown contour (m)
- Permian DERM registered bore
- Permian landholder unregistered bore
- Peabody tenement
- BMA tenement
- Vale tenement
- Existing Mountain Pit
- Proposed MEP mine
- Other existing mine
- Other proposed mine
- Model boundary
- No flow zone
- Vertical leakance

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Groundwater drawdown year 15 (2023)
Rangal Coal Measures

0 3 6

Kilometres

Scale: 1:150,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 7-4

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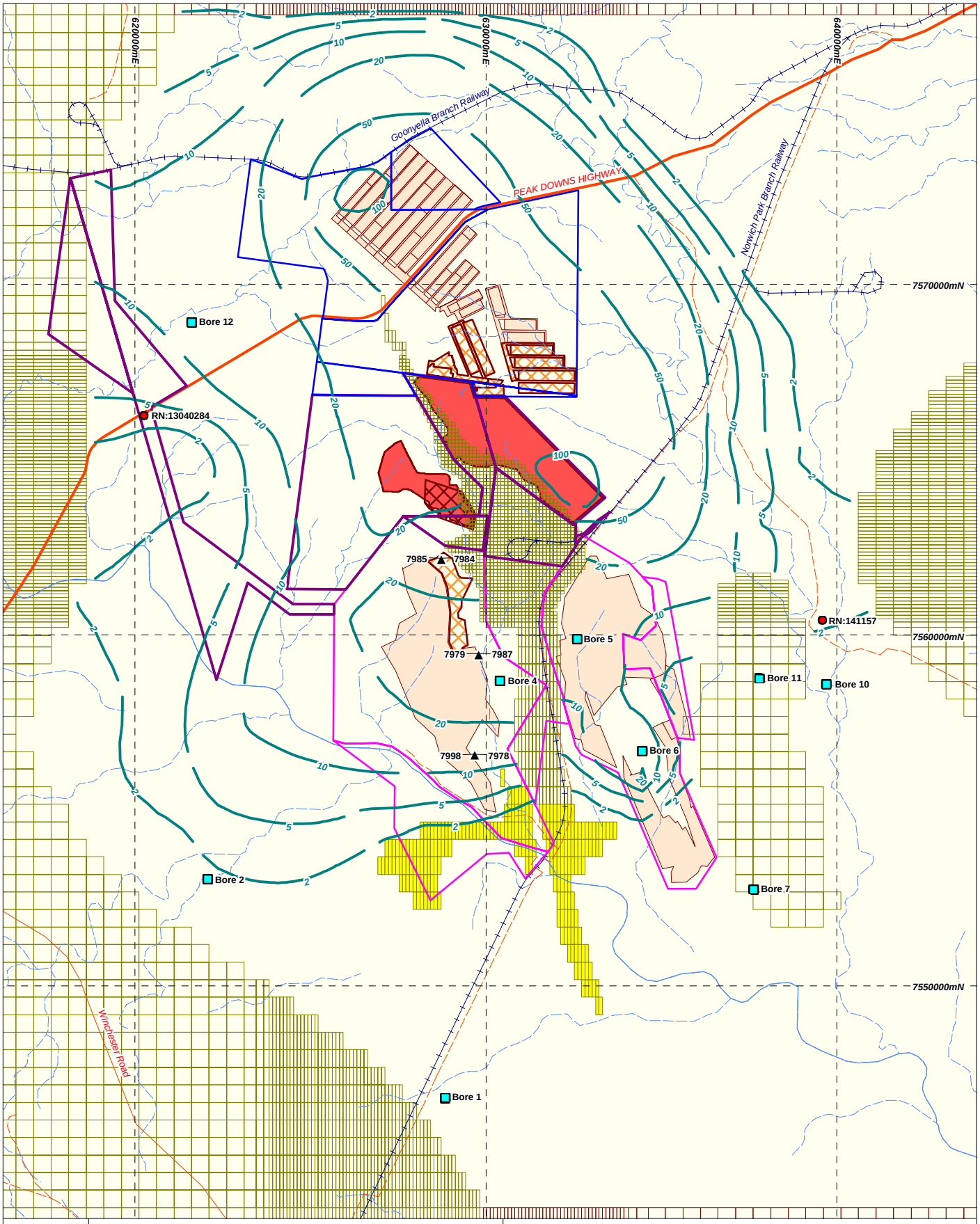


LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse
- Drawdown contour (m)
- Permian DERM registered bore
- Permian landholder unregistered bore
- Peabody tenement
- BMA tenement
- Vale tenement
- Existing Mountain Pit
- Proposed MEP mine
- Other existing mine
- Other proposed mine
- Model boundary
- No flow zone
- Vertical leakance

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

matrixplus

Peabody

P:\Projects\Peabody_MapInfoWorkspaces\PEA0801_M067H.wor

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Groundwater drawdown year 19 (2027)
Rangal Coal Measures

0 3 6

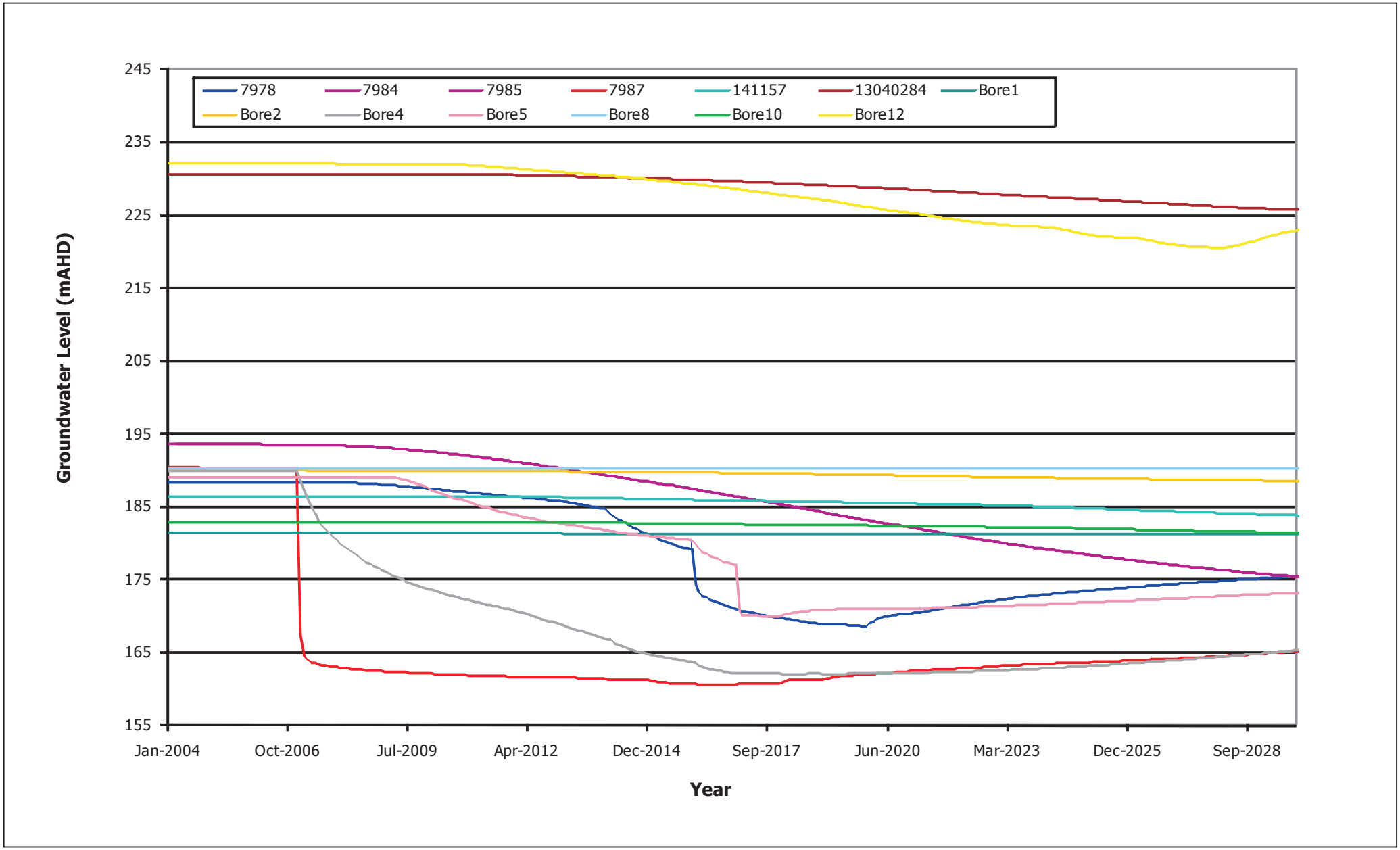
Kilometres

Scale: 1:150,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 7-5



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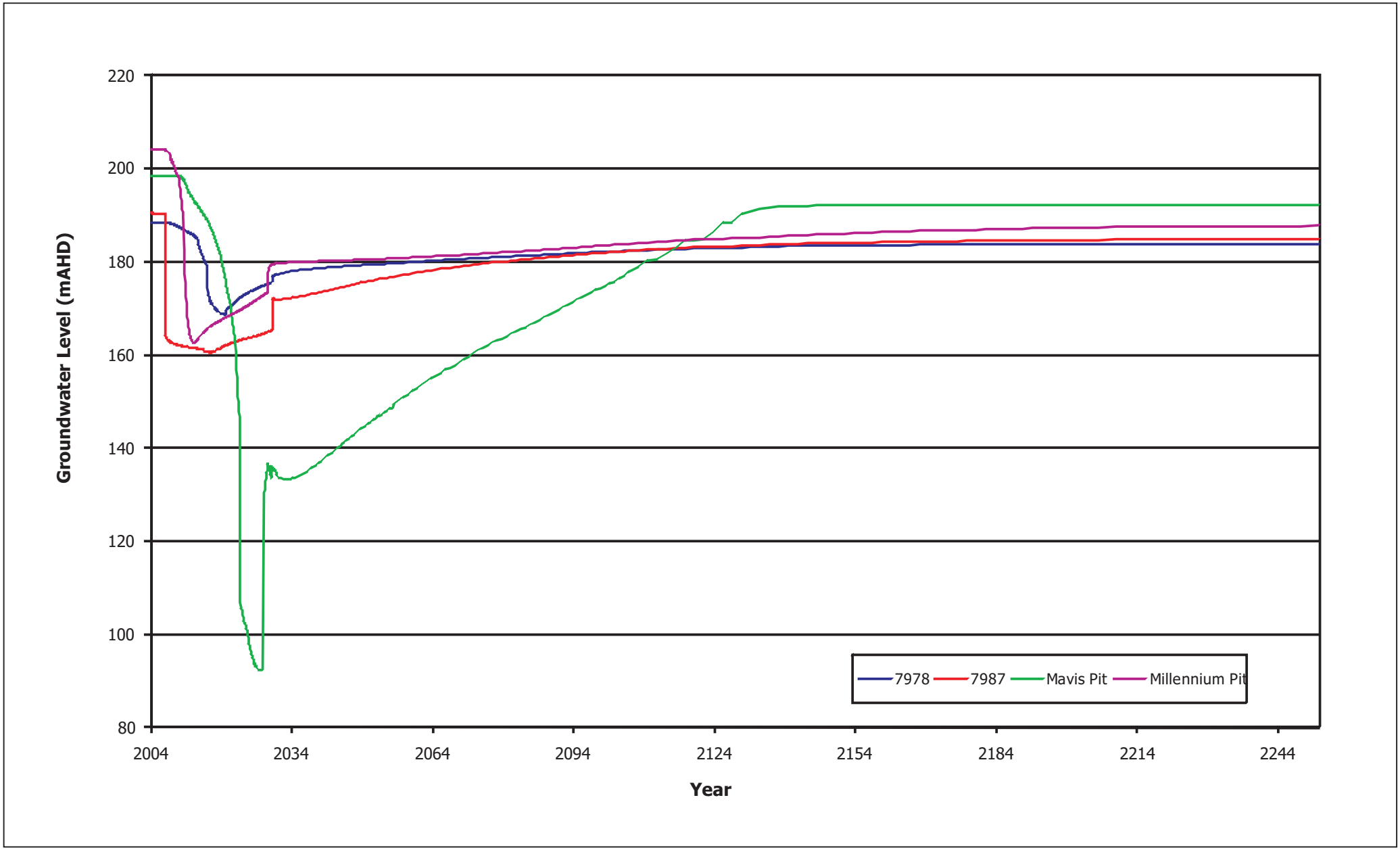
Peabody Energy Australia Pty Ltd
Groundwater Impact Assessment

Hydrograph of predicted groundwater drawdown in surrounding bores - Figure 7-6



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Peabody Energy Australia Pty Ltd
Groundwater Impact Assessment

Groundwater level recovery post-mining activities - Figure 7-7

7.5 SENSITIVITY ANALYSIS

While the model has been constructed with the best available understanding of model parameters, some of the parameters are assigned based on assumed or expected aquifer performance. Sensitivity analysis is performed in order to observe the level of uncertainty within the model predictions in order to quantify the errors associated with the aquifer parameters (Anderson and Woessner, 1992).

All non-variable aquifer parameters were assessed. The uncertainties of these parameters were evaluated by increasing and decreasing the parameters by an order of magnitude and re-running the simulation. In order to assess the confidence in predictions from the model, the simulated hydraulic heads within surrounding bores were compared for various parameters estimates (refer to **Table 7-3**).

The analysis demonstrates that predicted drawdowns in the Rangal Coal Measures are highly sensitive to recharge and relatively insensitive to the estimated values of storage coefficient. The model displays moderate sensitivity with the adjustment of specific yield.

Despite the current level of uncertainty the model is considered sufficiently accurate to gain an understanding of the impacts of the MEP and surrounding mines on the groundwater regime and is therefore suitable for the purposes of the EIS.

Table 7-3 Sensitivity analysis compared to modelled values

Parameter	Value	Average variation (m)	Variation range (m)
Storage coefficient	0.00004	-0.13	-1.08 – 0.02
	0.0004	-	-
	0.004	0.39	-0.01 – 2.50
Specific yield	0.03	-1.56	-9.97 – 3.32
	0.08	-	-
	0.16	1.13	-0.64 – 7.08
Recharge (L/day)	R * 0.1	-0.25	-1.97 – 0.00
	R = 3.2 x 10^{-6} & 1.3x 10^{-5}	-	-
	R * 10	2.68	0.00 – 21.29

NB: Values in **bold** represent parameters used in the final groundwater model

8 POTENTIAL GROUNDWATER IMPACTS

8.1 IMPACTS ON GROUNDWATER LEVELS

As mining progresses to depths below the pre-mining standing water level of the Rangal Coal Measures in the MEP pit areas and adjacent mines, groundwater will discharge into the pits. As a consequence surrounding groundwater levels will progressively lower forming a cone of depression around the pits.

It is expected that substantial groundwater drawdown will occur in the Rangal Coal Measures aquifer which is intersected by the mining. Other regional aquifer systems including the Quaternary alluvial will not experience groundwater drawdowns as they are not hydraulically connected to the affected Rangal Coal Measures.

The cumulative impacts of the existing Millennium and Poitrel Mines and the proposed Daunia Mine have been simulated in the model along with the MEP. Modelling suggests that groundwater drawdown from each mines dewatering will overlap resulting in an increased impact on the Rangal Coal Measures aquifer. Groundwater drawdowns are expected to extend beyond the bounds of Peabody and BMA mining leases.

8.1.1 Impacts on Surrounding Groundwater Users

A review of surrounding bores has identified 9 production bores that screen the Rangal Coal Measures aquifer. Predictive modelling indicates that the majority of bores screened within the Permian Rangal Coal Measures immediately surrounding the MEP will be impacted by dewatering throughout the life of the mine. The predicted maximum drawdown on surrounding groundwater user bores are summarised in **Table 8-1**.

The largest predicted drawdowns occur close to the pits with bores exhibiting water level reductions ranging from 19.10 - 27.91 m (refer to **Table 8-1**). Groundwater level changes of this magnitude would impede the use of these bores. However it is assumed that these bores (4 and 5), located within the Poitrel and Daunia mining leases, will not be utilised as production bores to extract groundwater.

Predicted drawdowns within surrounding landholder bores outside of mine leases are varied. Bores 12, 13040284 and 141157 exhibit groundwater reductions greater than 2 m, greater than the range of natural groundwater fluctuation (i.e. ±2 m) due to seasonal variation. Bore 12 has the greatest drawdown of the regionally located bores, experiencing drawdowns up to 11.58 m, which could potentially affect bore yields. Based on modelling results, this extensive drawdown cone is the result of significant dewatering of the nearby Carborough Downs Mine to the east of the bore.

Table 8-1 Predicted groundwater drawdown in the Rangal Coal Measures

Bore ID	Bore type	Distance from MEP pits (km)	Maximum predicted groundwater drawdown (m)
Bore 1	unregistered landholder	16.2	0.05
Bore 2	unregistered landholder	12.3	1.50
Bore 4	unregistered landholder	4.4	**27.91**
Bore 5	unregistered landholder	3.3	**19.07**
Bore 8	unregistered landholder	12.6	0.00
Bore 10	unregistered landholder	8.4	1.52
Bore 12	unregistered landholder	6.6	**11.58**
141157	DERM registered	7.2	**2.67**
13040284	DERM registered	6.6	**4.81**

The potential impact on the groundwater users of bores 4, 5, 12 and 141157 include:

- reduction in bore pumping rate due to lower groundwater levels;
- inlet valves within bores may have to be lowered in order to maintain sufficient head of water above the pump. This may increase the cost of extracting groundwater from bores;
- new pumps may be required if existing pumps are not powerful enough to lift groundwater from the increased depth beneath the surface; and
- in some situations, bores may need to be deepened or relocated in order to ensure sufficient long-term water supply.

The actual impact on groundwater users of these two bores is likely to be negligible given the minimal use of the aquifer due to marginal water quality and generally low inflow rates.

8.2 IMPACTS ON GROUNDWATER QUALITY

8.2.1 Impact on Environmental Values

Groundwater within the Rangal Coal Measures aquifer is generally of poor quality and the environmental value has been assessed as being "primary industry" (Section 3.8).

The impact from dewatering during mining on the Rangal Coal Measures aquifer will be volumetric, i.e. groundwater discharge into pits will reduce water levels but have no impact on water quality within the surrounding aquifer.

Based on analysis of exploration lithological samples, it is concluded that the stockpiled overburden excavated from the open cut pits is not expected to present an ARD (acid rock drainage) or salinity risk and there are no restrictions for the proposed uses for this material in regard to ARD or salinity. Therefore runoff/recharge from overburden stockpiles is not expected to impact on groundwater pH or salinity through leaching.

It is understood that the fine rejects (tailings) will initially be disposed of within pits. Construction of the tailings facility will include a low permeability base layer that will minimise seepage to groundwater. Therefore significant impacts on groundwater quality are not considered likely.

There is potential for spills and contamination by metals and hydrocarbons from mine workshop, waste disposal and fuel storage areas. However adequate bunding and clean-up of spills as per standard practice or a legislated requirement at mine sites, should prevent contamination of shallow strata and subsequent leakage to the groundwater system.

In summary, as groundwater in Rangal Coal Measures aquifer is of poor quality, and there is no potential for it to be degraded further due to the MEP, the available information indicates the assigned environmental values will be maintained.

8.3 POST MINING IMPACTS

Following cessation of mining at the MEP and surrounding mines, dewatering will cease and groundwater will continue to discharge into the Mavis pit, which will be left as final void at the southern extent of the mine footprint. As the final void fills with groundwater seepage, direct rainfall and surface runoff water levels within the Rangal Coal Measures will begin to recover.

The high evaporation rates in the region will slow the rate of recovery of groundwater levels by constantly removing water from the final void water surface. Groundwater simulation results suggest that regional groundwater levels will recover reaching equilibrium conditions after approximately 350 years.

During the period of aquifer recovery, surrounding groundwater bores that have been affected (i.e. Bore 12) by dewatering during mining will experience a rebound in groundwater levels.

As a consequence of evaporation, the salinity level of the water in the final voids is expected to rise over time. However deteriorating water quality in the final void is not expected to impact upon the groundwater quality within the Rangal Coal Measures aquifer as the water in the void is unlikely to discharge or seep to the surrounding aquifer because:

- high evaporation rates will result in the final void water level being lower than the potentiometric level within the surrounding aquifer. Evaporation over the surface of the final void water body causes a permanent sink in the regional potentiometric surface within the vicinity of the final void;
- groundwater will flow under pressure towards the final void along a hydraulic gradient, from areas of high pressure head to areas of low pressure head (i.e. the final void). Accordingly, the permanent depression of the potentiometric surface within the vicinity of the void acts like a sink and will not permit potentially poorer water within the final void to flow outwards into the Rangal Coal Measures aquifer; and
- the Rangal Coal Measures aquifer outside the mining lease areas will continue to receive recharge via the same processes that occurred pre-mining and are not expected to change in quality from pre-mining levels.

The mining and dewatering operations are not expected to have a detrimental impact to the groundwater quality in the vicinity of the MEP. Hence, the post mining groundwater quality within the Rangal Coal Measures aquifer surrounding the MEP is expected to remain the same as pre-mining groundwater quality.

9 PROPOSED GROUNDWATER MONITORING AND MITIGATION

Regular groundwater level monitoring should be undertaken to enable groundwater level drawdowns to be identified prior to any impacts being experienced in surrounding bores. It is recommended that ten monitoring bores be installed within the Rangal Coal Measures. The monitoring program is summarised in **Table 9-1** and proposed bore locations are illustrated in **Figure 9-1**. It should be noted that bore locations are indicative only and should be finalised once the project has been approved and Environmental Authority conditions have been granted.

Construction of any bores should be in accordance with Minimum Construction Requirements for Water Bores in Australia, 2nd Edition September 2003 and the *Water Act 2000* and undertaken by a licensed water bore driller.

Groundwater level monitoring should be conducted at regular (quarterly) intervals, as the project is relatively long-term (i.e. approximately 20 years), water level data loggers could be installed which will be more cost effective than manual measurements. Full groundwater quality analysis for bores should be sampled initially during construction, followed by biannual analysis using low flow sampling techniques. A proposed list of parameters to be sampled is shown in **Table 9-1**. Sampling frequency and parameters should be reviewed annually to assess if the program requires alterations.

It is recommended that all groundwater monitoring, water level measurements and sample collection, storage and transportation be undertaken in accordance with the procedures outlined by the Murray Darling Basin Commission (1997).

The monitoring network should be installed as soon as practicable to allow collection of baseline data before the commencement of mining at the MEP. The groundwater level and quality data should be analysed on an annual basis by a qualified hydrogeologist to assess the impact of the MEP.

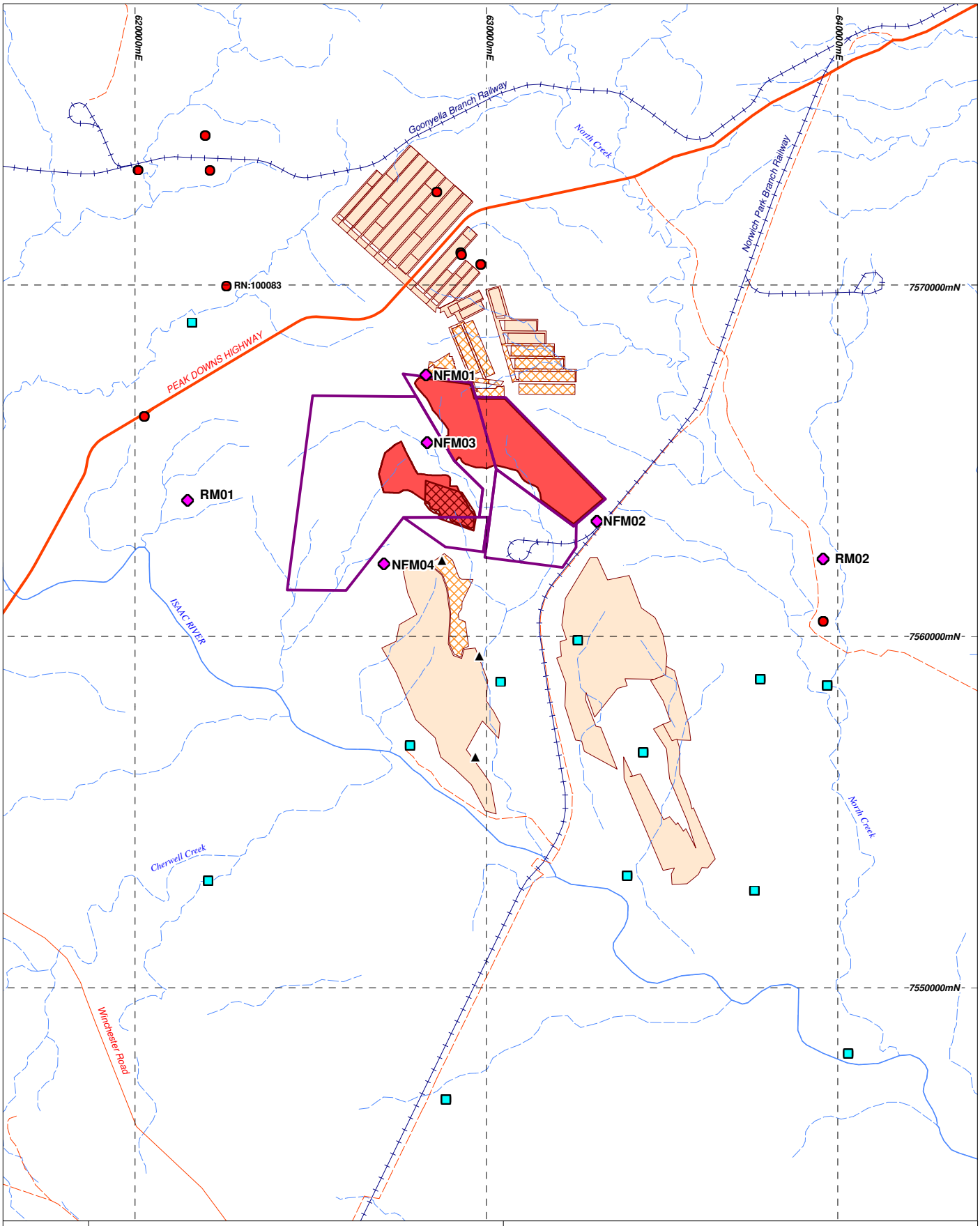
Dewatering of the open cut pits is necessary for mining at the MEP. Should a detrimental impact on groundwater supplies be detected, and shown to be related to this activity, then Peabody will seek to reach mutually agreeable arrangements with affected groundwater users. No practical mitigation measures exist for reducing the groundwater level drawdowns, therefore Peabody would need to assess options for providing an alternative, similar quality and volume water supply as that currently utilised by the affected landholder. As there is currently very limited use of the low-quality groundwater from the impacted aquifers, this is not considered a likely scenario. If required, options for alternative supplies include:

- deepen existing bores;
- replace/relocate bores;
- installation of additional bores; or
- provide water from an alternative source.

The proposed bores will provide groundwater levels in both local and regional extents, providing information on changes in groundwater levels. Two regional bores have been placed to provide impacts in known locations where dewatering associated with dewatering activities associated with the MEP alone. This was determined from the study of the expected groundwater impact areas presented in the respective EIS groundwater report chapters.

Table 9-1 Proposed groundwater monitoring program

Bore ID	Parameter	Frequency
NFM01	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
NFM02	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
NFM03	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
NFM04	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
NFM05	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
NFM06	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
RM01	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions
RM02	groundwater level	quarterly
	groundwater quality	biannual – ph, EC, TDS, °C, major cations & anions



LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- River
- Watercourse
- DERM registered bore
- Landholder unregistered bore
- Poitrel monitoring bore
- Proposed monitoring bore
- MEP tenement
- Existing Mountain Pit
- Proposed MEP mine
- Other existing mine
- Other proposed mine

Data Source:
Topography (250k) - Geoscience Australia. Infrastructure, Tenement - Minserve.

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Millennium Expansion Project

Proposed groundwater monitoring bore locations

0 3 6

Kilometres

Scale: 1:150,000 (A4)

12/05/2010

Datum: GDA94
Projection: MGA55

FIGURE 9-1

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Peabody

APPENDIX A
MASS BALANCE

Table A-1 Whole of model mass balance

Mass balance 5 Years (2013)			Mass balance 5 Years (2013)		
Cumulative ML			Current rate ML/day		
	In:	Out:		In:	Out:
Storage =	20363	1887	Storage =	14.8	1.9
Constant head =	0	0	Constant head =	0.0	0.0
Drains =	0	18970	Drains =	0.0	13.2
River leakage =	23058	20097	River leakage =	12.6	11.0
Head dep. bounds =	2878	8767	Head dep. bounds =	1.6	4.8
Recharge =	3416	0	Recharge =	1.9	0.0
Total=	49715	49721	Total=	30.9	30.9
% Discrepancy	-0.01		% Discrepancy	-0.19	

Mass balance 10 Years (2018)			Mass balance 10 Years (2018)		
Cumulative ML			Current rate ML/day		
	In:	Out:		In:	Out:
Storage =	55467	7402	Storage =	15.6	2.2
Constant head =	0	0	Constant head =	0.0	0.0
Drains =	0	49613	Drains =	0.0	13.9
River leakage =	46143	39942	River leakage =	12.6	10.9
Head dep. bounds =	5831	17548	Head dep. bounds =	1.6	4.8
Recharge =	6868	0	Recharge =	1.9	0.0
Total=	114310	114504	Total=	31.8	31.8
% Discrepancy	-0.17		% Discrepancy	-0.15	

Mass balance 15 Years (2023)			Mass balance 15 Years (2023)		
Cumulative ML			Current rate ML/day		
	In:	Out:		In:	Out:
Storage =	79508	13466	Storage =	13.2	3.3
Constant head =	0	0	Constant head =	0.0	0.0
Drains =	0	69502	Drains =	0.0	10.9
River leakage =	69437	59218	River leakage =	12.8	10.6
Head dep. bounds =	8966	26336	Head dep. bounds =	1.7	4.8
Recharge =	10361	0	Recharge =	1.9	0.0
Total=	168271	168522	Total=	29.6	29.6
% Discrepancy	-0.15		% Discrepancy	-0.11	

Mass balance 19 Years (2027)			Mass balance 19 Years (2027)		
Cumulative ML			Current rate ML/day		
	In:	Out:		In:	Out:
Storage =	93057	20534	Storage =	9.3	4.8
Constant head =	0	0	Constant head =	0.0	0.0
Drains =	0	77534	Drains =	0.0	5.5
River leakage =	88225	75341	River leakage =	12.9	11.0
Head dep. bounds =	11678	32306	Head dep. bounds =	1.9	4.1
Recharge =	13200	716	Recharge =	1.9	0.5
Total=	206159	206429	Total=	26.0	26.0
% Discrepancy	-0.13		% Discrepancy	-0.05	

Mass balance 20 Years (2028)			Mass balance 20 Years (2028)		
Cumulative ML			Current rate ML/day		
	In:	Out:		In:	Out:
Storage =	93057	20534	Storage =	4.6	5.3
Constant head =	0	0	Constant head =	0.0	0.0
Drains =	0	77534	Drains =	0.0	0.8
River leakage =	88225	75341	River leakage =	12.9	10.4
Head dep. bounds =	11678	32306	Head dep. bounds =	1.9	4.8
Recharge =	13200	716	Recharge =	2.0	0.0
Total=	206159	206429	Total=	21.3	21.3
% Discrepancy	-0.13		% Discrepancy	0.01	

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Millennium Expansion Project

Environmental Impact Statement

APPENDIX F5:

AIR

Noise Mapping Australia

Scalable Consulting Solutions

www.noisemapping.com.au

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Document title:

Millennium Mine Expansion

Document type:

Air Quality Assessment

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Contents

1. INTRODUCTION 4
1.1 Project Description 4
1.2 Locality Description 5
1.3 Identification of Issues to Be Addressed 6

2. DESCRIPTION OF EXISTING ENVIRONMENT 7
2.1 Climate 7
2.2 Dust 7

3. AIR QUALITY CRITERIA 11
3.1 Environmental Protection (Air) Policy 11
3.2 EPA License and Permits – Guideline 8 11
3.3 Site Specific Air Quality Criteria 12

4. AIR QUALITY MODELLING 13
4.1 Modelling Methodology 13
4.1.1 Preparation of Meteorological Data 13
4.1.2 Development of the Emissions database 15
4.1.3 Dispersion Model 18
4.2 Air Quality Results 19
4.3 Air Quality Assessment 21
4.4 Recommendations and Mitigation Measures 22

5. GREENHOUSE GAS EMISSIONS 23
5.1 Estimated Greenhouse Emissions 23
5.2 Discussion and Abatement Measures 27
5.3 Climate Change Adaptation 28

6. CONCLUSION 29

APPENDIX 1 CLIMATE DATA FOR MORANBAH 33

APPENDIX 2 DUST EMISSION RATE CALCULATION METHODOLOGY 36

APPENDIX 3 WINDROSES FOR THE SITE 39

APPENDIX 4 GREENHOUSE GAS SCOPE DESCRIPTION 40

1. Introduction

METServe, on behalf of Peabody Energy Australia Pty Ltd ('Peabody'), engaged Noise Mapping Australia ('NMA') to prepare an air quality assessment for the proposed Millennium Expansion Project (MEP) east of Moranbah.

The objective of this assessment is to provide Peabody with information to assist with obtaining the necessary approvals for the proposed expansion.

This report addresses the following issues:

- Description of existing air quality conditions;
- Description of air emissions from existing operations;
- Likely change in air quality following commencement of mining;
- Assessment of air quality to appropriate standards;
- Assessment of greenhouse gas emissions;
- Recommendations for relevant impact mitigation measures.

1.1 Project Description

The Millennium Coal Mine is an existing open-cut coal mine, operated by Millennium Coal Pty Limited (MCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Limited (Peabody). The Mine has been operating since 2005 with approval to produce at a rate of 2.0 Million tonnes per annum (Mtpa).

The Run-of-Mine (ROM) coal is currently extracted from two granted Mining Leases (ML) namely, ML70313 "Millennium West" and ML 70344 "Mountain Pit". The ROM coal is washed in a Coal Handling and Preparation Plant (CHPP) on an adjoining infrastructure lease, ML 70312 "Millennium East". Peabody proposes to extend the current open-cut mining operation into two new lease areas namely, Mineral Development Licence (MDL) 136 "Mavis Downs" and Mining Lease Application (MLA) 70401. Mining will also continue within ML 70313. The proposed expansion areas are collectively referred to as the "Millennium Expansion Project" (MEP). It is proposed the open-cut coal mining will slightly increase the existing Run of Mine (ROM) extraction rate from 5 Million tonnes per annum (Mtpa) to 5.5 Mtpa, to enable an estimated production rate of up to 3.5 Mtpa product coal. Mining involves clearing of vegetation, salvage of topsoil, stripping of overburden, extraction of the coal, placement of topsoil or growth media and revegetation. Coal mining will most likely be performed using truck and shovel terrace mining methods. Mined areas would be progressively rehabilitated.

The site is accessed from Peak Downs Highway approximately 16 km west of Coppabella and 22 km east of Moranbah. The site access road traverses pastoral holdings prior to entering ML 70313 in the northwest corner of the Millennium Coal Mine. The mine access road traverses a number of New Chum Creek tributaries and eventually New Chum Creek itself, prior to reaching the main industrial area. The access road then continues on to the CHPP on ML 70312. The access road is shared by the Poitrel Mine which lies to the south of the Millennium Mine.

Coal processing – mined coal will be transported to the processing area on ML 70312 via haul

trucks. As part of the coal processing, coal fines and reject material will be produced as by-products. The existing Coal Handling & Preparation Plant (CHPP) on ML 70312 will be used to process the coal, following suitable infrastructure upgrades to facilitate the proposed increase in production associated with the MEP. Any major modification to the CHPP will be the subject of a separate application as the CHPP is owned by the Red Mountain Joint Venture.

The washed coal will be conveyed and stockpiled for offsite transport via the existing rail network.

1.2 Locality Description

The operation is situated appropriately 22 km east of Moranbah in a well established grazing and mining region.

The area surrounding the site is undulating, comprising mines, open farmlands and native scrublands.

There are several existing mines near the proposed mine expansion, the largest of these being Peak Downs Mine. This mine is one of the most extensive open-cut in the Moranbah district and is situated approximately 20km south-west of the subject site. This mine is approximately 45km long (in a north-west south-east alignment) and 2 km wide. To the north-west of the site is Isaac Plains mine. This mine is in the process of expanding into an areas south-west of the site. Poitrel Mine, a greenfield development, is situated immediately to the south of the site. To the east of the mine is the Carborough Downs underground mine. The existing Millennium open cut mine is situated to the west of the proposed expansion.

The railway spur servicing the Millennium Mine also services Peak Downs Mine. It is understood that the annual coal production from Peak Downs mine is approximately 9 million tonnes p.a. (BHP 2009) and that it transported from the site along this railway spur. The spur connects to the main line at Coppabella, approximately 17 km to the north east of MEP.

The closest sensitive locations are shown on **Figure 1** along with the mine site. The sensitive receptors and separation distances to the closest approach proposed mine extension are contained in **Table 1**. Generally, each of the homesteads is closer to one of the other mines (eg. Winchester Downs Homestead is 8 km from Peak Downs) rather than Millennium Mine.

Table 1: Properties adjacent to the Site

Site No	***Description***
Winchester Downs Homestead	Approximately 12 km south west
Watonga Homestead	Approximately 9 km west
Broadlea Homestead	Approximately 11 km north west
Moorevale Homestead	Approximately 8 km north east
Annandale Homestead	Approximately 8 km north east

The agricultural land comprises improved pastures as well as small areas of natural tree cover. Most of the roads to the homesteads are unpaved, but are generally maintained in good condition.

1.3 Identification of Issues to Be Addressed

The processes at the MEP comprise extraction, handling and placement of soil, overburden and coal. These processes will result in the release of particulate matter into the atmosphere. There is a potential for the ground level concentration of particulates and deposition of particulate matter to exceed environmental air quality goals and as a result this is the primary focus of this report.

The assessment of particulates needs to identify three main issues:

1. The existing exposure level in the environment
2. The likely emissions, including the control effects of rain and water application
3. The meteorology for the site to determine the transport and dilution effects of the atmosphere.

It is necessary to identify key stages in the project and model using a suitable atmospheric dispersion model, in this case CSIRO's TAPM. Impacts are assessed by taking into account the combined effect of existing and predicted exposures. The modelling adopted for this project involves a sophisticated approach to identify the emissions for each hour over a two year period using meteorological data to refine the emission rates. The meteorological data was also obtained from TAPM. By following this approach a realistic estimate of dust emissions has been made incorporating the usual control methods adopted by the mine.

The combustion of diesel in mining machines will result in gaseous emissions of CO, NOx and SO_2. Blasting also results in gaseous emissions. In practice, the sources of gaseous emissions are widely dispersed, have low levels of emission and a very localised impact. Thus the likelihood of exceeding environmental air quality goals beyond the lease boundary is minimal. As a consequence it is not proposed to address the gaseous emissions.

However the use of diesel fuels, release of methane from coal and other matters makes the project a source of greenhouse gasses. This report has addressed the emissions of greenhouse gasses using the Australian Greenhouse Office Factors and Methods Workbook (AGO 2009) and the National Greenhouse and Energy Reporting system (NGER).

2. Description of Existing Environment

2.1 Climate

The closest Bureau of Meteorology weather monitoring station to the MEP site is Moranbah, refer to Appendix 1 for a summary of the main statistics collected at Moranbah. This is a manual station with the weather records recorded twice daily. The closest Bureau of Meteorology continuous recording automatic weather station (AWS) is at Emerald.

Moranbah is situated in an inland tropical area. The region has a warm climate with two distinct seasons, a dry winter season and a wet summer season. Winter temperatures average from 10 ºC to 25 ºC, while summer temperatures range from around 20 ºC to 35 ºC. The region averages approximately 600 mm of rainfall each year, falling mostly between November and March.

During the wet summer season the soil moisture content increases and there is increased grass ground cover. This results in lower dust emissions from most activities, including local roads. During the dry winter season the soil moisture content reduces (particularly at the surface) and grass cover reduces. The dust emissions are more prevalent from most activities during this period. This is also the period when grass fires (including permit fire) are likely to occur. These types of fire release significant quantities of smoke into the lower atmosphere.

There is a dominant easterly component to the winds at Moranbah. Thus any particulate or gaseous emissions from MEP are likely to travel toward the township.

2.2 Dust

Potential sources of particulate emissions from the surrounding environment primarily comprise:

- farming and grazing activities;
- existing mining operations;
- unsealed roads; and
- smoke from grass/bush fires (permitted or otherwise).

A survey of the existing dust levels was obtained at two locations, one to the west of the proposed development and the other to the south-west. The equipment used comprised a TSI Dusttrak Aerosol monitor configured to record PM10 concentrations on five minute intervals. To convert between five minute averaging time and 24 hours averaging it is necessary to arithmetically average the 288 five minute measurements making up the twenty four hours. The equipment was located within the house compound at least 4 m from buildings.

Existing atmospheric dust concentrations were obtained at Winchester Downs homestead over a period of 1 week from 16 March 2009 to 24 March 2009. The dust sampler recorded the PM10 in five minute intervals and the PM10 (24 hour) was calculated from the samples. The PM10(24 hour) is expressed as a running average, rather than limiting the average to only those measurements on same calendar day. The second monitoring site is Watonga Homestead. Existing atmospheric dust concentrations were obtained at this location over a period of 5 days from 10 March 2009 to 14 March 2009.

Winchester Downs Homestead appears visually to be unaffected by coal dusts. There monitoring shows there to be a daily cycle in the dust concentration levels. The minimum dust levels appear to occur about 18:00 and seem to vary between 3 µg/m^3 and 4 µg/m^3. The daily maximums occur

about 12 hours later and typically about 5 µg/m^3 higher than the minimums. A number of short-term peaks occurred over the monitoring period up to 80 µg/m^3 (60 minute average). This is most likely due to dust sources in the vicinity of the monitor such as vehicles on the farm roads, mowing lawns etc.

Existing dust concentration levels were also recorded at Watonga Homestead over the period of five days from 10 March 2009 to 14 March 2009 approximately. There were no high dust episodes during the monitoring period.

Over the monitoring period the days were warm to hot with light (2 m/s to 4 m/s) south-east to east winds. There was heavy cloud cover on the 18th March and 19th March and 1.4 mm of rainfall recorded on the 20th March. Evaporation rates were high between around 6 mm to 7 mm per day. The period leading up to the monitoring was also relatively free of rain with the heavy rain concluding on 26th Feb 2009. The monitoring period was likely to provide reliable estimates of elevated atmospheric dust concentrations.

For both these locations the existing PM10(24 hour) dust levels are presented in Table 2 and Figures 2 and 3.

The assumed dust deposition level is to be 25 mg/m^2/day from NMA 2007. The TSP concentrations are taken to be twice the measured PM10 as found in NMA 2007. The assumed ambient PM2.5 to PM10 ratio of 1:2.74 is based on Cohen 1999 is:

(a) PM2.5(24 hour) = 2 µg/m3
(b) PM2.5(annual Average) = 2 µg/m3

Table 2: Measured Existing Air Quality at Homesteads adjacent to the ML

Location	***PM10 (24 hour) µg/m3***
Winchester Downs Homestead	5 to 8
Watonga Homestead	5 to 7

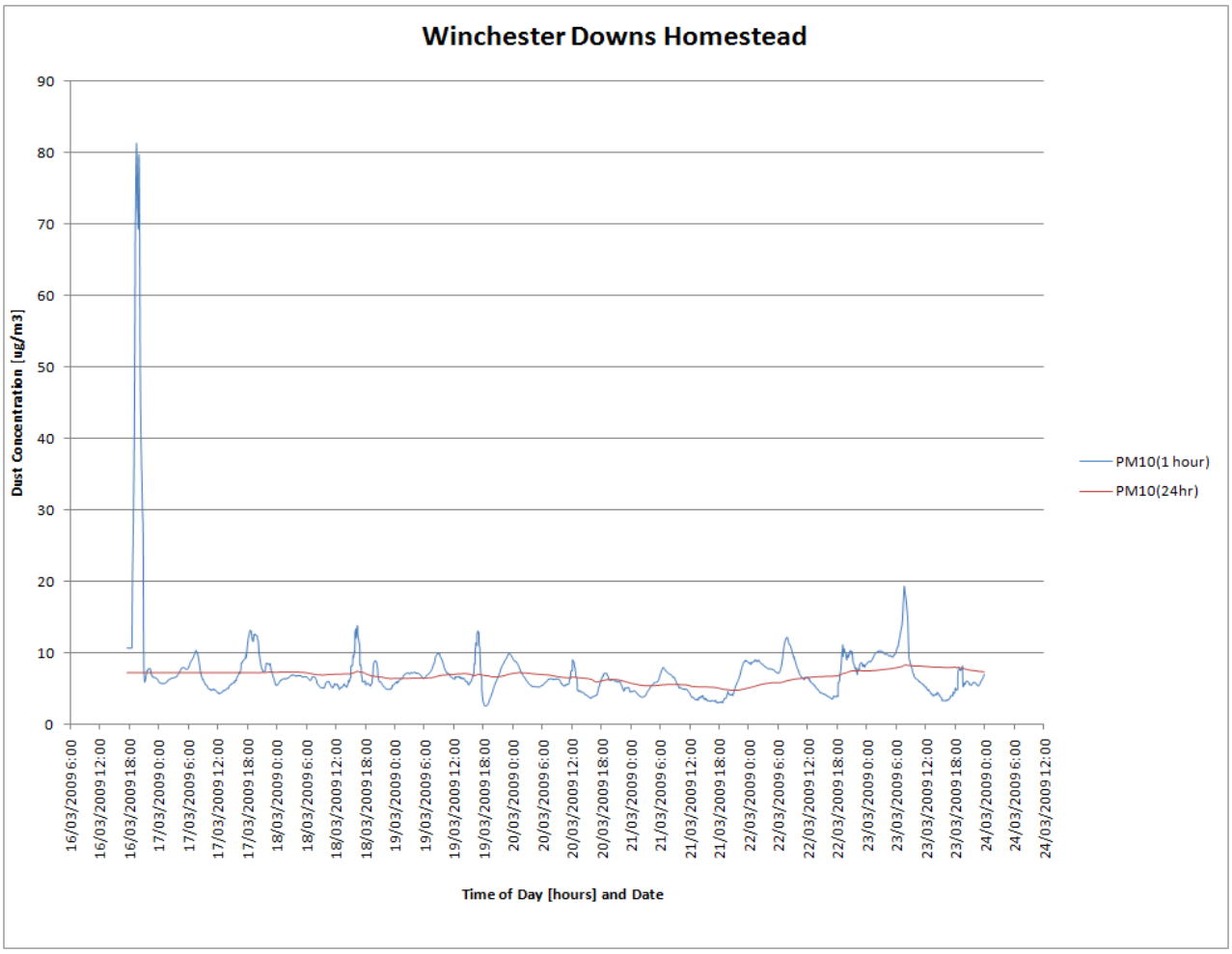


Figure 2: Measured Atmospheric Dust Concentration at Winchester Downs Homestead

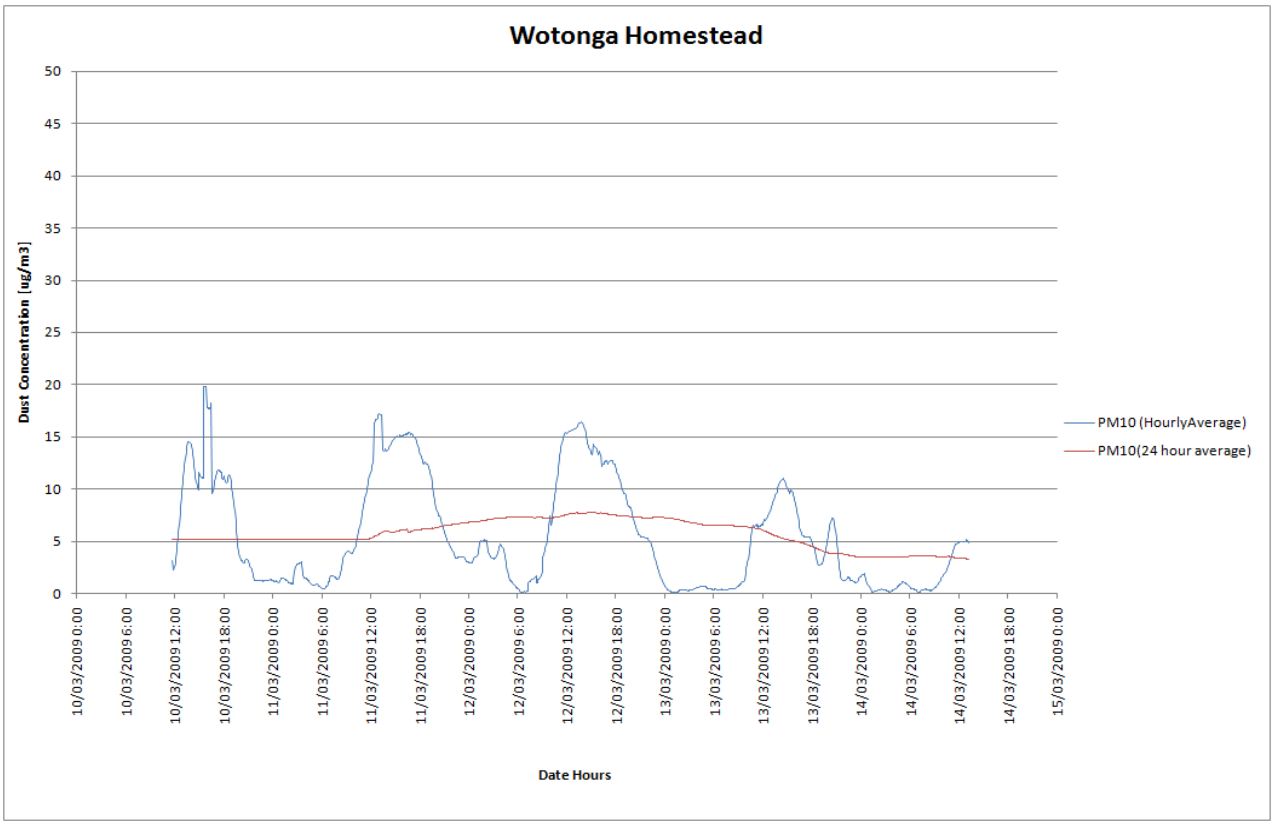


Figure 3: Measured Atmospheric Dust Concentration at Watonga Homestead

3. Air Quality Criteria

3.1 Environmental Protection (Air) Policy

The Queensland Environmental Protection (Air) Policy 2008 (EPP(Air) 2008) commenced on 1 January 2009. The EPP (Air) 2008 (Part 2 Section 5) aims to achieve the object of the *Environmental Protection Act 1994* (the Act) in relation to Queensland's air environment. The object of the Act is ".. to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development)."

Specifically the EPP (Air) 2008 addresses the environmental values to be enhanced or protected namely—

(a) the qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and

(b) the qualities of the air environment that are conducive to human health and wellbeing; and

(c) the qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and

(d) the qualities of the air environment that are conducive to protecting agricultural use of the environment.

In order meet the environmental values, Schedule 1 of the EPP (Air) nominates relevant air quality indicators and goals. Relevant air quality indicators from Schedule 1 are those dealing with particulates, as follows:

a) Total suspended particulate 90 µg/m^3 averaged over a year.

b) PM2.5 8 µg/m^3 averaged over one year.

c) PM2.5 25 µg/m^3 averaged over 24 hours.

d) PM10 50 µg/m^3 averaged over 24 hours, and no greater than 5 occurrences per year.

All these indicators are qualities of the air environment that are conducive to human health and wellbeing. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

The particulate PM10 goal of 50 µg/m3 averaged over 24 hours, and no greater than 5 occurrences per year is an implementation of the NEPM protection measure for ambient air quality which Queensland agreed to implement in 1998.

3.2 EPA License and Permits – Guideline 8

Although the EPP(Air) 2008 is the primary reference for air quality criteria in Queensland, it does not address dust deposition. Dust deposition monitoring is the most common method to measure the level of dustiness in areas surrounding developments and is used as a indicator to undertake more detailed investigations. The sampling is conducted in accordance with Australian Standard AS3580.10.1. Furthermore, licenses for mines issued by DERM historically include a dust deposition limit.

The relevant guideline for the assessment of air quality in relation to the MEP is the DERM's (Formerly EPA), "Preparing an Environmental Management Overview Strategy (EMOS) for Non-standard Mining Projects". This guideline requires that the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place. According to the guideline, the maximum permissible measured dust levels relevant to the proposed MEP comprise:

(a) Dust deposition of 120 milligrams per square metre per day, averaged over one month; and

(b) PM10 150 µg/m^3 averaged over 24 hours, at a sensitive or commercial place downwind of the operational land.

The PM10 criterion has been superseded by the more recent and more stringent EPP(Air) 2008 levels for PM10.

3.3 Site Specific Air Quality Criteria

Dusts are often described as respirable and inhalable. Respirable dusts are those small enough to penetrate the nose and deep into the lung. Respirable dusts that penetrate past the nose and upper respiratory system are likely to be retained in the body. This involves dusts having an aerodynamic diameter of up to 10 µm. Inhalable dusts are dusts which enter the body but are collected in the nose and upper respiratory system and rejected. Inhalable dusts are those having an aerodynamic diameter of nominally 10 µm and larger.

As a general guide dusts having diameters of 7 to 10 µm are mostly large enough to be caught by nose and throat. Particles in the range 0.5 to 7 are small enough to reach the lung yet large enough to be retained. Since these dusts remain in the lung they may be hazardous to health and well being. It does not follow that these dusts are hazardous. The smaller diameter dusts have a high surface area to volume ratio and since hazardous substances attach to the surface of the dust, the ultra-fine dusts potentially have a higher ratio of hazardous substances attached to the surface of an otherwise benign dust. Hazardous substances are typically associated with combustion sources rather than the crustal material from earth moving/ mining.

In summary the applicable air quality criteria (from EPP Air and EPA Guideline 8) are:

- dust concentration of PM2.5 25 µg/m3 averaged over 24 hours;
- dust concentration of PM2.5 8 µg/m3 averaged over a year;
- dust concentration of PM10 of 50 µg/m3 over a 24 hour averaging time and no more 5 occurrences per annum;
- total suspended particulate 90 µg/m3 averaged over a year; and,
- dust deposition of 120 mg/m2/day;

All these indicators (except deposition) are qualities of the air environment that are important to human health and wellbeing. The deposition (or dust fallout) is for assessing dust nuisance. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

4. Air Quality Modelling

4.1 Modelling Methodology

Typically, particulate matter is characterised by its size. The particulate size ranges specified in ambient air criteria are total suspended particulate (TSP), particulate matter below 10 microns (PM10) and particulate matter below 2.5 microns (PM2.5). By definition, TSP includes both the PM10 and PM2.5 fractions, and PM10 includes the 2.5 fraction.

Under normal conditions, dust particles with aerodynamic diameters of more than PM10 will typically fall out and be deposited onto the ground within several minutes of release.

The PM10 and PM2.5 dusts do not have a significant settling velocity and will generally behave in a gaseous fashion, that is, the fall out time is significantly longer than a few minutes. The settling velocity for PM10 dust is nominally 5 mm/s while for PM2.5 it is 0.5 mm/s. This may be compared with PM20 where the settling velocity is approximately 20 mm/s (Baumeister, 1982).

Once outside air enters an otherwise still room then these suspended particulates will fallout onto horizontal surfaces, leading to dust deposition. Particulates will also fallout onto horizontal surfaces by joining with moisture in the atmosphere or by electrostatic forces. Except for dust fallout with rainfall, these aspects are not addressed in the modelling methodology.

The air quality modelling methodology comprised three phases namely:

(a) preparation of meteorological data;

(b) development of an emissions database using US-EPA AP-42 (2003) 5th Update 2003 and the Australian National Pollution Inventory (NPI) “Emission Estimation Technique Manual for Mining Version 2.3”; and

(c) modelling of the likely downwind ground level concentrations using The Air Pollution Model (TAPM).

4.1.1 Preparation of Meteorological Data

TAPM predicts meteorology and pollutant concentration for a range of pollutants important for air pollution applications. The model consists of coupled prognostic meteorological and air pollution concentration components, eliminating the need to have site-specific meteorological observations. Instead, the model predicts the flows important to local-scale air pollution, such as sea breezes and terrain induced flows, against a background of larger-scale meteorology provided by synoptic analyses.

Some limitations of TAPM include:

- it is not suitable for horizontal domain sizes above approximately 1,000 km by 1000 km.
- it cannot be used to accurately represent deep atmospheric circulations or extreme weather events (cyclones).
- it cannot be used for very steep terrain because of the use of a terrain following coordinate system in the model. Thus the model cannot represent discontinuities in terrain height (for

example, cliffs or bluffs).

- it assumes that cloud processes are resolved by the typical inner grid spacings used in the model (i.e. 3km or less). Therefore no large-scale cloud convection parameterisation is included.

These limitations are of minor significance to the modelling of pollution for this study. The area of interest is much smaller than the maximum horizontal domain size. Extreme weather events (such as cyclones) are not of interest from an air pollution perspective. The terrain does not have significant cliffs or bluff bodies within the region and it is expected that the inclusion of large-scale cloud convection would only slightly change the radiation and moisture balances.

TAPM is highly regarded in the scientific community as a suitable tool to develop meteorological data sets for sites without site-specific meteorological observations. However, the meteorological dataset can be improved by incorporating local meteorology. In this instance the dataset from Emerald AWS was used to nudge the results. Nudging is the process by which the TAPM database meteorology (based on BoM records) but having six hourly steps is refined and aligned with actual measurement data on a finer hourly time step.

The TAPM meteorological file developed for the site covered the two year period 2004 and 2005. This period was used for modelling since Queensland was generally free of extreme weather events such as cyclones.

The general features of winds affecting plume dispersion are illustrated in the wind rose diagrams for the year 2004 and 2005 (Appendix 3). The wind roses summarise the wind statistics at a 10 m height on site, as calculated by the TAPM meteorological model. The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – N, NNE, NE, ENE ,E etc. The length of the bar represents the frequency of occurrence of winds from that direction, and the colour of the bar sections correspond to wind speed categories. It is noted that the predominant wind direction during the year is from the north-east through to the south-east. The representative frequency of Pasquil stability classes for the region is based on data from TAPM. Pasquil stability classes represent the stability of the atmosphere. The stability Class F conditions (stable conditions), which result in poor dispersion of pollutants does not occur during the day. Table 3: Frequency of Stability Classes at Site shows the frequency of stability classes for the site.

Table 3: Frequency of Stability Classes at Site

Stability Class	***Description***	***Frequency of Occurrence (%)***
A	Very unstable	2
B	Moderately unstable	13
C	Slightly unstable	18
D	Neutral	21
E	Slightly stable	9
F	Stable	36

4.1.2 Development of the Emissions database

The development of an accurate and representative emissions database has been primarily based on National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3 (NPI 2003) as well as US-EPA AP-42 (2003) 5th Update 2003 SKM 2005. The main mining activities and processes that produce, or could produce, dust emissions were identified for the MEP operations and throughput. Flowcharts for handling of overburden and coal were developed and an emission factor (from NPI) was attributed to every handling point, handling activity and transport section. In addition emissions for exposed surfaces were identified and included in the database.

All emission factor equations and default emission factors in NPI are for uncontrolled emissions. However this database has included the control effects from rainfall and from water trucks as is typically used at coal mines. In the model of the MEP the emissions were calculated for every hour of the day for the two years of the modelling. Calculating emissions is a four-step process:

1. Identify sources of emissions.
2. Obtain information on the scale of the activity
3. Apply the relevant emission factor equation or default emission factor from NPI 2003 to the activity data, see Appendix 2;
4. Where applicable, apply control efficiency reduction factors based on rainfall or water truck use

The steps to establish the moisture content of overburden and un-mined coal due to rain comprises:

1. The TAPM model was initially run in meteorology mode only and an hourly meteorological file for the entire year extracted. This TAPM calculated and generated file contains, inter alia, wind speed and rainfall for each hour;
2. If any rain occurred during that hour then the moisture content of the ground is assumed to be saturated (i.e. 10%);
3. If there was at least 1mm of rain during the preceding three hours the moisture content of the ground is assumed to be 10%;
4. Otherwise the assumed moisture content for the ground or overburden is 4% during the wet season and 2% during the dry season.

The steps to establish the moisture content of roads and haulage routes due to rain and water truck operations comprises:

1. If any rain occurred during that hour then the moisture content of the road is assumed to be 5%;
2. If there was at least 1mm of rain during the preceding three hours the moisture content of the road is assumed to be 5%;
3. For all other hours the moisture content of the moisture content of the road varies randomly between 0% and 1.66%. Thus the maximum control efficiency of watering by water trucks is 50 per cent (1.66% moisture content).

Rather than adopt a constant emission rate for all hours, the model uses a methodology that provides an emission rate from every operation, for each hour of the simulation period that includes the effects of dust emission controls due to rainfall and the operation of water trucks. In addition,

the emissions from wind-generated dusts have also been included, with control only provided by rainfall.

The emission database also includes a pit retention factor, as specified in the NPI 2003 of 50% for TSP and 5% for PM10. It is assumed that the Pit retention factor for PM2.5 is also 5%.

The main dust sources comprise the in-pit crusher, excavator, unpaved roads, conveying and dumping ROM, conveying, dumping and spreading overburden, loading trucks and loading trains.

Two main cases are addressed. The first case is during the initial phase of the mine out of pit dumping of overburden. The second case is a fully developed mine with in-pit disposal of overburden.

A description of modelling Case 1 and Case 2 are contained in Table 4. The annual emission rates are contained in Table 5 for the individual dust sources. The total annual emission rates are contained in Table 6 for the combined dust sources including the pit retention factor.

Table 4: Modelling Cases

Item	***Case 1***	***Case 2***
Title	Out of pit spoil dumping	In pit spoil dumping
Annual Product Coal (MTPA)	7.5	7.5
In pit operations	Two 30 m^3 excavators on overburden One 16 m^3 excavator on coal/waste parting Nine 230t rear dump trucks to overburden dump Four 140t rear dump trucks to CHPP	Two 45m3 electric rope shovel on overburden One 30 m^3 excavators on overburden One 16 m^3 excavator on coal/waste parting Fourteen 230t rear dump trucks to in pit overburden dump Four 140t rear dump trucks to CHPP
Out of pit operations	Overburden dump Haul road	Haul Road
Plant	Stockpiles	Stockpiles

Modelling Case 1 represents the year 2015. The current Millennium pit is still active and the Mavis Pit is just commencing coal production. However, there is significant overburden removal from the Mavis Pit. All the spoil is dumped out of the pit onto a spoil dump which has a height of approximately 60 m above natural terrain. The model assumes worst-case configuration for dust emissions and propagation into the local area from the operations, namely the out of pit dumping occurs at the maximum height of the spoil heap. This also provides the longest haul route for trucks hauling the overburden. Since dust emissions from the haul route is proportional to the length of the route, this will provide the highest dust emissions from the haul route.

Modelling Case 2 is represented by the year 2019. The current Millennium Pit has ceased operations and the Mavis pit is providing the full production. All the overburden is returned to the previously extracted areas of the Mavis Pit. The year 2019 has the highest annual projected overburden removal for the Mavis Pit during the in-pit overburden dumping.

Table 5: Dust Emissions for Main Dust Activities in Tonnes/Annum (excluding Pit retention factor)

Location	Activity	Emission [t/a] for Dust Fraction and Year					
		2015			2019		
		PM2.5	PM10	TSP	PM2.5	PM10	TSP
Mavis Pit	Coal - Excavator	15.10	125.83	261.73	20.49	170.72	355.09
	OB - Excavator	5.79	48.28	102.07	6.77	56.43	119.31
	OB - Loading in Pit	-	-	-	6.76	56.37	119.17
	OB - Dozer in Pit	-	-	-	4.20	35.01	148.78
	OB - Dump Truck Dumping	-	-	-	57.64	480.32	1340.43
	OB - Truck Movement	-	-	-	9.70	80.82	393.99
	Wind Erosion Pit Works	0.15	1.29	2.58	0.15	1.29	2.57
	Wind Erosion OB Dump	-	-	-	0.31	2.57	5.15
Millennium Pit	Coal - Excavator	4.27	35.57	73.99	-	-	-
	OB - Excavator	0.89	7.40	15.65	-	-	-
	OB - Truck Movement	0.43	3.59	17.52	-	-	-
	Wind Erosion Pit Works	0.15	1.29	2.58	-	-	-
Mavis Out Pit OB Dump	OB - Loading in Pit	5.79	48.22	101.95	-	-	-
	OB - Dozer in Pit	4.20	35.01	148.78	-	-	-
	Wind Erosion OB Dump	0.31	2.57	5.15	-	-	-
	OB - Dump Truck Dumping	49.31	410.92	1146.76	-	-	-
Millennium Out Pit OB Dump	OB - Loading in Pit	0.05	0.39	0.82	-	-	-
	OB - Dozer in Pit	4.20	35.01	148.78	-	-	-
	Wind Erosion OB Dump	0.31	2.57	5.15	-	-	-
	OB - Dump Truck Dumping	7.56	62.99	175.78	-	-	-
OB Haul Route	Mavis Haul Route	6.48	54.03	263.42	-	-	-
	Millennium Haul Route	3.17	26.43	128.86	-	-	-
CHPP	Coal - Truck Dumping	2.61	21.73	51.74	2.61	21.73	51.74
CHPP	Coal - Handling	0.00	0.02	0.04	0.00	0.02	0.04
CHPP	Coal - Wind Erosion	0.15	1.29	2.57	0.15	1.29	2.57
Coal Haul Route	Truck - Coal Haul	3.11	25.95	126.51	3.30	27.48	133.99

Table 6: Dust Emissions for Main Dust Sources in Tonnes/Annum (including Pit retention factor)

Operation	***Emission type***	***Out of Pit Dumping Case***			***In Pit Dumping Case***		
		PM2.5	***PM10***	***TSP***	***PM2.5***	***PM10***	***TSP***
In pit sources combined	Coal & Overburden	25	212	452	101	839	2360
Out of pit sources	Overburden	84	704	2252	3	27	134
CHPP	Coal	3	23	54	3	23	54

4.1.3 Dispersion Model

TAPM was adopted as the dispersion model for the MEP. According to Hurley 2005, air pollution predictions for environmental impact assessments usually use Gaussian plume/puff models driven by observationally-based meteorological inputs. An alternative approach is to use prognostic meteorological and air pollution models, which have many advantages over the Gaussian approach and are a viable tool for performing year-long simulations. TAPM performs well for general dispersion in complex rural conditions. In particular, TAPM performs very well for the prediction of extreme pollution statistics, important for environmental impact assessments, for particulates.

TAPM V3 was used to determine the downwind ground level pollutant concentrations. It is designed to predict ground-level concentrations or dry deposition of pollutants emitted from one or more sources, which may be stacks, area sources, volume sources, line sources or any combination of these.

The sources in the TAPM model comprised the in-pit sources, the out-of pit sources and the CHPP and plant. All the sources were modelled as volume sources having dimensions similar to the extent of the source.

The in-pit sources were modelled as a volume source having a footprint of 1km by 1km and a height of 50 m high (above the natural surface). This applies to both the in-pit and out-of-pit dumping cases. This is similar to the height of the landforms surrounding pits and the overburden dump.

The out-of-pit source was also modelled as a volume source having a footprint of 1.5km by 1.5km and a height of 20 m high (above the natural surface). This accounts for the height of the overburden dump.

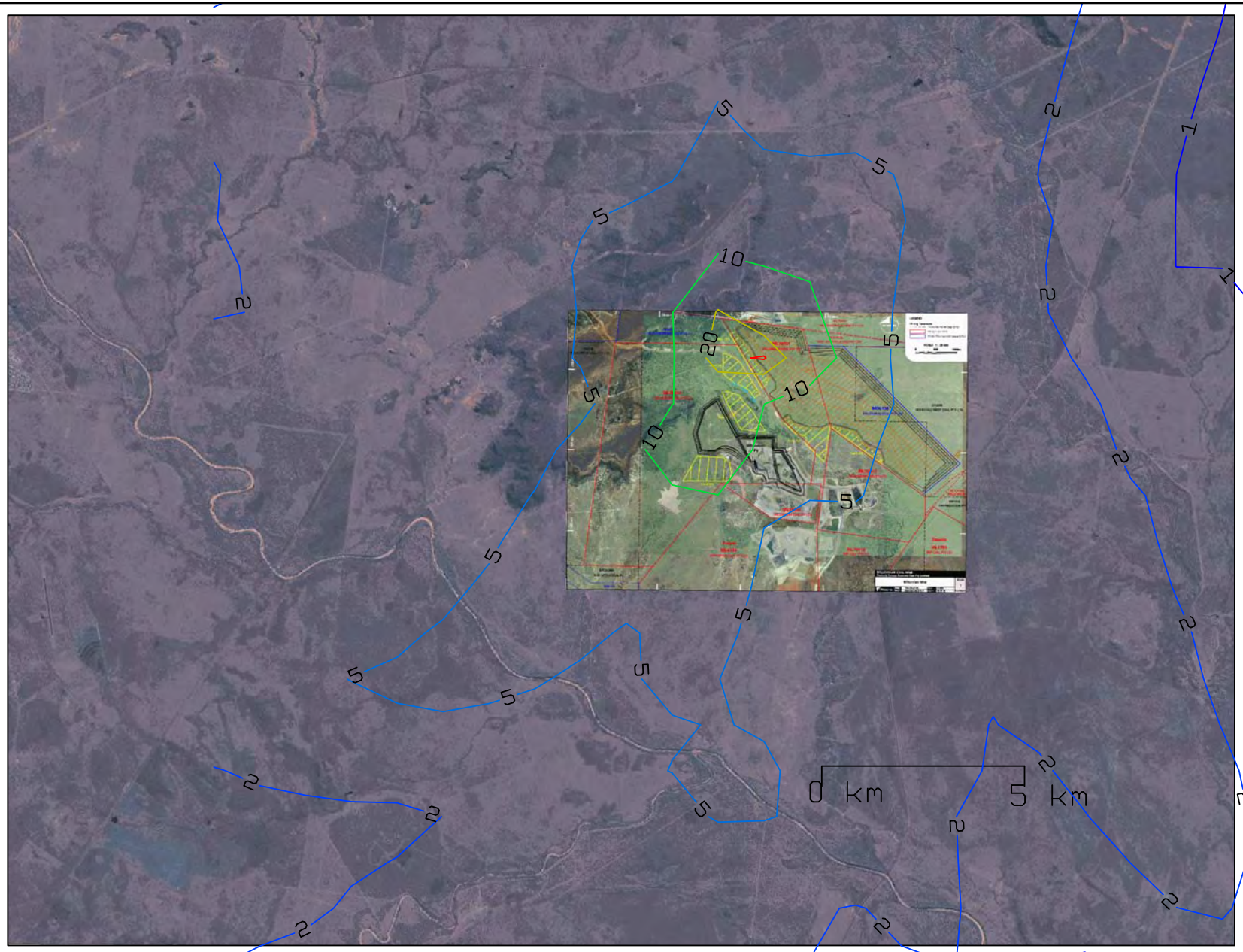
The wind erosion from stockpiles and CHPP was modelled as a volume sourcee having a footprint of 0.6km by 0.6km and a height of 25 m high (above the natural surface).

4.2 Air Quality Results

The calculated dust emissions described in Section 4.1.2 were included in the TAPM model at the appropriate locations. The likely dust levels due to the operation of the mine at each nearby sensitive receptor have been determined and these are shown in ***Table 7*** for Case 1, the out of pit dumping case and ***Table 8*** for Case 2, the in-pit dumping case.

The calculated dust deposition and concentration contours are contained in:

- **Figure 4** – Case 1 PM2.5 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 5** – Case 1 PM2.5 (annual average) with concentration contours expressed in terms of µg/m^3;
- **Figure 6** – Case 1 PM10 (24 hour) 5^{th} highest with concentration contours expressed in terms of µg/m^3;
- **Figure 7** – Case 1 TSP (annual average) with concentration contours expressed in terms of µg/m^3; and,
- **Figure 8** – Case 1 Dust deposition (annual maximum month) with deposition contours expressed in terms of mg/m^2/day.
- **Figure 9** – Case 2 PM2.5 (24 hour) maximum with concentration contours expressed in terms of µg/m^3;
- **Figure 10** – Case 2 PM2.5 (annual average) with concentration contours expressed in terms of µg/m^3;
- **Figure 11** – Case 2 PM10 (24 hour) 5^{th} highest with concentration contours expressed in terms of µg/m^3;
- **Figure 12** – Case 2 TSP (annual average) with concentration contours expressed in terms of µg/m^3; and,
- **Figure 13** – Case 2 Dust deposition (annual maximum month) with deposition contours expressed in terms of mg/m^2/day.



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APPROVED BY :

Mark Simpson
NOISE MAPPING AUSTRALIA

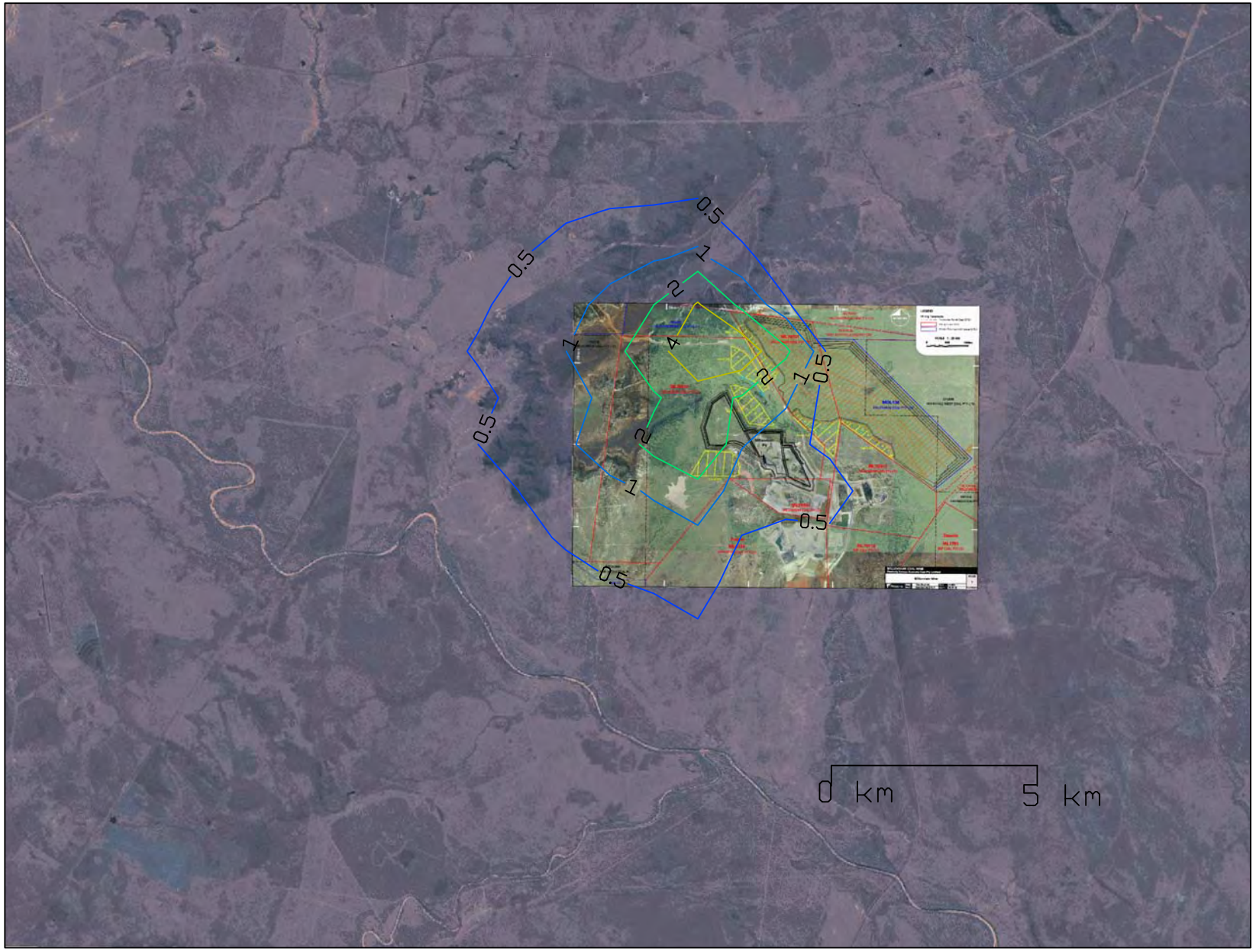
13/5/2010
DATE :

DRAWN	CMS
DATE	13 May 10
CAD DRAWING	004
REVISION No:	2

Millenium Expansion

TITLE
Case 1 – Out Pit Dump
Dust Concentration Contours
PM2.5 24hr Maximum in ug/m3

SCALE	DRAWING No.	
NTS	Figure 04	A4



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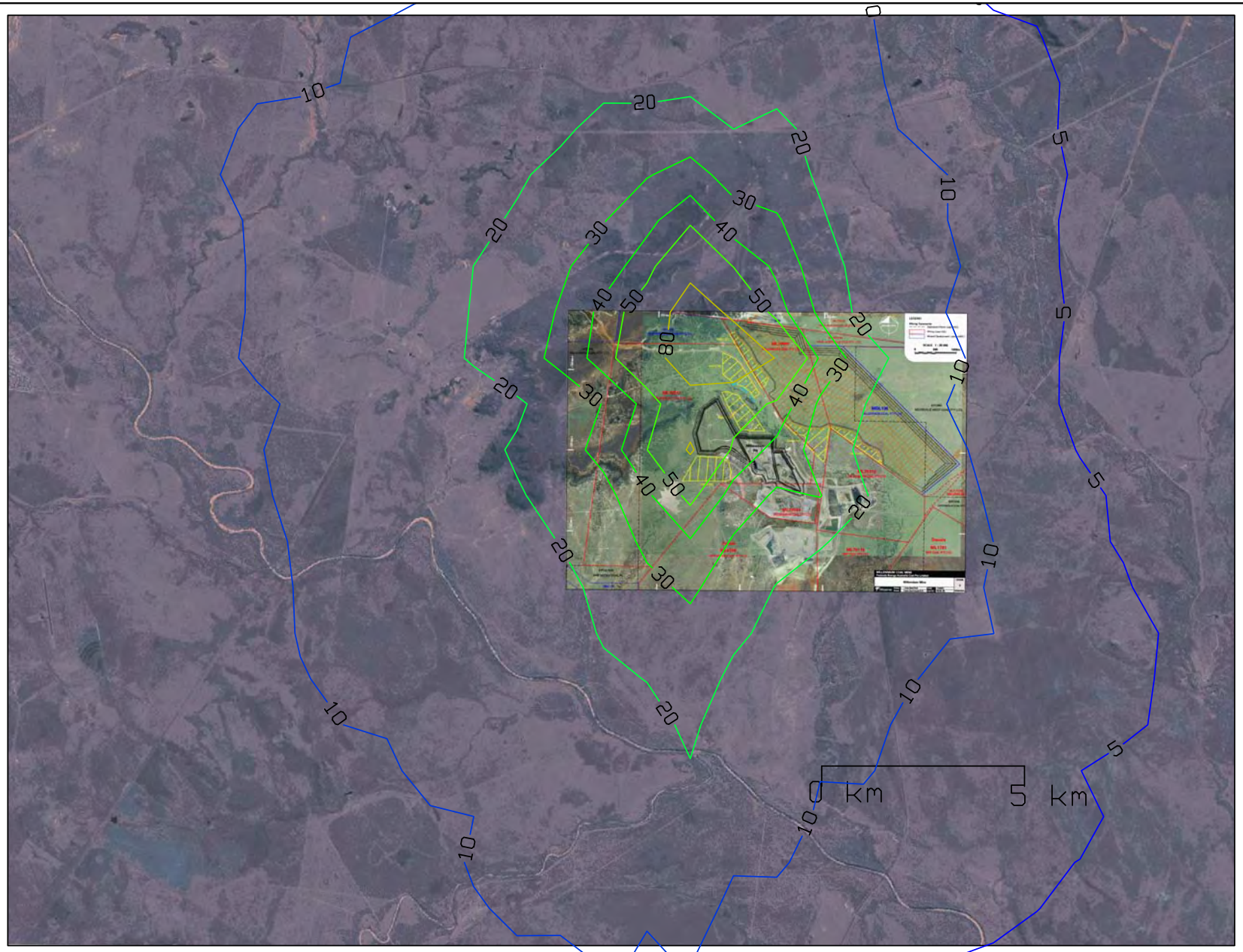
REVISION No:	2

Millenium Expansion

TITLE
Case 1 – Out Pit Dump
Dust Concentration Contours
PM2.5 Annual Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 05	A4



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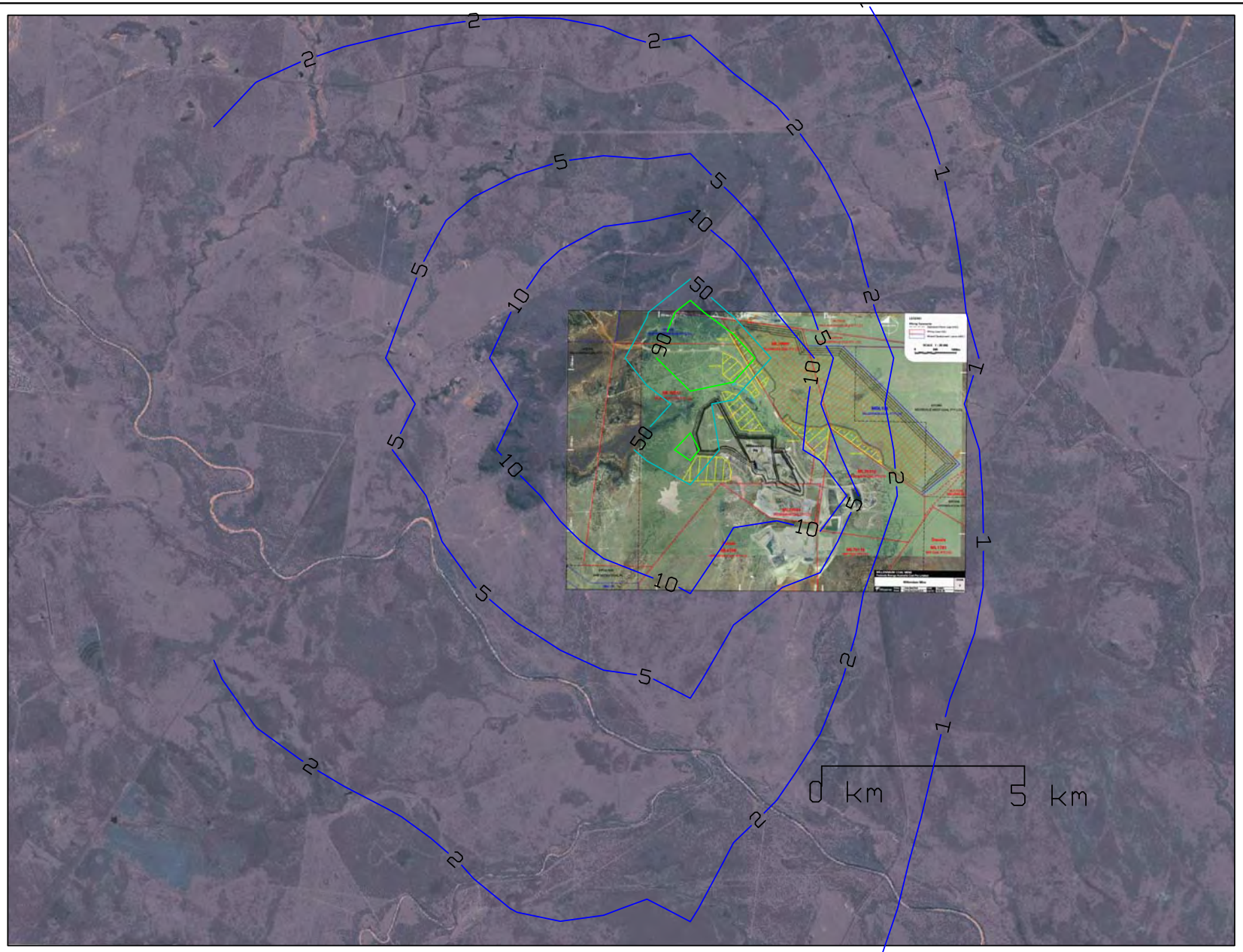
CAD DRAWING	006
REVISION No:	2

Millenium Expansion

TITLE
Case 1 – Out Pit Dump
Dust Concentration Contours
PM10 5th Highest 24 Hour Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 6	A4



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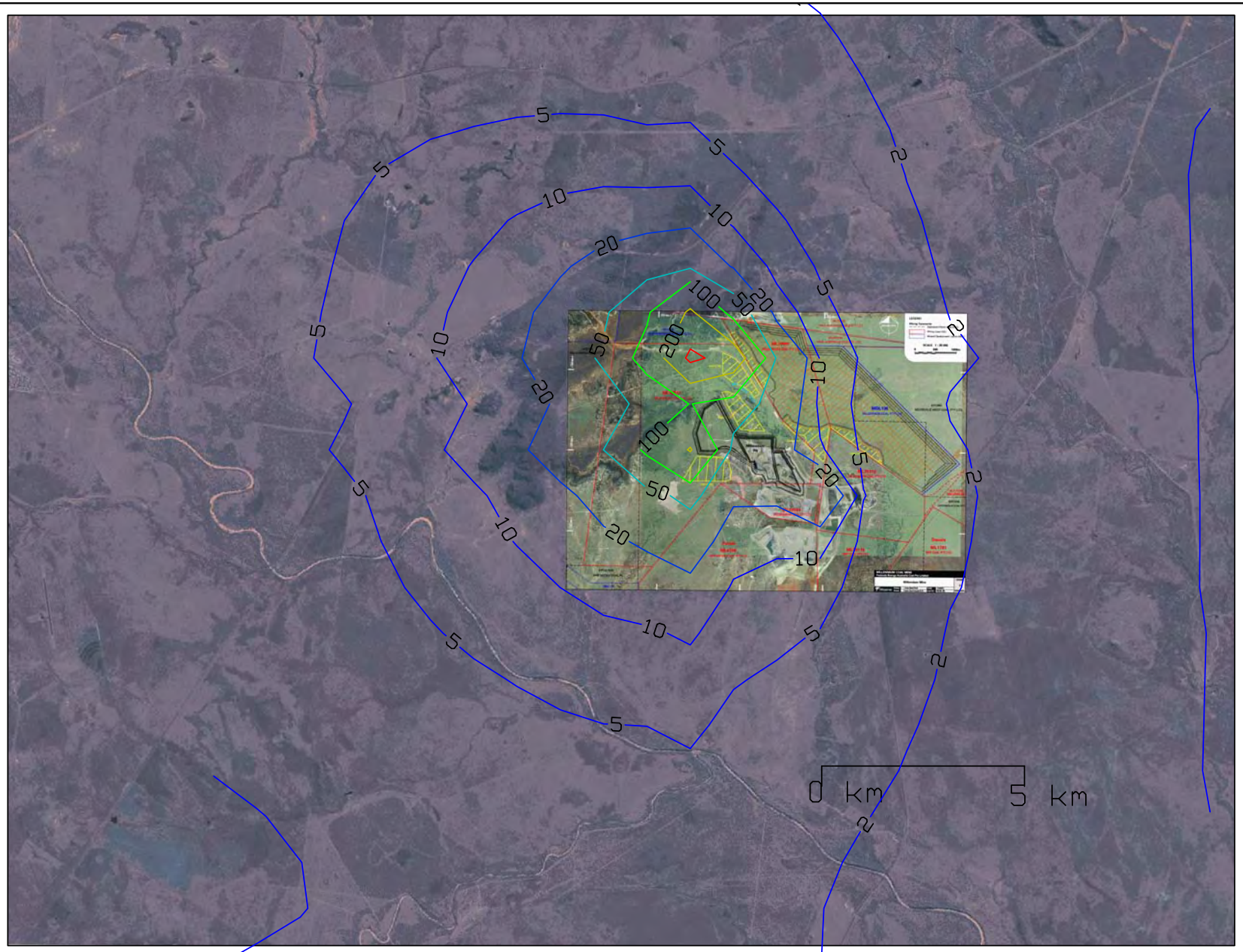
Millenium Expansion

TITLE
Case 1 – Out Pit Dump
Dust Concentration Contours
TSP Annual Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 07	A4



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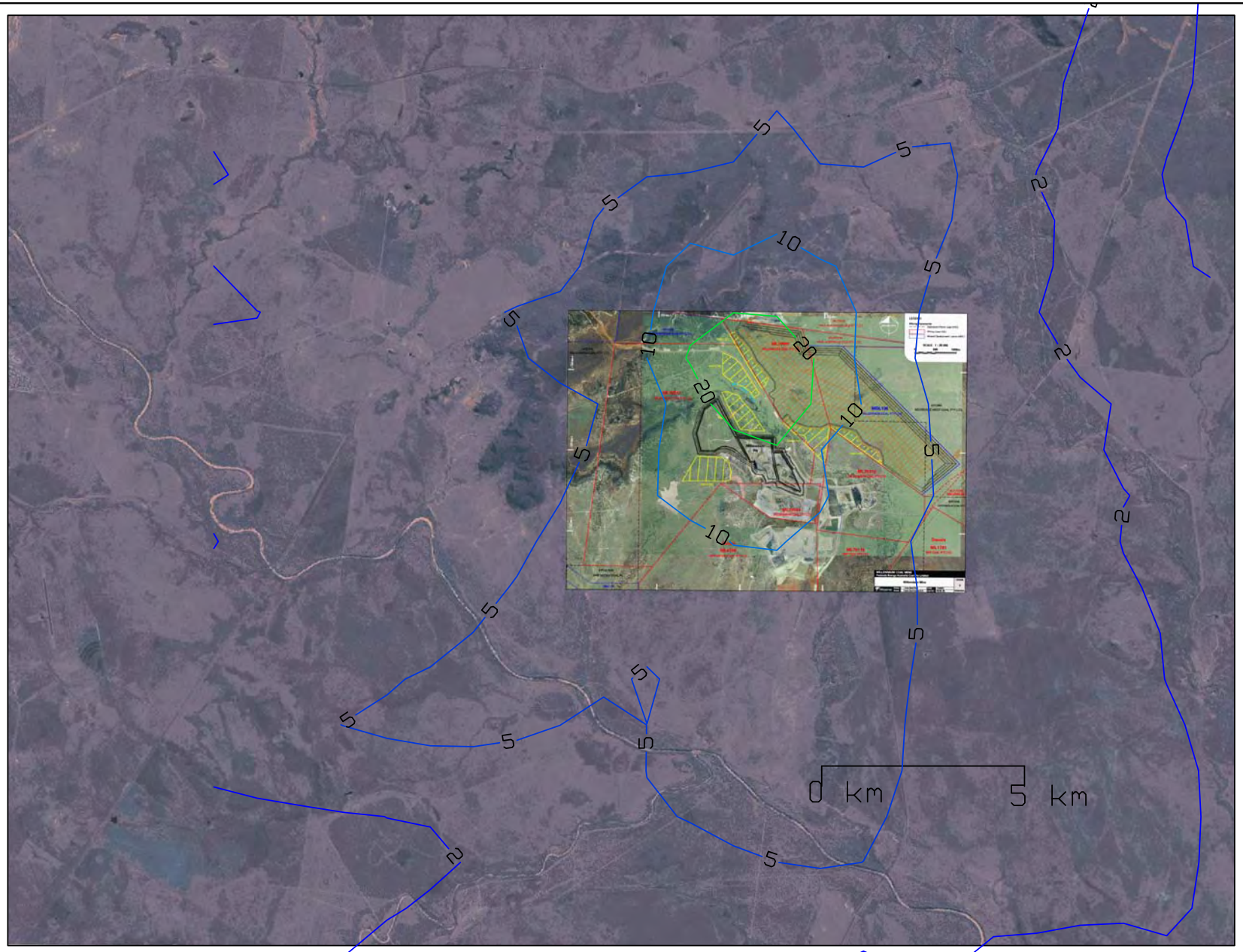
REVISION No:	2

Millenium Expansion

TITLE
Case 1 – Out Pit Dump
Dust Deposition Contours
TSP Annual Average in mg/m2/day

SCALE	DRAWING No.	
NTS	Figure 08	A4



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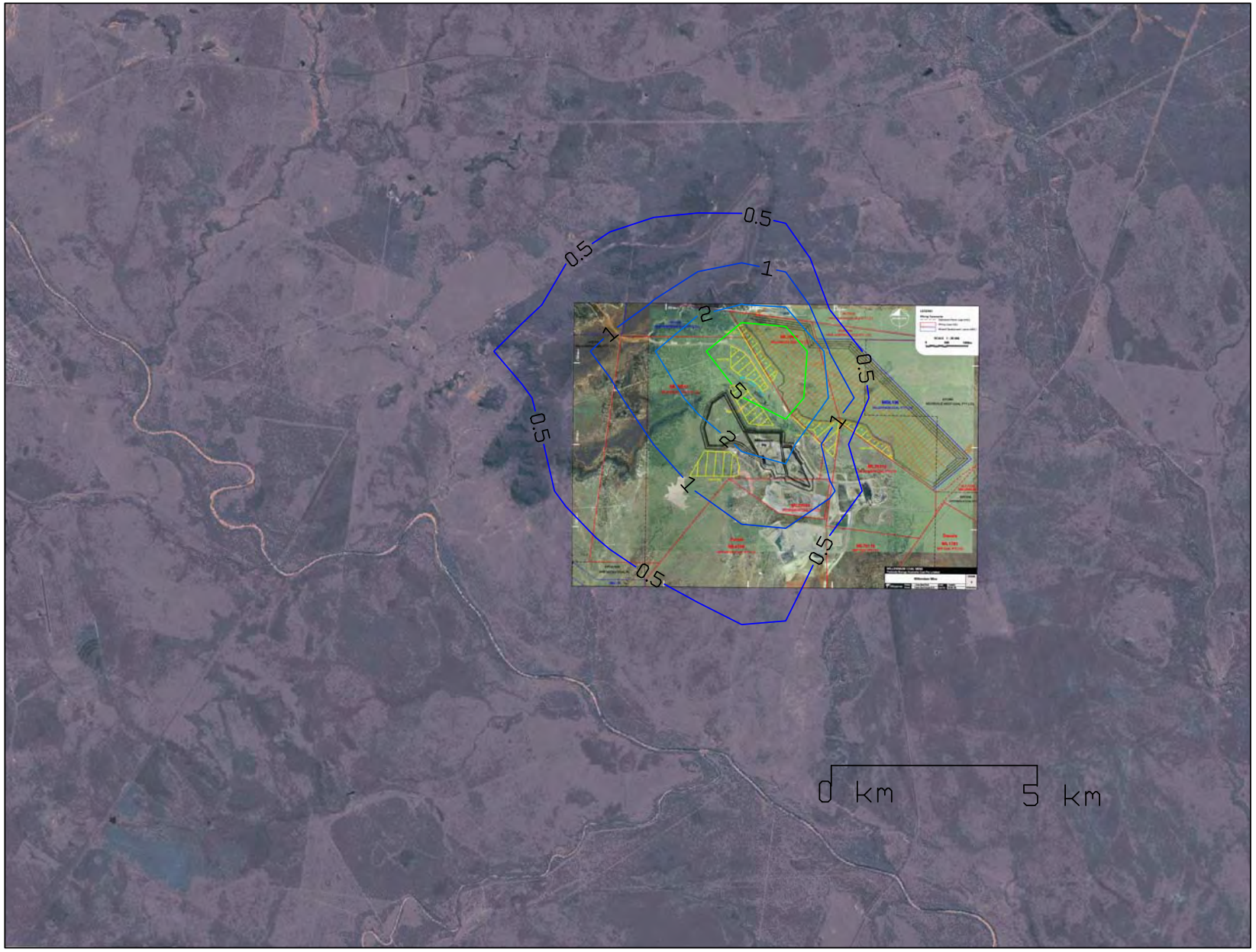
DATE	13 May 2010
CAD DRAWING	009
REVISION No:	2

Millenium Expansion

TITLE
Case 2 – In Pit Dump
Dust Concentration Contours
PM2.5 24hr Maximum in ug/m3

SCALE	DRAWING No.	
NTS	Figure 09	A4



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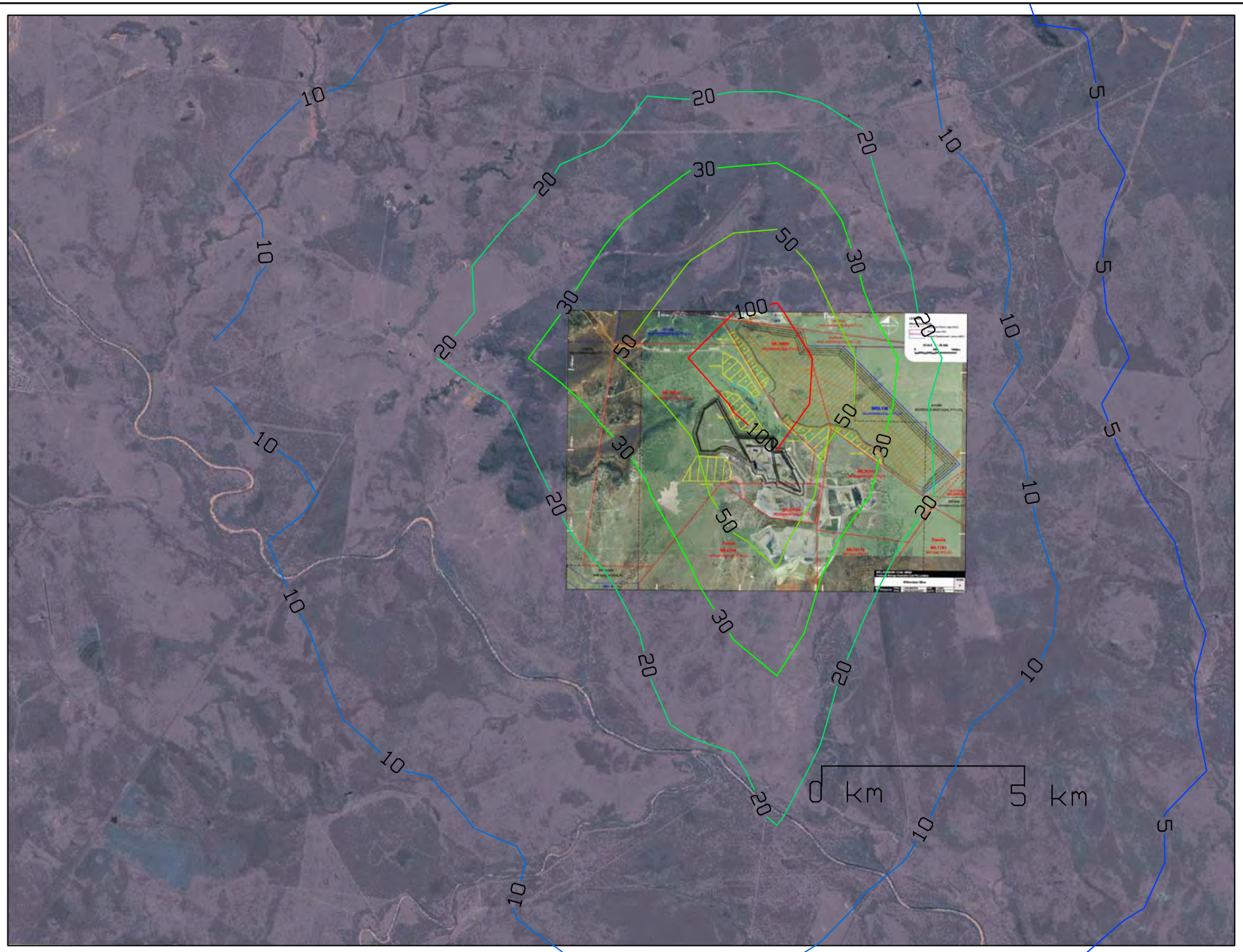
REVISION No:	2

Millenium Expansion

TITLE
Case 2 – In Pit Dump
Dust Concentration Contours
PM2.5 Annual Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 10	A4



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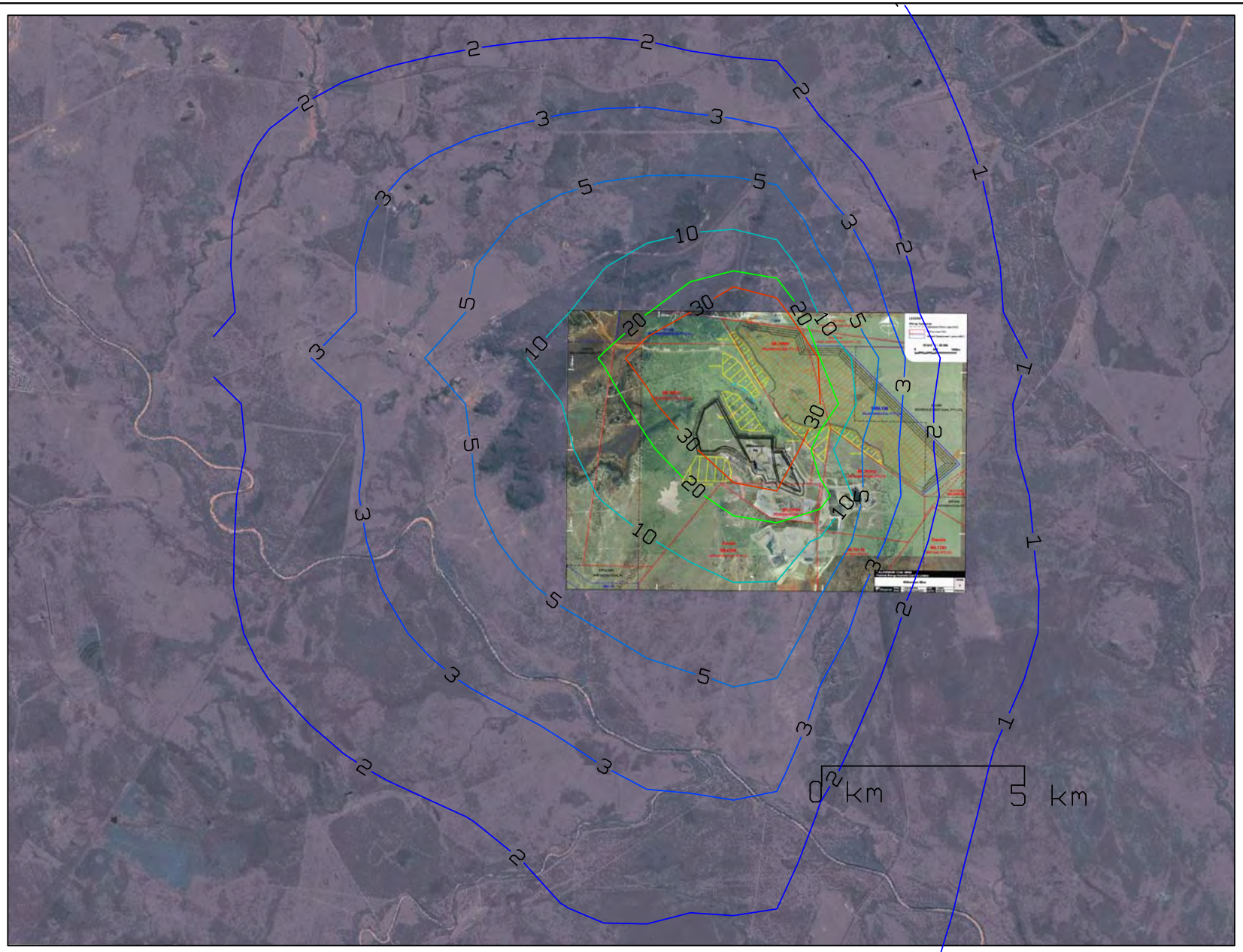
CAD DRAWING	11
REVISION No:	2

Millenium Expansion

TITLE
Case 2 – In Pit Dump
Dust Concentration Contours
PM10 5th Highest 24 Hour Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 11	A4



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DATE :

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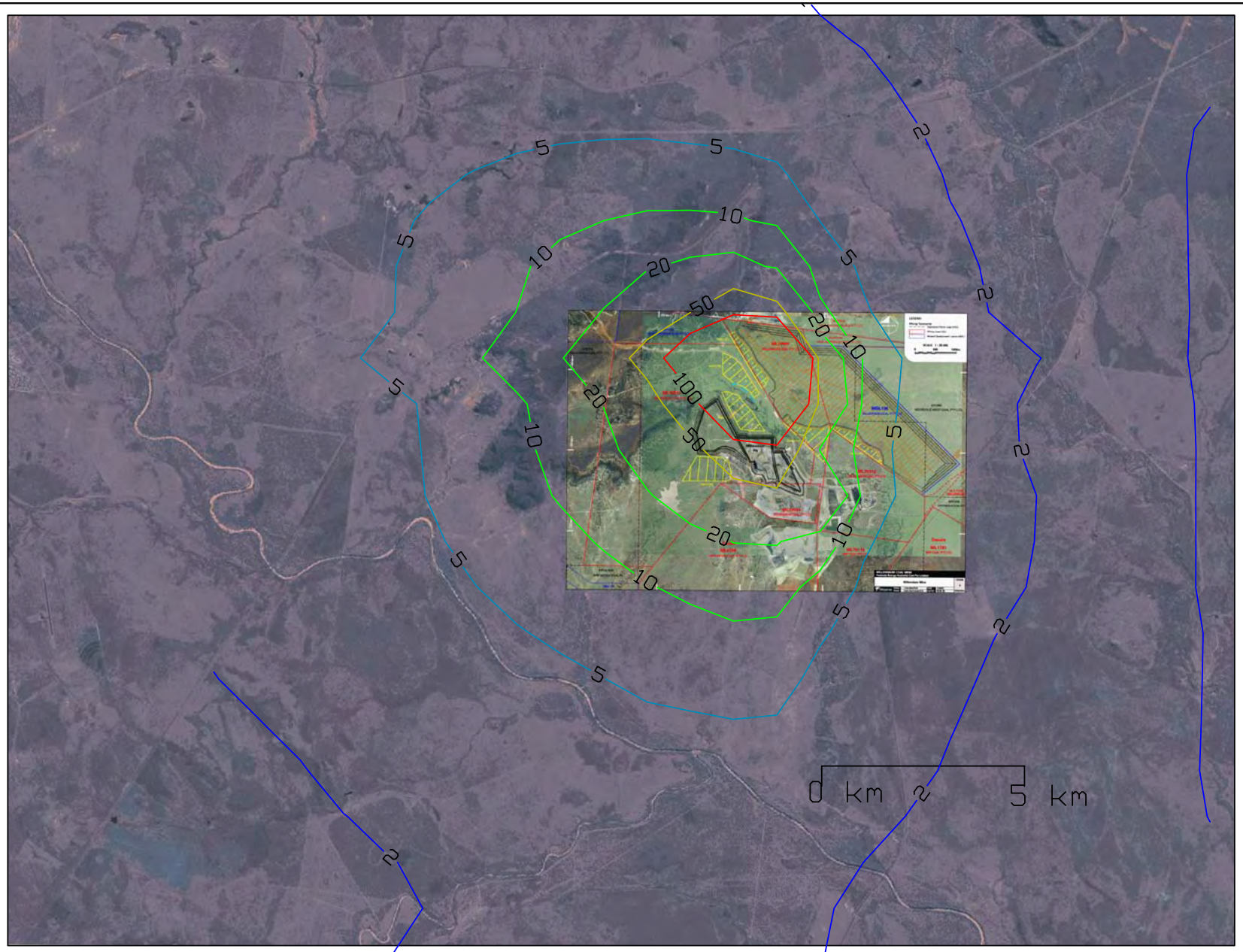
DATE	13 May 2010
CAD DRAWING	012
REVISION No:	2

Millenium Expansion

TITLE
Case 2 – In Pit Dump
Dust Concentration Contours
TSP Annual Average in ug/m3

SCALE	DRAWING No.	
NTS	Figure 12	A4



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CAD DRAWING	013
REVISION No:	1

Millenium Expansion

TITLE
Case 2 – In Pit Dump
Dust Deposition Contours
TSP Annual Average in mg/m2/day

SCALE	DRAWING No.	
NTS	Figure 13	A4

Table 7:Predicted Dust Concentration and Dust Deposition For Sensitive Receptors (including assumed ambient levels) – Case 1

Homestead	***Calculated Dust Levels At Nearby Residences***				
	PM2.5 (24 hour) (Maximum) ***(µg/m^3)***	***PM2.5 (annual average)*** ***(µg/m^3)***	***PM10 (24 hour) (5th Highest)*** ***(µg/m^3)***	***TSP(Annual Average)*** ***(µg/m^3)***	***Dust Deposition (annual)*** ***(mg/m^2/day)***
Limit	**25**	**8**	**50**	**90**	**120**
Existing Ambient	***2***	***2***	***8***	***28***	***25***
Winchester Downs	5	2	16	30	28
Watonga	6	2	26	34	35
Broadlea	6	2	24	32	31
Moorvale	3	2	13	29	27
Annandale	3	2	13	29	27

Table 8: Predicted Dust Concentration and Dust Deposition For Sensitive Receptors (including assumed ambient levels) – Case 2

Homestead	***Calculated Dust Levels At Nearby Residences***				
	PM2.5 (24 hour) (Maximum) ***(µg/m^3)***	***PM2.5 (annual average)*** ***(µg/m^3)***	***PM10 (24 hour) (5th Highest)*** ***(µg/m^3)***	***TSP(Annual Average)*** ***(µg/m^3)***	***Dust Deposition (annual)*** ***(mg/m^2/day)***
Limit	**25**	**8**	**50**	**90**	**120**
Existing Ambient	***2***	***2***	***8***	***28***	***25***
Winchester Downs	4	2	18	30	28
Watonga	6	2	27	33	31
Broadlea	5	2	23	31	30
Moorvale	4	2	16	29	27
Annandale	4	2	16	29	27

4.3 Air Quality Assessment

The predicted average ground level concentrations at nearby sensitive areas have been modelled and Section 4.1 contains a full description of the modelling methods. The methodology includes both normal and expected maximum emission conditions and the worst case meteorological conditions. Expected worst case emissions are modelled by virtue of the modelling methodology. The emissions are not aggregated then averaged over the year, but varied on an hour-by-hour basis incorporating the effects of dust control and wind speed dependent emissions. By adopting this methodology the model incorporates periods when there is very little dust control and periods when there are high emission rates (upset conditions).

The ground level predictions were made at all residential locations and the contours cover adjacent industrial and agricultural developments. The tabulated results include the cumulative effects from sources other than Millennium. All the techniques used to obtain the predictions have referenced and key assumptions and data sets explained.

The averaging period for ground level concentrations of contaminants are consistent with the relevant averaging periods for air quality indicators and goals in the Environmental Protection (Air) Policy 2008 and National Environmental Protection (Ambient Air Quality) Measure (NEPM).

Air

Case 1

This case with out-of-pit dumping readily complies with the dust limits at all sensitive receptors. Watonga Homestead and Broadlea Homestead are the most adversely affected. The nuisance dust deposition levels are likely to increase by about 20%, although the absolute levels are well within guideline levels.

Case 2

This case with in-pit dumping complies with the dust limits at all sensitive receptors. Watonga and Broadlea are the most adversely affected. The nuisance dust deposition levels are likely to increase by about 10%, although the absolute levels are well within guideline levels.

The in-pit dumping case is an improvement on the out of pit dumping case. Some of the reasons for the improvement include the shorter haul route for the overburden and some of the overburden dumping takes place within the pit. However the out of pit dumping case has much higher source heights and this will result in higher environmental dust concentration and deposition levels.

Comment

The cumulative impact from the MEP on the broader more distant environment is minimal. Dust deposition levels are within 10% of ambient levels within 5 km of the mine. It is not anticipated that this development will adversely impact on the air shed and, as a consequence, affect other developments or competing uses.

The separation distance(s) between the facility and neighbouring sensitive receptors are adequate for any ‘worst case’ emissions that may occur during operations. The modelling procedure accounts for worst-case emissions by placing the sources in the position likely to lead to the

highest dust levels in the local area and by modelling without watering or other forms of dust suppressions for significant periods of the modelling period. The cumulative impacts (with other sources) are addressed by including existing ambient conditions.

The human health risks associated with the emissions are well within acceptable levels. All emissions are described by limits from either the National Environmental Protection Council (Ambient Air Quality) Measure or the Environmental Protection (Air) Policy 2008

4.4 Recommendations and Mitigation Measures

Although the mine has a very low impact it is proposed that the mine investigate ways to minimise dust emissions from overburden dumping, particularly during easterly winds. These may include orientation of overburden mounds, dumping dry material low in the pit and moist material high on the spoil mound.

Although much of these measures are standard operating procedures for mine, Table 9 provides a summary of control procedures to mitigate dust emissions.

Table 9: Dust Mitigation Measures

Source	**Mitigation Measure**
Mining Areas	Disturb the minimum area necessary for mining and rehabilitate promptly.
Coal handling area	Use water sprays and water trucks to keep handling areas moist
Stockpile	Maintain water sprays on coal stockpile and transfer points
Haul Roads	Maintain haul roads in good condition and regular use of water truck. Investigate use of chemical suppressants if haul roads become too slippery.
Other Roads	Keep number of other roads to a minimum and those required maintain in good condition and regular use of water truck. Once a road is no longer in use barricade and revegetate.
Overburden Placement	Keep these areas moist, particularly areas used by dump trucks. Place dry material low on overburden dump and damp material in the elevated areas of the overburden dump.

5. Greenhouse Gas Emissions

The Australian Department of Climate Change (DCC) delivers the majority of programs under the Australian Government's climate change strategy including the Australian Greenhouse Office (AGO) Greenhouse Challenge Plus. The DCC provides a workbook, the 'National Greenhouse Accounts (NGA) Factors' (June 2009) to enable industry to calculate greenhouse gas emissions (GHG) using appropriate methods and emission factors.

The National Greenhouse and Energy Reporting Act 2007 (the NGER Act) introduced a national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. It is the follow on program from the Greenhouse Challenge. The NGER doesn't cover Scope 3 reporting. Hence NGER is used for Scope 1 and Scope 2 future emissions and the 2009 NGA Workbook was used to estimate the Scope 3 future emissions from the project.

The scope that emissions are reported under is determined by whether the activity is within the organisation's boundary (direct emissions are scope 1) or outside it (indirect emissions scope 2 and scope 3), refer to Appendix 4 for description.

5.1 Estimated Greenhouse Emissions

The MEP commences mining in 2010, mining approximately 2 million tonnes ROM coal in the first year. The production rate would be ramped up in the following years to approximately 5.2 million tonnes ROM coal by 2014. Tonnages would then remain constant until 2026 in the final full production year of the mine in 2031. Since the Coal Handling plant is not part of this project, there is no significant use of Queensland grid electricity.

The principal sources of Scope 1 greenhouse gas emissions would be:

- the consumption of diesel by the mining fleet;
- methane emissions (fugitive) from coal;
- burning of cleared vegetation.

The key assumptions underlying the greenhouse gas inventory are listed below.

- The Scope 1 emissions or direct emissions for diesel transport are calculated using the 69.5 kg CO2-e/GJ (CO2+CH4+N20) or 2.7 kg CO2-e/L factor for energy factor of 38.6 GJ/kL.
- The Scope 1 emissions or direct emission associated with coal seam methane release prior to the production of coal (fugitive) for open cut mining in Queensland is 0.017 tonnes CO2-e/tonne raw coal.
- The Scope 1 emissions or direct emissions for ANFO is 0.167 t CO2 / t product.
- The Scope 1 emissions or direct emissions associated with clearing vegetation is estimated considered to be minor.
- The Scope 3 emissions or indirect emissions for production of diesel is 5.3 kg CO2-e/GJ, from NGA 2009.

- The Scope 3 emissions or indirect emissions as the consequence of transportation by Queensland Rail to the port is 1.01 kg CO2-e/kWh

Based on these assumptions the projected emissions over the life of the MEP are contained in Table 10 for Scope 1 emissions and Table 11 for Scope 2 and 3 emissions. It should be noted there are no Scope 2 emissions.

The electricity and diesel consumption has been estimated based on the reporting for the current Millennium Mine. In 2007 the diesel consumption was 13.1 million litres, 1,500 tonnes of ANFO for 0.7MTPA ROM coal and 13.4 million BCM of overburden. A BCM is assumed to weigh 1.86 tonnes. In 2008 the diesel consumption was 13.9 million litres, 3,100 tonnes of ANFO for 1.7MTPA ROM coal and 8.5 million BCM of overburden. It is understood that currently mains electricity powers the CHPP and diesel generators supply electricity elsewhere.

Based on these reported results it is assumed that:

(a) Diesel consumption is likely to be 0.45 l/tonne of ROM or overburden moved;

(b) ANFO consumption is likely to be 200 tonnes/Million tonnes of overburden; and,

(c) Electricity consumption by QR is approximately 11,500 kWh per return journey per 10,000 tonnes of coal between the site and the port.

Table 10: Greenhouse Gas Emissions for Life of Mine (Scope 1)

Year	Source Data					Greenhouse Gas Emissions (tonnes *10^3 CO2-e)				
	Coal ROM	Overburden	ANFO	Diesel for Machinery	Cleared and Burnt	Scope 1				
	M tonnes	M tonnes	k tonnes	kL	ha	Coal ROM	Diesel	ANFO	Clearing woodland	Total
2010	2.0	55	6	25824	33	34	70	0.009	0.006	***104***
2011	3.8	112	11	52117	90	65	141	0.019	0.016	***205***
2012	4.0	113	11	52592	75	68	142	0.019	0.014	***210***
2013	5.2	110	11	51631	65	88	139	0.018	0.012	***228***
2014	5.2	109	11	51434	69	88	139	0.018	0.012	***227***
2015	5.2	111	11	52185	71	88	141	0.018	0.013	***229***
2016	5.5	110	11	51862	78	93	140	0.018	0.014	***234***
2017	5.5	109	11	51552	66	93	139	0.018	0.012	***233***
2018	5.5	110	11	51904	47	93	140	0.018	0.008	***234***
2019	5.5	112	11	52995	47	93	143	0.019	0.008	***237***
2020	5.5	102	10	48285	42	93	130	0.017	0.008	***224***
2021	5.5	108	11	50976	53	94	138	0.018	0.010	***231***
2022	5.5	104	10	49184	60	93	133	0.017	0.011	***226***
2023	5.5	105	10	49652	51	93	134	0.018	0.009	***228***
2024	5.5	111	11	52600	54	93	142	0.019	0.010	***236***
2025	5.5	76	8	36552	116	94	99	0.013		***192***
2026	5.5	35	3	18010		93	49	0.006		***142***
2027	0.1					2				***2***
Total	**86**	**1690**	**169**	**799,354**	**899**	**1462**	**2158**	**0.282**	**0.162**	***3621***

Table 11: *Greenhouse Gas Emissions for Life of Mine (Scope* 2 and 3*)*

Year	Source Data				Greenhouse Gas Emissions (tonnes * 10^3 CO2 -e)				
	Coal ROM	Overburden	Diesel for Machinery	Train trips	Scope 2		Scope 3		
	M tonnes	M tonnes	kL			Total Scope 2	Diesel	Electricity QR	Total Scope 3
2010	2.0	55	25824	20	-	0	5	0.23	***5.5***
2011	3.8	112	52117	38	-	0	11	0.44	***11.1***
2012	4.0	113	52592	40	-	0	11	0.47	***11.2***
2013	5.2	110	51631	52	-	0	11	0.61	***11.2***
2014	5.2	109	51434	52	-	0	11	0.61	***11.1***
2015	5.2	111	52185	52	-	0	11	0.61	***11.3***
2016	5.5	110	51862	55	-	0	11	0.64	***11.3***
2017	5.5	109	51552	55	-	0	11	0.64	***11.2***
2018	5.5	110	51904	55	-	0	11	0.64	***11.3***
2019	5.5	112	52995	55	-	0	11	0.64	***11.5***
2020	5.5	102	48285	55	-	0	10	0.64	***10.5***
2021	5.5	108	50976	55	-	0	10	0.64	***11.1***
2022	5.5	104	49184	55	-	0	10	0.64	***11.7***
2023	5.5	105	49652	55	-	0	10	0.64	***10.8***
2024	5.5	111	52600	55	-	0	11	0.64	***11.4***
2025	5.5	76	36552	55	-	0	7	0.64	***8.1***
2026	5.5	35	18010	55	-	0	4	0.64	***4.3***
2027	0.1			1	-	0		0.01	***0.01***
Total	**86**	**1,690**	**799,354**		**-**	**0**	**164**	**10.01**	***175.5***

5.2 Discussion and Abatement Measures

Other matters that will be addressed include the sizing and selection of mobile diesel powered equipment. Fuel consumption rates are an integral part of the decision matrix for their selection and fuel costs and efficiencies one of the most important parameters. Therefore higher fuel prices have made coal producers increasingly aware of fuel costs and the subsequent flow-on effect in reducing greenhouse gas emissions.

Peabody are committed to the concept of sustainable development and in December 2005 joined Greenhouse Challenge Plus, which was part of the Australian Government's Climate Change Strategy. Since the introduction of NGER Peabody produces an annual report of greehhouse gas emissions. Peabody are committed to reducing the greenhouse gas emissions of the operations, accelerating the uptake of energy efficiency, integrating greenhouse issues into business decision making and providing more consistent reporting of greenhouse gas emission levels. Already they have reduced greenhouse gas emissions, including major projects at Wilkie Creek and North Goonyella.

Direct means of reducing greenhouse gas emissions could include such measures as:

- minimising clearing at the site;
- integrating transport for the MEP with other local industries such that greenhouse gas emissions from the construction and running of transport are minimised;
- maximising the use of renewable energy sources.
- Improved accuracy in greenhouse gas measurement by advancing from default factors to direct measurement methodologies

Indirect means of reducing greenhouse gas emissions could include such measures as:

- carbon sequestration at nearby or remote locations by:
  - progressive rehabilitation of disturbed areas; and
  - planting trees or other vegetation external to the MEP to achieve greater biomass than that cleared for the MEP.
- carbon trading through recognised markets.

The Environmental Management Plan will include a specific module to address greenhouse abatement. That module will include:

- commitments to the abatement of greenhouse gas emissions from the MEP with details of the intended objectives, measures and performance standards to avoid, minimise and control emissions,
- commitments to energy management, including undertaking periodic energy audits with a view to progressively improving energy efficiency;
- a process for regular review of new technologies to identify opportunities to reduce

emissions and use energy efficiently, consistent with best practice environmental management;

- any voluntary initiatives such as projects undertaken as a component of the national Energy Efficiency Opportunities program, or research into reducing the lifecycle and embodied energy carbon intensity of the project's processes or products;
- opportunities for offsetting greenhouse emissions, including, if appropriate, carbon sequestration and renewable energy uses; and
- commitments to monitor, audit and report on greenhouse emissions from all relevant activities and the success of offset measures

5.3 Climate Change Adaptation

The Garnaut Review (2008) states "Effects of future warming on rainfall patterns are difficult to predict because of interactions with complex regional climate systems. Best-estimate projections show considerable drying in southern Australia, with risk of much greater drying. The mainstream Australian science estimates that there may be a 10 per cent chance of a small increase in average rainfall, accompanied by much higher temperatures and greater variability in weather patterns."

The life of the mine is typically of the order of 20 years and the likely changes over this time will be gradual and relatively minor. A reduction in rainfall and an increase in temperatures will result in higher dust emissions. However, the changes are only likely to be small and within the capacity of Peabody management to respond within the bounds of current dust control technology. It is expected the risk of a significant increase in emissions is very small.

Peabody commits to undertake, where practicable, a cooperative approach with government, other industry and sectors to address adaptation to climate change. Peabody is committed to reducing its greenhouse gas emissions and is an active contributor to research programs to develop clean coal technologies.

6. Conclusion

Monitoring of the existing environment has revealed that the existing PM10 levels are relatively low. There appears to be a diurnal cycle with the lowest dust levels at night and the highest during the day. The monitoring results were typical for the Moranbah area.

It was determined that the key issue to be addressed in the Air Quality assessment is dust and that other air pollution measures have minor and impacts localised to the lease area. From the EPP(Air) there are four environmental objectives associated with health and wellbeing. From the DERM Licensing and Permits, a single nuisance objective was obtained.

The modelling was carried out using the TAPM air quality model. This model was also used develop the meteorology data set used in the modelling. The modelling simulation was carried out over 2 years 2004 and 2005.

The development of the representative emissions database has been primarily based on National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3. The main mining activities and processes that produce, or could produce, dust emissions were identified for the MEP operations. Flowcharts for handling of overburden and coal were developed and an emission factor (from NPI) was attributed to every handling point, handling activity and transport section. In addition emissions from exposed surfaces were identified and included in the database.

Modelled air quality concentrations at the most exposed existing off-site sensitive receptors have been compared with the appropriate national and international ambient air quality standards including the Environmental Protection (Air) Policy 2008 and the National Environmental Projection Council (Ambient Air Quality) Measure and DERM “Preparing an Environmental Management Overview Strategy (EMOS) for Non-standard Mining Projects”.

The predicted average ground level concentrations at nearby sensitive areas were modelled and Section 4.1 contains a full description of the modelling methods. The methodology includes both normal and expected maximum emission conditions and the worst case meteorological conditions. The ground level predictions were made at all residential locations and the contours cover adjacent industrial and agricultural developments. All the techniques used to obtain the predictions have referenced and key assumptions and data sets explained.

Two cases were modelled, one having an out-of-pit overburden dump and the second an in-pit dump. It was found that the both cases readily complied with all limits. .

All the dust modelling results show the effects of the easterly wind components with the highest levels to the west of the site. The nuisance dust deposition levels at Watonga Homestead are likely to increase deposition by about 10% to 20%, though they are likely to remain well within these nuisance guideline levels.

The impact on the broader, more distant, environment is minimal. Dust deposition levels are within 10% of ambient levels within 5 km of the mine. Thus it is not anticipated that this development will adversely impact on the air shed and, as a consequence, affect other developments or competing uses.

The EPP(Air) indicates that 5th highest PM10 limit of 50 µg/m^3 is a health and well being objective. Hence an exceedance of this limit would be considered to have a potential health risk. Mitigating

this aspect is that the health risks are greater in urban communities than in rural communities. In urban areas, the PM10 comes from combustion sources and which potentially contain hazardous compounds. These types of hazardous compounds are not usually associated with dust from mines. As a result emissions from the mine are considered to be a lower risk.

A greenhouse gas assessment was carried out utilising the NGER emission factors, the 2009 NGA workbook and the best available projections for the mine. The project will result in greenhouse gas emissions as the result of the use of diesel fuel, explosives, clearing and indirectly in the use of electrical power. Methane will be released from the coal seam. The total emissions are small and unlikely to have a measureable effect on climate. Nevertheless Peabody will seek new and improved ways to reduce greenhouse gas emissions and use clean coal technologies, whilst maintaining active involvement in all appropriate greenhouse gas programs.

Glossary of Terms

PM10	particles in the air environment with an equivalent aerodynamic diameter of not more than 10microns.
PM2.5	particles in the air environment with an equivalent aerodynamic diameter of not more than 2.5 microns
TSP	total suspended particles are particles in the air environment with an equivalent aerodynamic diameter of not more than 50 microns.
air emission	a substance released into the air.

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Appendix 1 Climate Data for Moranbah

Statistic Element	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Ann
Mean maximum temperature (Degrees C)	33.9	33.2	32.3	29.6	26.6	23.7	23.6	25.3	29.2	32.4	33.2	34	29.7
Highest temperature (Degrees C)	45	41.1	40.4	36	33.9	31.9	31	32.9	38	40.5	42.7	42.5	45
Lowest maximum temperature (Degrees C)	23.3	22	22	17.8	14.2	10.6	13.9	11	18.9	17.5	21	20	10.6
Mean number of days >= 30 Degrees C	27	23.7	25.5	12.9	2.3	0.3	0.1	1.7	11.3	24.5	25.1	26.7	181.1
Mean number of days >= 35 Degrees C	10.9	8.2	4.2	0.7	0	0	0	0	0.7	5.8	8.4	13	51.9
Mean number of days >= 40 Degrees C	0.6	0.2	0	0	0	0	0	0	0	0.1	0.4	0.7	2
Mean minimum temperature (Degrees C)	21.9	21.8	20.2	17.5	14.4	11.2	9.8	10.9	14.1	17.7	19.5	21.1	16.7
Lowest temperature (Degrees C)	14.9	15.5	14.3	6	5	1.1	0.2	3	5.9	11.2	11.9	15	0.2
Highest minimum temperature (Degrees C)	28.5	26.5	27	25.2	21.6	21.9	18	18.7	23.6	23.6	25.6	27.9	28.5
Mean number of days <= 2 Degrees C	0	0	0	0	0	0.1	0.2	0	0	0	0	0	0.3
Mean number of days <= 0 Degrees C	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean rainfall (mm)	102.1	98.3	47.3	37.4	36.8	23	19	23.1	8.1	37.1	68.4	97.3	597.7
Highest rainfall (mm)	315	347.4	268	271	196.6	170.3	103.6	247.3	39.4	146.6	220.3	318.2	1009.6
Lowest rainfall (mm)	9.4	0.3	0.2	0	0	0	0	0	0	0	0	4.6	280.7
Highest daily rainfall (mm)	120.4	150.8	164.8	143.8	58	43.4	60	150.8	20.4	73.8	86	116	164.8
Mean number of days of rain	8.4	7.7	4.8	4.2	3.8	3.3	2.6	2	2.1	4.2	6	7.2	56.3
Mean number of days of rain >= 1 mm	6.3	6.1	3.5	3	2.8	2.1	1.9	1.6	1.3	3.1	4.8	5.6	42.1
Mean number of days of rain >= 10 mm	2.9	2.6	1.2	1.2	1	0.7	0.6	0.7	0.3	1.2	2.1	2.5	17

Mean number of days of rain >= 25 mm	1.3	1.1	0.5	0.4	0.4	0.3	0.2	0.2	0	0.4	1.1	1.3	
Mean daily solar exposure (MJ/(m*m))	24.5	22.4	22.6	19.2	16.5	14.7	16.1	18.8	22.6	24.8	25.9	25.6	21.1
Mean number of clear days	5.3	4.1	7.8	10.2	11.5	13.6	16.8	17	17.2	14.3	10.1	7.2	135.1
Mean number of cloudy days	10.6	10.7	8.3	7.2	7.7	6.7	4.9	4.1	2.4	4.8	6.7	8.5	82.6
Mean daily evaporation (mm)	8.2	7.6	7.1	5.9	4.4	3.6	3.8	4.9	6.7	8.1	8.6	8.7	6.5
Mean 9am temperature (Degrees C)	26.4	25.8	24.7	22.1	18.9	15.4	14.6	16.5	20.5	24	25.2	26.4	21.7
Mean 9am wet bulb temperature (Degrees C)	22.3	22.3	20.9	18.8	16	12.8	11.7	13	15.7	18.7	20	21.5	17.8
Mean 9am dew point temperature (Degrees C)	20.2	20.4	18.7	16.6	13.5	10.2	8.5	9.4	11.5	14.8	16.5	18.6	14.9
Mean 9am relative humidity (%)	70	74	70	72	73	73	69	66	59	59	61	64	67
Mean 9am cloud cover (okas)	4.4	4.5	3.6	3.2	3.3	2.8	2.3	2	1.7	2.3	3.2	3.7	3.1
Mean 9am wind speed (km/h) for years 1986 to 2009	7.5	7.7	8.1	7.7	6.2	5.5	5.3	6.6	7.7	8.4	8.4	8.4	7.3
Mean 3pm temperature (Degrees C)	32.7	31.9	31.3	28.6	25.7	22.8	22.8	24.4	28.3	31.3	32.1	32.8	28.7
Mean 3pm wet bulb temperature (Degrees C)	22.9	23.1	21.6	19.8	17.8	15.6	14.8	15.4	17.2	19.5	20.8	22.2	19.2
Mean 3pm dew point temperature (Degrees C)	17.2	18	15.6	13.7	11.4	8.9	7	6.7	7.4	10.5	12.9	15.7	12.1
Mean 3pm relative humidity (%)	42	47	41	43	44	44	39	35	30	30	34	39	39
Mean 3pm cloud cover (oktas)	5	5.1	4.4	4.3	3.9	3.1	2.7	2.7	2.4	3.3	3.9	4.5	3.8
Mean 3pm wind speed (km/h) for years 1986 to 2009	8.7	9.6	9.4	8.8	6.8	6.5	6.9	7.6	8.4	8.4	8.9	8.8	8.2

Source: Bureau of Meteorology web site (2009) for Moranbah.

Appendix 2 Dust Emission Rate Calculation Methodology

Unpaved Roads

The emission factor for unpaved roads within the site is based on US-EPA AP-42 (2003) 5th Update 2003. The Australian National Pollution Inventory (NPI) "Emission Estimation Technique Manual for Mining Version 2.3" references the AP-42 document, although a previous edition of AP-42. In keeping with recommendations contained in a review of the NPI document by Sinclair Knight Mertz (SKM) "Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques", June 2005 commissioned by Western Australian Department of Environment, the latest AP-42 emission rates have been adopted for this analysis.

The emission rate in AP-42 for industrial unpaved roads is contained in Equation 1.

$$E = k\,(s/12)^a (W/3)^b \quad \text{.....(1)}$$

Where:

E is the emission rate in kg/VKT

VKT is Vehicle kilometre travelled;

k = PM10 0.423; TSP 1.383;

s = surface material silt percentage, taken to be 5.1%;

W = average mass of vehicles in tonnes;

a = PM10 0.9; TSP 0.7; and,

b = 0.45.

In the event that water or chemical dust suppressants are used on the haul road the dust emission factors may be significantly reduced. To address is effect it is proposed to adopt the US-EPA AP42 approach to water control effectiveness. This curve is used to reduce emissions from roads resulting from rainfall and water truck use. Refer to Figure 13.2.2-2 extracted from AP42 showing the control efficiency of watered roads.

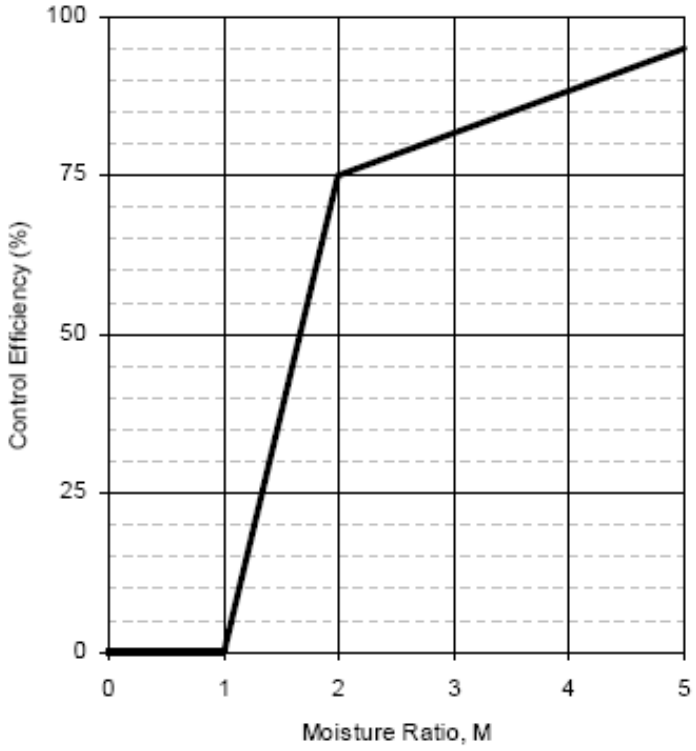


Figure 13.2.2-2. Watering control effectiveness for unpaved travel surfaces

Wind Erosion From The Active Stockpile

The NPI recommends that where information is scarce, a default emission rate of 0.4 kg/ha/h (3504 kg/ha/yr) for TSP with 50% being PM10.

Other Sources

All other Sources refer to the NPI default emission rates.

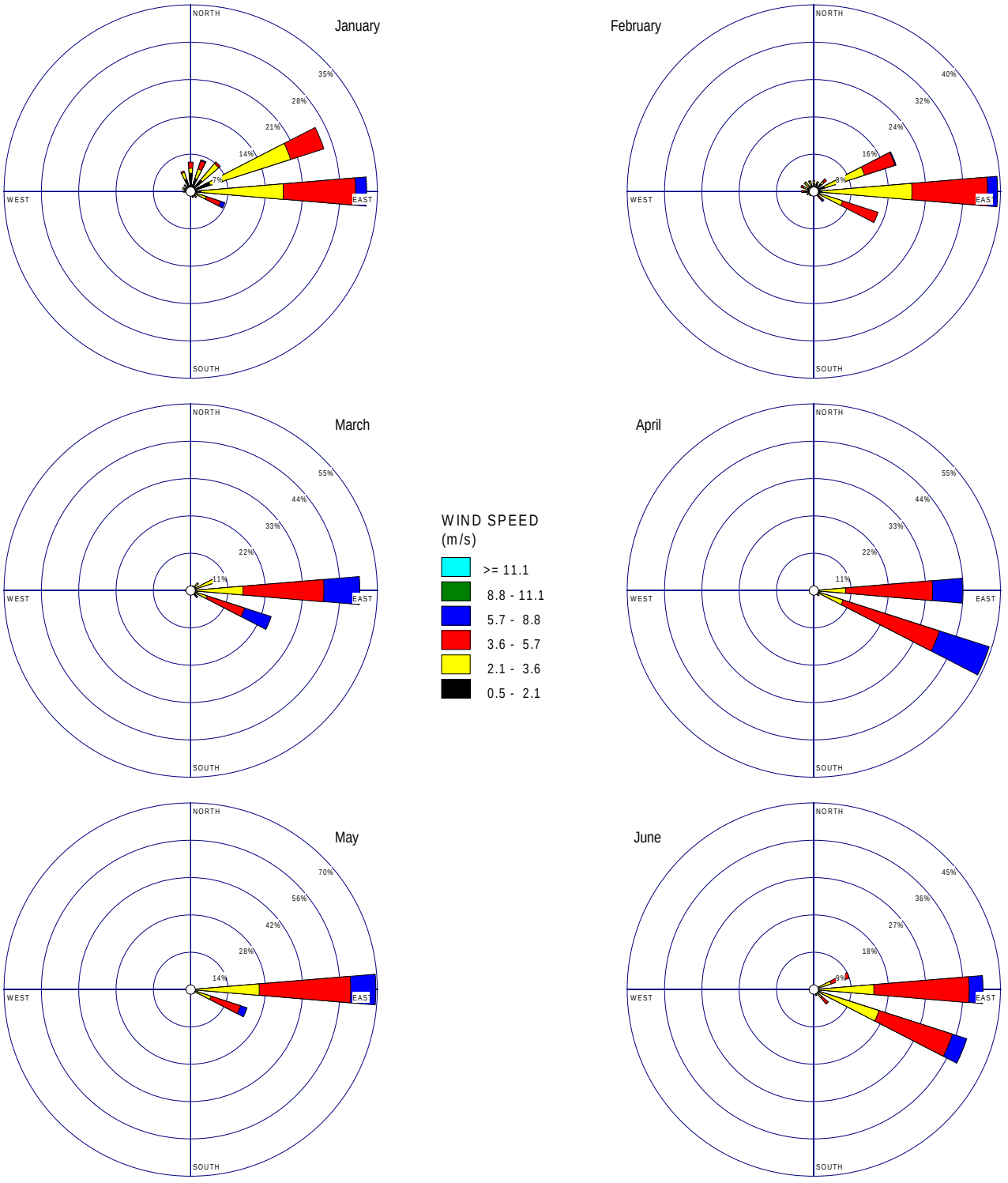
Appendix 3 Windroses for the Site

WIND ROSE PLOT:

Millenium Mine

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Roses for First Six Months

DATA PERIOD:

2004-2005
Jan 1 - May 31
00:00 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

Chris Simpson

NOISE MAPPING AUSTRALIA
SCALABLE CONSULTING SOLUTIONS

DATE:

6/08/2010

PROJECT NO.:

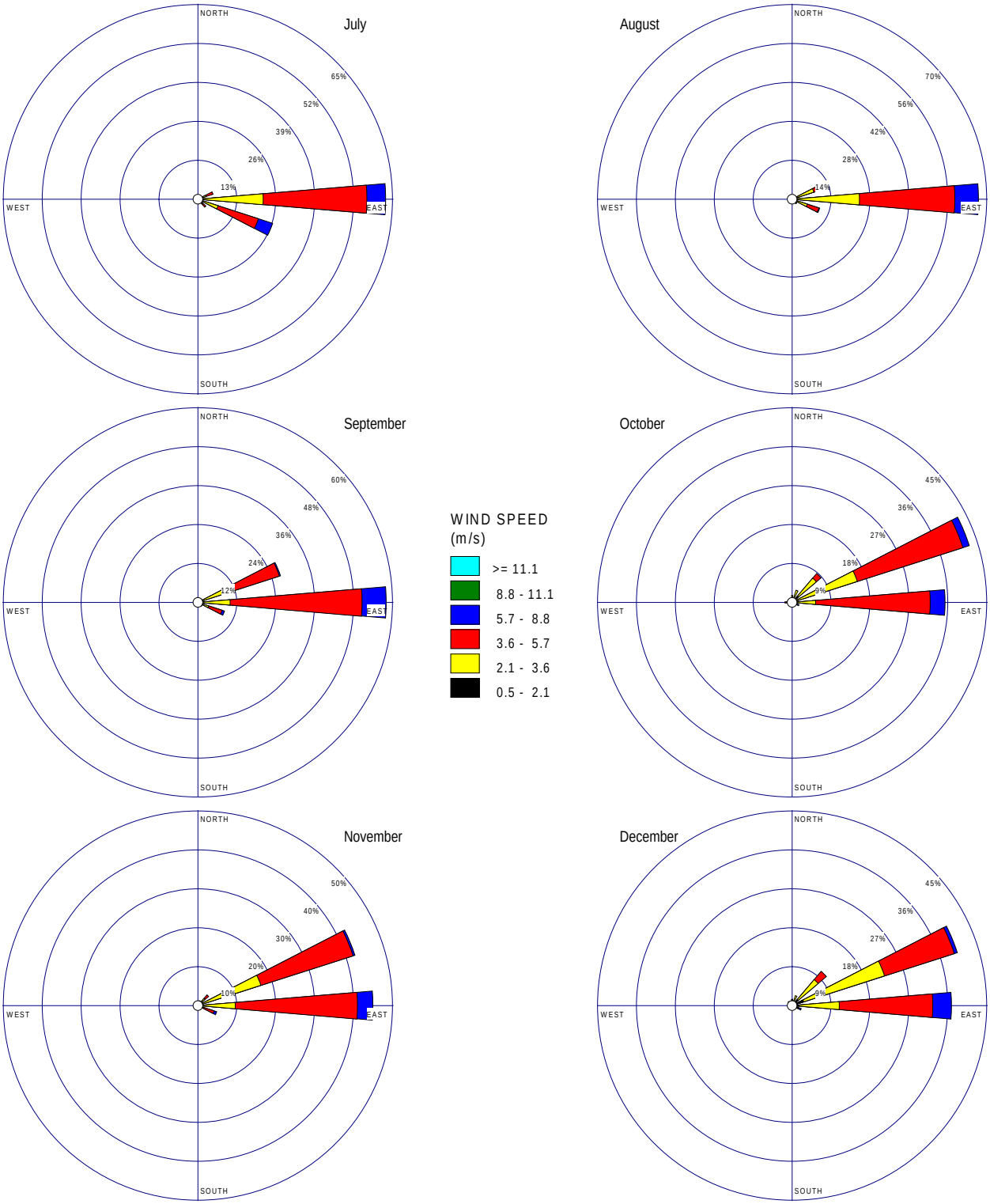
081021M

WIND ROSE PLOT:

Millenium Mine

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Roses for Last Six Months

DATA PERIOD:

2004-2005
June 1 - December 31
00:00 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

Chris Simpson

NOISE MAPPING AUSTRALIA
SCALABLE CONSULTING SOLUTIONS

DATE:

6/08/2010

PROJECT NO.:

081021M

Appendix 4 Greenhouse Gas Scope Description

Scope 1 Emissions

Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal).

Scope 2 Emissions

Indirect emission factors are used to calculate scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

Scope 3 Emissions

These indirect emissions are attributable the consequence of an organisation's activities but are not owned or controlled by the activities, the transport and combustion of the extracted coal.

The main greenhouse gases associated with the Project are:

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)

These gases differ in their capacity to trap heat and contribute to the greenhouse effect. The capacity of each gas to contribute to global warming is referred to as it's 'global warming potential' (GWP) and is measured relative to that of carbon dioxide i.e. carbon dioxide has a GWP of 1, whereas methane has a GWP of 21 because one tonne of methane has the same capacity to contribute to global warming as 21 tonnes of carbon dioxide.

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F6:

NOISE

Noise Mapping Australia

Scalable Consulting Solutions

www.noisemapping.com.au

ABN 50 099 432 372

Document title:

Millennium Mine Expansion

Document type:

Noise and Vibration Assessment

Prepared for:

Matrix Plus Consultants

Document & Date issued:

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by:.....

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Contents

1. INTRODUCTION 1
1.1 PROJECT DESCRIPTION 1
1.1 LOCALITY DESCRIPTION 2
1.2 CLIMATE 3
2. EXISTING NOISE ENVIRONMENT 5
3. NOISE CRITERIA 10
3.1 ENVIRONMENTAL PROTECTION ACT 10
3.1.1 Acoustic Quality Objectives 10
3.1.2 Controlling Background Creep 11
3.2 EPA ECOACCESS GUIDELINE - LOW FREQUENCY NOISE 11
3.3 BLASTING CRITERIA 12
3.4 RAILWAY NOISE GOALS 12
3.5 ROAD TRAFFIC NOISE GOALS 13
3.6 SUMMARY OF NOISE AND VIBRATION GOALS 13
4. NOISE MODELLING 17
4.1 NOISE MODEL 17
4.2 METEOROLOGY 19
4.3 NOISE MODEL PARAMETERS 20
4.4 NOISE MODELLING RESULTS 23
4.5 NOISE ASSESSMENT 25
5. CONCLUSION 26
GLOSSARY OF ACOUSTICAL TERMS 27
LIST OF REFERENCES 28
APPENDIX 1 CLIMATE DATA FOR MORANBAH 29
APPENDIX 2 WINDROSES FOR THE SITE 32

1. Introduction

Matrixplus Consulting Pty Ltd ('Matrixplus'), on behalf of Peabody Energy Australia Pty Ltd ('Peabody'), engaged Noise Mapping Australia ('NMA') to prepare a noise and vibration assessment for the proposed Millennium Expansion Project (MEP) east of Moranbah.

The objective of this assessment is to provide Peabody with information to assist with obtaining the necessary approvals for the proposed expansion.

This report addresses the following issues.

- Description of existing noise conditions;
- Description of noise emissions from existing operations;
- Likely change in noise environment following commencement of increased mining;
- Assessment of noise at sensitive receptors to appropriate standards;
- Recommendations for relevant impact mitigation measures and monitoring program.

1.1 Project Description

The Millennium Coal Mine is an existing open-cut coal mine, operated by Millennium Coal Pty Limited (MCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Limited (Peabody). The Mine has been operating since 2005 with approval to produce at a rate of 2.0 Million tonnes per annum (Mtpa).

The Run-of-Mine (ROM) coal is currently extracted from two granted Mining Leases (ML) namely, ML70313 "Millennium West" and ML 70344 "Mountain Pit". The ROM coal is washed in a Coal Handling and Preparation Plant (CHPP) on an adjoining infrastructure lease, ML 70312 "Millennium East". Peabody proposes to extend the current open-cut mining operation into two new lease areas namely, Mineral Development Licence (MDL) 136 "Mavis Downs" and Mining Lease Application (MLA) 70401. Mining will also continue within ML 70313. The proposed expansion areas are collectively referred to as the "Millennium Expansion Project" (MEP).It is proposed the open-cut coal mining will slightly increase the existing Run of Mine (ROM) extraction rate from 5 Million tonnes per annum (Mtpa) to 5.5 Mtpa, to enable an estimated production rate of up to 3.5 Mtpa product coal. Mining involves clearing of vegetation, salvage of topsoil, stripping of overburden, extraction of the coal, placement of topsoil or growth media and revegetation. Coal mining will most likely be performed using truck and shovel terrace mining methods. Mined areas would be progressively rehabilitated.

The site is accessed from Peak Downs Highway approximately 16 km west of Coppabella and 22 km east of Moranbah. The site access road traverses pastoral holdings prior to entering ML 70313 in the northwest corner of the Millennium Coal Mine. The mine access road traverses a number of New Chum Creek tributaries and eventually New Chum Creek itself, prior to reaching the main industrial area. The access road then continues on to the CHPP on ML 70312. The access road is shared by the Poitrel Mine which lies to the south of the Millennium Mine.

Coal processing – mined coal will be transported to the processing area on ML 70312 via haul trucks. As part of the coal processing, coal fines and reject material will be produced as by-products. The existing Coal Handling & Preparation Plant (CHPP) on ML 70312 will be used to process the coal, following suitable infrastructure upgrades to facilitate the proposed increase in production associated with the MEP. Any major modification to the CHPP will be the subject of a separate application as the CHPP is owned by the Red Mountain Joint Venture.

The washed coal will be conveyed and stockpiled for offsite transport via the existing rail network.

1.1 Locality Description

The operation is situated appropriately 22 km east of Moranbah in a well established grazing and mining region.

The area surrounding the site is undulating, comprising mines, open farmlands and native scrublands.

There are several existing mines near the proposed mine expansion, the largest of these being Peak Downs Mine. This mine is one of the most extensive open-cut in the Moranbah district and is situated approximately 20km south-west of the subject site. This mine is approximately 45km long (in a north-west south-east alignment) and 2 km wide. To the north-west of the site is Isaac Plains mine. This mine is in the process of expanding into an areas south-west of the site. Poitrel Mine, a greenfield development, is situated immediately to the south of the site. To the east of the mine is the Carborough Downs underground mine. The existing Millennium open cut mine is situated to the west of the proposed expansion.

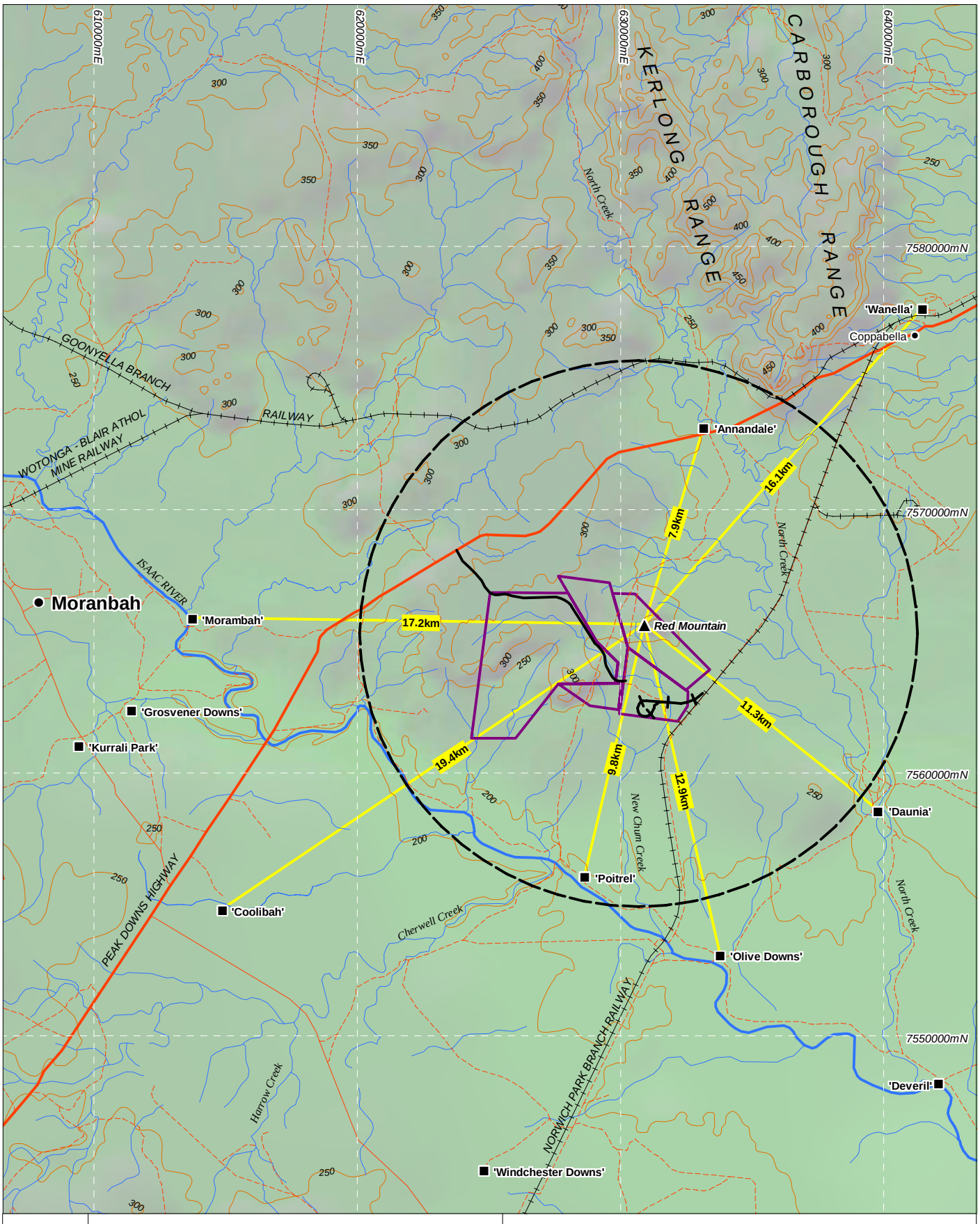
The railway spur servicing the Millennium Mine also services Peak Downs Mine. It is understood that the annual coal production from Peak Downs mine is approximately 9 million tonnes p.a. (BHP 2009) and that it transported from the site along this railway spur. The spur connects to the main line at Coppabella, approximately 17 km to the north east of MEP.

The closest sensitive locations are shown on **Figure 1** along with the mine site. The sensitive receptors and separation distances to the closest approach proposed mine extension are contained in **Table 1**. Generally, each of the homesteads is closer to one of the other mines (eg. Winchester Downs Homestead is 8 km from Peak Downs) rather than Millennium Mine.

Table 1: Properties adjacent to the Site

Site No	*Description*
Winchester Downs Homestead	Approximately 15 km south west
Wotonga Homestead	Approximately 9 km west
Broadlea Homestead	Approximately 11 km north west
Moorevale Homestead	Approximately 8 km north east
Annandale Homestead	Approximately 8 km north east

The agricultural land comprises improved pastures as well as small areas of natural tree cover. Most of the roads to the homesteads are unpaved, but are generally maintained in good condition.



LEGEND

- Project Tenement
- Highway
- Road
- Track
- Railway
- River
- Watercourse
- 50m Contour
- 10km Radius (centre of open cut)
- Site Access Road
- Site Rail Loop
- Town
- Homestead

matrixplus

Peabody

22/05/2009

Data Source:
Topography - Geoscience Australia. Tenement - Peabody.

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M054A.wor

Millennium Coal Pty Limited

Millennium Expansion Project

Homestead Location Plan

0 4 8

Kilometres

Scale: 1:200,000 (A4)

Datum: GDA94
Projection: MGA55

FIGURE 1

1.2 Climate

The closest Bureau of Meteorology climate data station to the subject site is Moranbah, refer to Appendix 1. The region has a warm climate with two distinct seasons, a dry winter season and a wet summer season. Winter temperatures average from 10 C to 25 C, while summer temperatures range from around 20 C to 35 C. The region averages approximately 600 mm of rainfall each year, falling mostly between November and March.

The warm wet season encourages cricket, cicadas and other wildlife. This usually causes higher ambient noise levels. During the dry winter season the ambient noise levels are lower since the cooler conditions and lack of water reduces insect activity. The greatest noise impact from mining usually occurs during the cool dry season since these cooler conditions are more favourable to the propagation of noise at large distances (particularly at night) and the cooler conditions also result in lower ambient noise levels. Daytime conditions throughout the year are always warm to hot since the area is subject to high solar loads. The environmental noise levels from mines are often lower during the day than at night.

2. Existing Noise Environment

Potential sources of noise from the surrounding environment primarily comprise:

- farming and grazing activities;
- residential activity noise;
- existing mines; and
- road-based traffic.

Existing noise levels were obtained at Winchester Downs homestead over a period of 8 days from Tuesday 31 March 2009 to Tuesday 7 April 2009. The calibrated ARL EL215 Type 2 environmental noise logger recorded the noise level statistics in hourly intervals.

The noise levels are presented in terms of the $L_{A10(60\ minute)}$, $L_{A90(60\ minute)}$ and $L_{Aeq\ (60\ minute)}$, refer to Table 2 for a summary of the measured noise levels at Winchester Downs Homestead.

Noise levels were also obtained near Wotonga Homestead over a period of 8 days from 25 May 2010 to 1 June 2010. The actual location was on the Millennium lease but at a setback distance from the Peak downs Highway what was similar distance to the Watonga Homestead setback. The calibrated Rion NL22 Type 2 environmental noise logger recorded the noise level statistics in 15 minute intervals. The noise levels at this location are likely to be slightly quieter that near the residence as domestic noise sources, such as people, cars, machinery pets and air conditioning, are excluded

The noise levels are presented in terms of the $L_{A10(15\ minute)}$, $L_{A90(15\ minute)}$ and $L_{Aeq\ (15\ minute)}$, refer to Table 3 for a summary of the measured noise levels near Wotonga Homestead and Figure 3 for a chart of the measured noise levels. Although the statistical period is 15 minutes, rather than 60 minutes it will not have any impact on the statistical results.

A noise survey was conducted over a period of 9 days from Saturday 6 May 2006 to Saturday 13 May 2006 at Moorvale homestead. These measurements were extracted from the NMA 2007, refer to Table 4. The ambient noise level measurements were conducted using a calibrated ARL EL215 Type 2 environmental noise level meter.

The $L_{A90(60\ minute)}$ reported in the tables for the day, evening and night comprises the Assessment Background Level (ABL). For both the $L_{A10(60\ minute)}$) and $L_{Aeq(60\ minute)}$ the table refers to the average result. The rating background level (RBL) is the median of the ABL for the period in question.

The $L_{A90\ (60\ minute)}$ noise levels at all the monitoring locations are consistently above the noise floor of the sound level meters hence it is not necessary to correct the measured results for equipment limitations.

It is likely the noise levels at these residences are due to road traffic, residential activity noise or farming noise rather than existing mining operations. This was confirmed by attended noise monitoring that was carried out during the day, evening and night on public roads close to Winchester Downs and Wotonga Homesteads. The purpose of the attended monitoring was to establish whether mining noise was currently audible at these properties. Mining-related noise was not audible at any of these locations during the attended monitoring period, refer to Table 5.

Table 2: Measured Existing Noise Levels [in dB(A)] at Winchester Downs Homestead

Date	$L_{A90(60\ minute)}$ Background Noise Level			$L_{Aeq\ (60\ minute)}$ Noise Level				$L_{A10(60\ minute)}$ Noise Level		
	Day	Evening	Night	24 hour	Day	Evening	Night	Day	Evening	Night
31 March 2009	32	29	26	53	50	42	30	47	41	29
1 April 2009	32	32	27	48	48	48	38	44	45	40
2 April 2009	32	29	26	51	48	43	30	44	42	30
3 April 2009	35	32	27	56	52	48	36	47	47	40
4 April 2009	31	29	27	49	48	43	38	47	44	34
5 April 2009	32	30	30	51	50	43	34	50	37	35
6 April 2009 (Monday)	33	30	28	51	53	51	31	54	46	32
7 April 2009	34	30	-	52	52	53	-	51	48	-
Rating Background Level/Median	**32**	**30**	**27**	**51**	**50**	**53**	**34**	**47**	**44**	**34**

Table 3: Measured Existing Noise Levels [in dB(A)] Near Wotonga Homestead

Date	$L_{A90(15\ minute)}$ Background Noise Level			$L_{Aeq\ (15\ minute)}$ Noise Level				$L_{A10(15\ minute)}$ Noise Level		
	Day	Evening	Night	24 hour	Day	Evening	Night	Day	Evening	Night
25 May 2010	37	28	28	45	45	44	36	46	47	39
26 May 2010	40	25	23	46	48	45	44	51	50	47
27 May 2010	36	23	26	48	45	47	42	47	51	46
28 May 2010	35	26	28	47	45	45	39	47	49	52
29 May 2010	38	25	20	46	47	44	41	49	49	43
30 May 2010	37	25	23	47	47	47	43	49	51	48
31 May 2010	35	21	20	48	43	47	44	45	52	45
1 June 2010	35	23	26	49	46	48	43	49	53	46
Rating Background Level/Median	**36**	**25**	**24**	**47**	**46**	**46**	**42**	**47**	**50**	**46**

Table 4: Measured Existing Noise Levels [in dB(A)] at Moorvale Homestead (NMA 2007)

Date	$L_{A90(60\ minute)}$ Background Noise Level			$L_{Aeq\ (60\ minute)}$ Noise Level			
	Day	Evening	Night	24 hour	Day	Evening	Night
6 May 2006	36	33	31	-	48	38	36
7 May 2006	32	34	29	44	46	40	35
8 May 2006	30	32	40	45	47	44	36
9 May 2006	36	27	27	46	48	41	37
10 May 2006	36	32	27	46	46	41	39
11 May 2006	36	36	28	45	46	44	37
12 May 2006	36	28	28	45	47	40	37
13 May 2006	38	33	28	47	50	40	36
14 May 2006	35	29	29	47	49	41	35
15 May 2006	38	-	28	-	49	-	38
Rating Background Level/Median	**36**	**32**	**28**	**45**	**47**	**41**	**36**

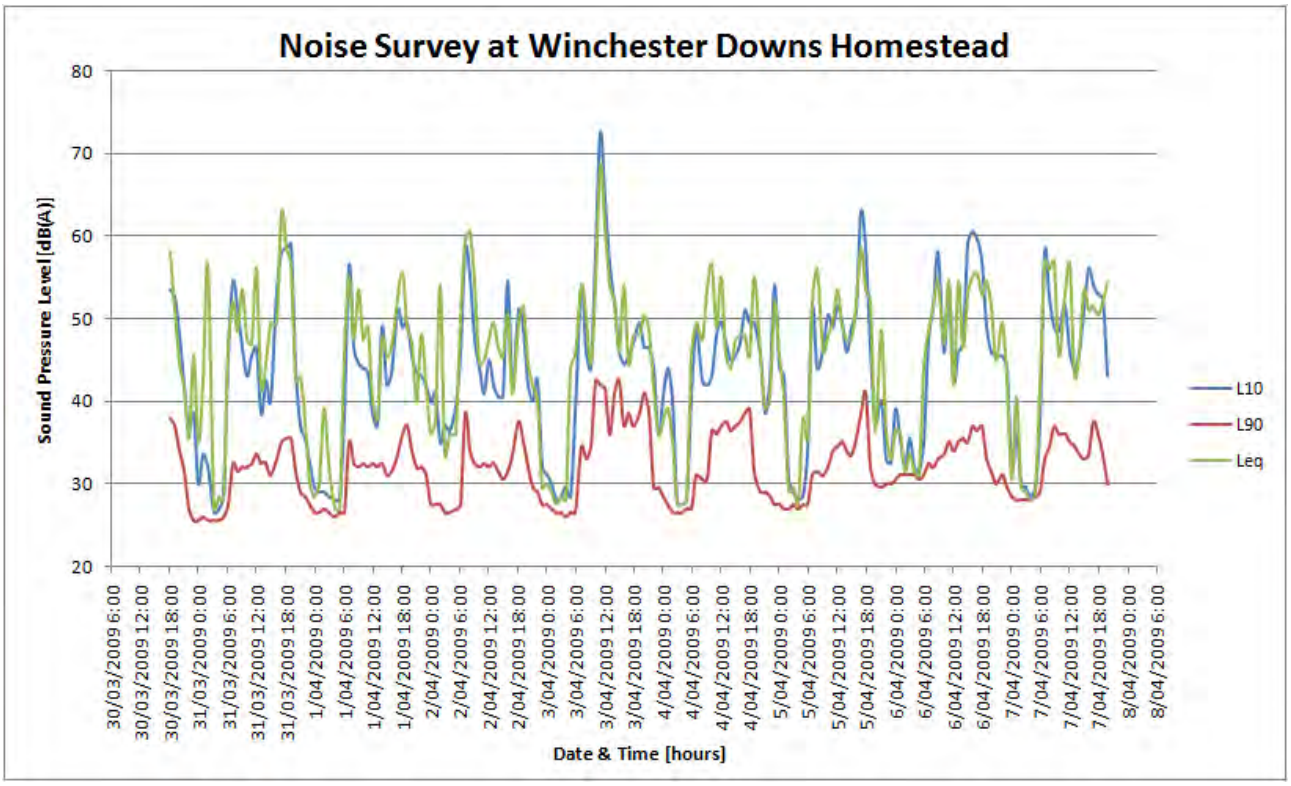


Figure 2: Measured Noise Levels at Winchester Downs Homestead

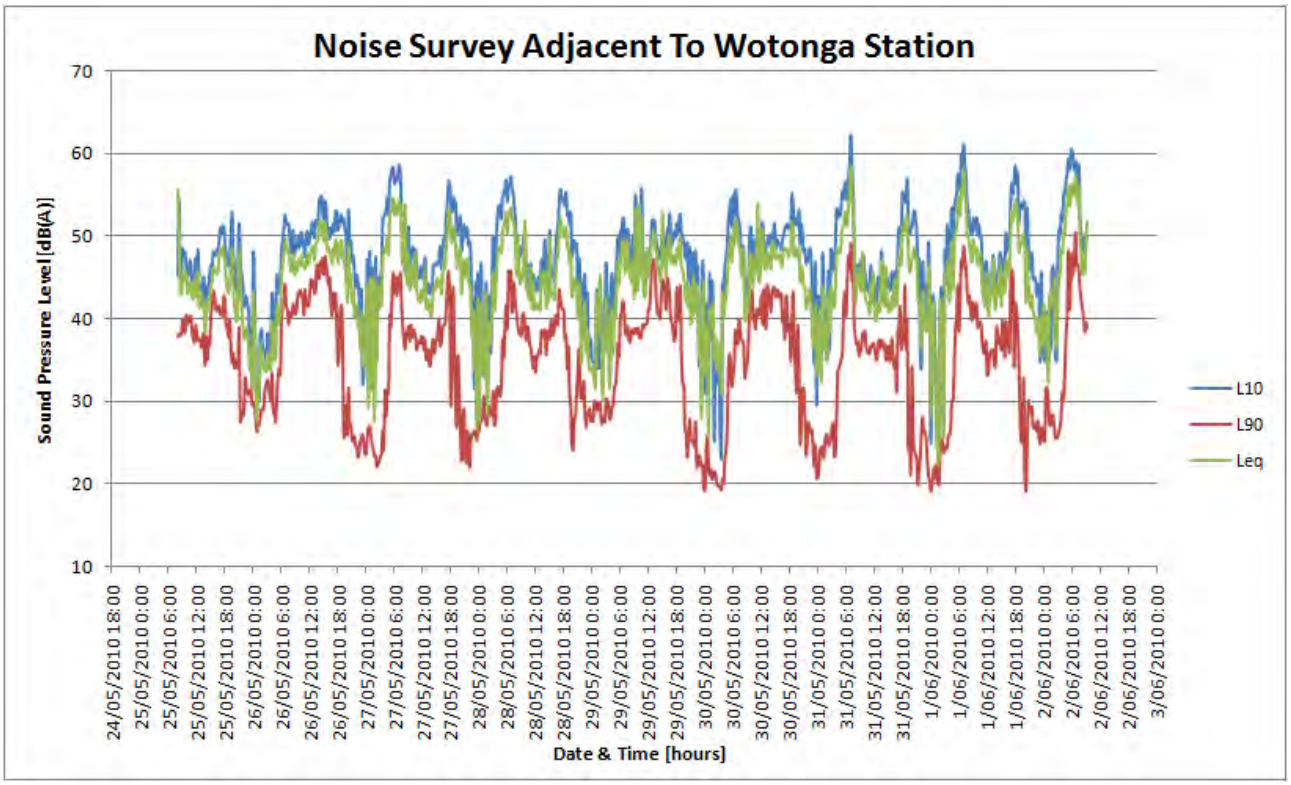


Figure 3: Measured Noise Levels Adjacent to Wotonga Homestead

Table 5: Attended Noise Measurements on Public Roads adjacent to Homesteads and Site [in dB(A)]

Homestead	Time [hours]	L_{A10} [dB(A)]	L_{Aeq} [dB(A)]	L_{A90} [dB(A)]	Comment
Winchester Downs	01:00	35	33	30	No industrial noise
Winchester Downs	11:15	44	44	39	No industrial noise, distant traffic
Winchester Downs	17:30	41	39	38	No Industrial noise, insect noise, distant traffic
Winchester Downs	21:45	44	42	38	No Industrial noise, insect noise
Wotonga	12:00	46	42	35	No Industrial noise, distant traffic
Wotonga	22:15	47	45	43	No Industrial noise, insect noise, distant traffic

The existing open cut mines in the area are likely to blast overburden regularly. However, this has not been monitored as part of this assessment.

3. Noise Criteria

3.1 Environmental Protection Act

The objective of the Environmental Protection Act 1994 is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The *Environmental Protection Act 1994* states a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm. This is termed the 'general environmental duty'.

Environmental harm is defined as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.

The noise level goals for operations may be determined from the Environmental Protection (Noise) Policy 2008 (EPP(Noise) 2008)

The EPP (Noise) 2008 came into effect on 1 January 2009. There are two main considerations namely:

1. Acoustic quality objective (noise levels that are conducive to human health and well being, ensuring a suitable acoustic environment for individuals to sleep, study or learn, be involved in recreation, including relaxation and conversation; and preserve the qualities of the acoustic environment that are conducive to protecting the amenity of the community); and
2. Controlling background creep.

3.1.1 Acoustic Quality Objectives

The 'acoustic quality objectives' seek to protect the amenity of an acoustic environment. The indoor night-time goals effectively address sleep disturbance and sleep awakenings, while during the day it protects conversation.

The acoustic quality objectives are expressed as indoor noise level goals for dwellings at Night (10pm to 7am) and outdoor noise level goals during the Day (7 am to 6 pm) and Evening (6 pm to 10 pm). Furthermore the EPP noise also includes Acoustic Quality objectives for critical habitats (as defined in a conservation plan under the Nature Conservation Act 1992) and marine parks under the Marine Parks Act 2004. These objectives are all contained in Table 6.

The indoor noise quality objective for dwellings assumes the windows of the residences are open. The equivalent external noise levels measured at least 4 m from the residence would be 5 decibels higher (to allow for the reduction of noise through the building envelope). However, it is not uncommon for bedrooms in hot, arid or tropical areas to be air-conditioned. For air conditioners to work efficiently the windows of dwellings are kept closed. For these air conditioned dwellings (where windows are closed) the assumed noise reduction from outside to inside is 20 decibels, i.e. the equivalent external noise levels measured at least 4 m from the residence would be 20 decibels higher than the Acoustic Quality objective noted in Table 6. It is noted that air

conditioners emit noise, making the inside of rooms noisier. This methodology conservatively assumes the air conditioners do not have any noise emissions.

Table 6: Acoustic Quality Objectives for Dwellings During the Day (7 am to 6 pm), Evening (6 pm to 10 pm) and Night (10 pm to 6 am)

Location	Time of Day	Acoustic Quality Objectives (Measured at the receptors) dB(A)			Environmental Value
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$	
Dwelling outdoors	Daytime & evening	50	55	65	Health and well being
Dwelling indoors	Daytime & evening	35	40	45	Health and well being
Dwelling indoors	Night-time	30	35	40	Health wellbeing in relation to the ability to sleep
Protected area, or an area identified under a conservation plan under the Nature Conservation Act 1992 as a critical habitat or an area of major interest	anytime	The level of noise that preserves the amenity of the existing area or place			Health and biodiversity of ecosystems
Marine park under the Marine Parks Act 2004	anytime	The level of noise that preserves the amenity of the existing area or place			Health and biodiversity of ecosystems

Source: EPP (Noise) 2008

3.1.2 Controlling Background Creep

The controlling background creep objective seeks to avoid intrusiveness. When setting limits it is not intended that the acoustic environment be permitted to deteriorate and this is achieved by controlling background creep. To the extent that it is reasonable to do so, noise from an activity must not be:

1. For noise that is continuous noise measured by $L_{A90,T}$ no greater than the existing acoustic environment measured by $L_{A90,T}$; or
2. For noise that varies over time measured by $L_{Aeq,adj,T}$ more than 5 dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

3.2 EPA Ecoaccess Guideline - Low Frequency Noise

The EPA Ecoaccess Guideline "Assessment of Low Frequency Noise" has identified a number of industrial sources and processes having high noise levels and frequency content less than 200 Hz.

Industrial sources may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high, even though the dB(A) level measured is relatively low. Typically, annoyance is experienced in the otherwise quiet environs of residences, offices and factories adjacent to, or near, low frequency noise sources. Generally, low level/low frequency noises become annoying when the masking

effect of higher frequencies is absent. This loss of high frequency components may occur as a result of transmission through the fabric of a building, or in propagation over long distances.

Where a noise emission occurs exhibiting an unbalanced frequency spectra, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance.

3.3 Blasting Criteria

Open cut coal mining procedures often include drilling and blasting of overburden material above the coal to make removal of that material easier. Holes are drilled at regular intervals, charged with ANFO and blasted.

Blasting should generally be limited to the hours of 9 am to 3 pm, Monday to Friday, and from 9 am to 1 pm on Saturdays. Blasting should not generally take place on Sundays or public holidays.

Blasting outside these recommended times should be approved only where:

a) blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter airblast overpressure and ground vibration limits should apply); or,

b) there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise-sensitive place, then

a) the airblast overpressure must be not more than 115dB(linear) peak for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and,
b) the airblast overpressure must not exceed 120dB(linear) peak for any blast.

Blasting operations must be carried out in such a manner that if ground vibration should propagate to a vibration-sensitive place:

a) the ground-borne vibration must not exceed a peak particle velocity of 5mm per second for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and,
b) the ground-borne vibration must not exceed a peak particle velocity of 10mm per second for any blast.

3.4 Railway Noise Goals

Queensland Railways (QR) is responsible for setting noise level limits from rail traffic. The planning levels for a railway, assessed 1m in front of the most exposed part of an affected noise sensitive place are:

a) 65dB(A), assessed as the 24 hour average equivalent continuous A-weighted sound pressure level;
b) 87dB(A), assessed as a single event maximum sound pressure level.

It is beyond the scope of this study to assess the noise from the railway. The proposed wagon and locomotives are currently in service, as is the train configuration and other operational considerations.

Furthermore, there are no criteria directly applicable to assess the impact of noise from a railway noise generating development. It is recommended that railway noise be limited to a 3 dB(A) increase over the existing noise levels. Hence, the railway noise assessment is limited to assessing the increase in railway noise.

3.5 Road Traffic Noise Goals

Queensland Department of Main Roads (QDMR) is responsible for setting noise level limits from road traffic. The planning levels apply for major roads (Peak Downs Highway) but it is beyond the scope of this study to assess the noise from the road network. There are no criteria in Queensland to assess the impact of noise from a road traffic generating development. It is recommended that road noise be limited to a 3 dB(A) increase over the existing noise levels. Hence, the road traffic noise assessment is limited to assessing the increase in road traffic noise.

3.6 Summary of Noise and Vibration Goals

Application of Acoustic Quality Objectives

The noise level goals are based on the acoustic quality objectives and are expressed as outdoor noise level goals, at 4 m from residences. It is conservatively assumed that the residences have their windows open and the reduction through the building facade is 5 decibels.

Application of Background Creep Goals

The noise from most plant and equipment working in a coal mine varies over a short time period. Furthermore the noise propagation characteristics over large distances always results in fluctuating noise levels. Since all the noise sensitive locations are located at large distances from the mine it is reasonable to apply the limits for time vary noise. The noise level goals have been calculated from the method and is equal to $L_{Aeq,adj,T} = L_{A90,T}$ *+ 5 dB(A). The* $L_{A90,T}$ *is the rating background noise level calculated in Table 2 and*

Table 3: Measured Existing Noise Levels [in dB(A)] Near Wotonga Homestead

Date	$L_{A90(15\ minute)}$ Background Noise Level			$L_{Aeq\ (15\ minute)}$ Noise Level				$L_{A10(15\ minute)}$ Noise Level		
	Day	Evening	Night	24 hour	Day	Evening	Night	Day	Evening	Night
25 May 2010	37	28	28	45	45	44	36	46	47	39
26 May 2010	40	25	23	46	48	45	44	51	50	47
27 May 2010	36	23	26	48	45	47	42	47	51	46
28 May 2010	35	26	28	47	45	45	39	47	49	52
29 May 2010	38	25	20	46	47	44	41	49	49	43
30 May 2010	37	25	23	47	47	47	43	49	51	48
31 May 2010	35	21	20	48	43	47	44	45	52	45
1 June 2010	35	23	26	49	46	48	43	49	53	46

Rating Background Level/Median	**36**	**25**	**24**	**47**	**46**	**46**	**42**	**47**	**50**	**46**

Application of Low Frequency Noise Goals

It is possible that due to the propagation of noise over the large separation distances between the source of noise and the receiver that a loss of high frequency components may occur. Thus the low frequency noise goal of 50 dB(lin) applies at noise sensitive receptors

Application of Blasting Limits

The blasting goals apply and it is proposed to determine the maximum likely instantaneous charge that is permissible for the proposed MEP and compare this with typical blasting charge weights.

A summary of the noise and vibration goals for this project is contained in Table 7 and Table 8.

Application of Railway Goals

It is proposed to adopt a less than 3 decibel increase in the $L_{Aeq\ 24\ hour}$ noise levels as a measure of a minor change in the railway noise levels.

Application of Road Traffic Goals

It is proposed to adopt a less than 3 decibel increase in the $L_{Aeq\ 24\ hour}$ noise levels as a measure of a minor change in the road traffic noise levels.

Discussion

It is noted that the noise level goals to avoid background creep (Table 8) are lower than the Acoustic Quality objectives (Table 7) during the day and evening and similar at night for receptors unaffected by road traffic, i.e. Winchester Downs Homestead and Broadlea Homestead. This indicates the existing noise levels are relatively quiet and generally unaffected by industrial or traffic noise. However, road traffic on Peak Downs Highway has only caused a small increase in the noise levels at properties close to the highway. As a result the noise level goals at locations close to Peak Downs Highway are only slightly higher than those well removed from the highway.

As mentioned in Section 2, it is considered that there are two notional noise zones containing noise sensitive receptors surrounding the proposed MEP and they are related to proximity to Peak Downs Highway. Properties close to the Peak Downs Highway are significantly exposed to road traffic noise. This noise increases the ambient noise for properties up to 500 m from the highway. The homesteads close to the Peak Downs Highway include Wontonga, Tarkari, Moorvale and Annadale. Tarkari buildings are of a semi-permanent nature and it is not known if they are occupied. Thus Tarkari will not be considered further. The residences further from the Peak

Downs Highway are not subjected to significant noise from Peak Downs Highway. These homesteads (Winchester Downs and Broadlea) are likely to have lower ambient noise levels.

Table 7: Summary of Noise and Vibration Goals

Location	Time Period	Acoustic Quality Objectives (Measured at the receptors and to protect health and wellbeing) [dB(A)]			Low Frequency Noise Limit [dB]	Blasting	
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$		Noise [dBLin Peak]	Vibration PPV [mm/s]
All Residential Receptors	Day	40	45	50	-	115	5
	Evening	40	45	50	50	-	-
	Night	35	40	45	50	-	-

Table 8: Summary of Noise Level Goals to Avoid Background Creep

Location	Noise Goals to Avoid Background Creep $L_{Aeq, adj, 1 hr}$ [dB(A)]		
	Daytime	Evening	Night
Winchester Downs and Broadlea Homestead (sensitive receptors at least 500 m from Peak Downs Highway)	37	35	32
Wotonga, Moorvale and Annandale homesteads (sensitive receptors within 500 m of Peak Downs Highway)	41	30	29

4. Noise Modelling

4.1 Noise Model

A digital terrain noise model of the site and surroundings has been developed using PEN3D. The PEN3D General Prediction Model (GPM) is based on the method contained a book by Bies & Hansen (1988. pages 117, 127). The implementation is a more complex variation of the approach to sound propagation described in Concawe. Concawe is one of the most commonly used methodology to predict outdoors propagation from industrial sites. PEN also draws on aspects from ISO 9613-2. The PEN3D software was originally developed in 1993 and has been in constant development and review. The basic equation adopted by the GPM is:

$$Lp = Lw - 20 \log10(r) - 10\log10(4\pi) + AE$$

where

Lp is the sound pressure level at an observer

Lw is the sound power level of the source, in octave bands from 63 Hz to 8kHz

$20 \log10(r) + 10\log10(4\pi)$ is the distance attenuation (spherical)

AE is the excess attenuation factors

The excess attenuation factors AE comprise:

$$AE = Aa + Ag + Am + Ab + Af$$

Where:

Aa = Excess attenuation due to air absorption from Sunderland et. al.

Ag = Excess attenuation due to ground reflection

Am = Excess attenuation due to meteorological effects

Ab = Excess attenuation due to barriers

Af = Excess attenuation due to forests.

PEN is a sophisticated environmental noise model incorporating a 3D terrain model that permits accurate representation of the ground, ground cover, tree zones, mounds, barriers and weather conditions. PEN calculates a curved noise path based on surface friction, vertical temperature gradients and wind speed. All the noise calculations are based on this curved path. A finite differences approximation method is used to calculate the curved path. The curvature of the path determines the meteorology correction. The meteorology corrections are frequency and distance dependent and are limited to +12 decibels (downwind at night) and – 7 decibels (upwind and during the day) similar to the Concawe Category 1 and Category 6 meteorological corrections.

The excess attenuation due to ground reflection is obtained by combining the direct wave and the reflected wave incoherently, that is the energy from the ground wave is added to the direct wave. The ground reflection attenuation (or ground effects) will be between 0 and -3dB (a negative value is an increase in noise levels) for all cases. This contrasts with the coherent reflection approach.

The coherent approach is considered to be an “exact” method. For those situations where the source and receiver are located close to the same very hard reflecting plane and the path difference between the direct path and the reflected path is small, then the addition of the reflected wave and the direct wave will result in 6 dB increase rather than a 3 dB increase. However, at large distances the sound pressure level reduces at 12 dB per doubling with the coherent model (not 6 dB as per the incoherent model). This approach, while “exact”, is dubious as DTM models are rarely of sufficient accuracy nor can noise models truly account for the effects of atmospheric turbulence. Other methods such as the Nordic method or ISO 9613-2 divide the region between the source and receiver into three zones, and those zones closest to the source and to the receiver can potentially have higher absorption values. It follows then that if a noise source was measured say at a distance of 30 m and the sound power level is calculated by the commonly adopted formula PWL = SPL + 10log10(2 π r^2) then the calculations using the PEN3D methodology will remain conservatively high for all distances.

The ground reflection (or ground effects) is a complex calculation using the flow resistivity for the surface likely to provide the ground reflection and the likely angle of incidence of the reflected wave to the ground. In those instances where the ground is highly absorptive the excess correction will approach zero. For those surfaces which are highly reflective the correction will be - 3dB, ie will lead to an increase in noise levels of 3 dB(A) (simulates hemispherical propagation).

While there are numerous methods to calculate ground effect (and some of which provide significant attenuation (reduction of noise levels)), the PEN implementation is one of the more conservative estimates of ground effect in the far field. In the opinion of Bies & Hansen 1988, “as the distance from the source or frequency increases, the incoherent model will become more appropriate”.

The theoretical approach to meteorology implies that PEN is likely to provide more significant corrections than for other models. Thus at night or during downwind predictions the PEN calculations are likely to result in conservatively high results.

The likely barrier attenuations are calculated for four possible curved paths, namely:

- from source, to the top of barrier then to the receiver;
- source, reflection from ground (source side), top of barrier, receiver;
- source, top of barrier, reflection from ground (receiver side), receiver, and;
- source, reflection from ground (source side), top of barrier, reflection from ground (receiver side), receiver.

These are combined to obtain effective barrier attenuation. In the situation where the source and receiver are well above the ground and the barrier just intercepts line-of-sight then the barrier effect will be 5 dB(A). However, if the source and receiver are close to the ground and the noise barrier just intercepts line of sight (a pebble) the barrier effect will tend to zero.

Once the most likely curved path has been calculated the method determines if it intercepts any tree zones within the digital terrain model. If the curved noise path travels in the lower 75% of the tree zone then the full excess attenuation is applied for the distance travelled in the tree zone. If the curved noise path travels in the upper 25% of the tree zone then:

a) the average propagation height is determined;
b) the length in the zone is determined, and;
c) the forest excess attenuation is taken to be linearly interpolated between zero at the top of

the tree zone and full excess attenuation at 75% height.

Potentially tree zones can provide extremely high attenuations if the coverage of tree zones are large. However, in practice, the curved path adopted in the PEN methodology usually results in the noise rays passing above the tree zones (at night or during downwind conditions) and only intercepting tree zones if they exist on the tops of hills or whenever the noise ray approaches the ground. Tree zones can potentially provide higher than expected attenuations during calm neutral conditions.

4.2 Meteorology

The meteorology for the site was reviewed and four representative modelling cases were developed that are expected to lead to elevated noise levels at noise sensitive receptors surrounding the site. The modelling cases are summarised in Table 9. Over a year, each of these modelling cases occurs at least 10% of the time.

Table 9: Modelling Cases

Modelling Case Name	Wind Speed [m/s]	Wind Direction [deg]	Vertical temperature gradient [C/100m]	Temperature [C]	Humidity [%]
Day	3.0	135	-2	25	50
Evening	0	-	0	25	50
Night	0	-	3	5	50
Night with Wind	2.8	135	3	5	50

By referring to Table 10 and Table 11 it may be seen that the day case is representative of a day with strong incoming solar radiation, a typical day in inland tropical areas. The wind speed is slightly higher than that normally attributable to Stability Category A. The evening case is representative of the time 1 hour before sun set or after sunrise. It is the “neutral” meteorological case without any meteorological corrections. The night and night-with-wind cases are the meteorological cases likely leading to the highest environmental noise levels.

Table 10: Typical Pasquill Stability categories based on vertical temperature gradient

Stability Category	Range of vertical temperature gradient (°C/100m)	
	Minimum	Maximum
A	-3.0	-1.4
B	-1.4	-1.2
C	-1.2	-1.0
D	-1.0	0
E	0	2.0
F	2.0	4.5
G	<4.5	

Table 11: Stability categories

Wind Speed [m/s]	**Pasquill stability categories**							
	Day Time Incoming Solar Radiation mW/cm2				**1 hour before Sunset or after Sunrise**	**Night Time Cloud cover 6pm – 7am (octas)**		
	Strong >60	**Medium 30 to 60**	**Weak <30**	**Overcast**		**0 - 3**	**4-7**	**8**
≤ 1.5	A	A - B	B	C	D	F, G	F	G
2.0 – 2.5	A-B	B	C	C	D	F	E	E
3.0 – 4.5	B	B - C	C	D	D	E	D	D
5.0 - 6.0	C	C - D	D	D	D	D	D	D
> 6.0	D	D	D	D	D	D	D	D

Note1: Wind speed is measured to the nearest 0.5m/s.

Note 2: Category G is restricted to night-time with less than 1 octa of cloud and a wind speed less than 0.5m/s.

4.3 Noise Model Parameters

The DTM for the MEP is based on NASA Shuttle Radar telemetry. The model has a default ground cover of long grass and does not include any tree zones.

The noise sources comprise:

- Shovel operation in the pit;
- Dump truck, haul truck, shovel, excavator, rock drill, dozer contained with the pit;
- Dump truck in an exposed position on the top of the 60 m high out of pit overburden dump;
- Haul trucks between pit and CHPP; and
- various surface earth working machines.

The likely equipment noise levels are contained in Table 12.The noise levels are expressed as a sound power level and a sound pressure level at 100 m from a working machine. The octave band sound power levels are "linear" while the overall sound pressure levels are "A" weighted. The "A" weighting emulates the way the human ear responds to sound. These noise levels are mostly based on measurements obtained at mines in Queensland since August 2005 and published data. The sources include NMA reports associated with the EIS' for Kestrel Coal Mine Expansion, Isaac Plains Expansion and monitoring at Millennium Coal Mine and published data sources such as Parsons Brinkerhoff (2004).
For modelling the L_{Aeq} the maximum sound power levels have been corrected to account for load and operational cycles. For instance, it should be noted that mobile sources such as the haul and dump trucks operate in a complex cycle comprising low-load and high-load conditions at various positions along the route.

Table 12: Summary of Maximum Noise Levels From Mining Equipment

Item	Maximum Sound Power Levels (dB) in Octave Band Centre Frequency [Hz]								Overall dB(A)	Overall Sound Pressure Level at 100 m dB(A)
	63[#1]	125	250	500	1000	2000	4000	8000[#2]		
998 loader	97	114	110	113	112	114	107	101	118	70
Haul truck	107	115	110	110	108	107	102	97	113	65
Dump truck	115	123	118	118	116	115	110	105	121	73
D11 Dozer	110	112	114	106	108	105	103	97	113	65
Rock drill	113	117	112	116	115	114	116	115	122	74
Grader	106	108	110	102	104	101	99	93	109	61
Excavator (25 m^3)	111	122	118	117	115	110	104	99	119	71

Note 1: All energy in the audible frequencies below 63 Hz is added to the 63 Hz octave band

Note 2: All energy in the audible frequencies above 8000 Hz is added to the 8000 Hz octave band

In the noise model, the noise sources are positioned as follows:

- Dump trucks at 3 m above road elevation;
- Dump truck, loader, excavator, in-pit crusher, rock drill, dozer contained with the pit.

Two cases have been addressed. The first is during the initial phase of the mine when there will be an out of pit overburden dump. During this phase the overburden will be hauled to the external overburden dump. The overburden dump is at most 60 m higher than natural terrain. During the second phase there will be in-pit overburden dumps with trucks dumping the overburden. The in-pit overburden dump is also likely to exceed the height of the natural terrain and it is expected to exceed the natural surface by at most 60 m. The equipment lists for the two mining phases are contained in Table 13. The correction L_{Amax} to L_{Aeq} represents the difference between the absolute maximum noise level and the average noise levels of an operating machine having various loads and operating conditions and (if appropriate) moving around a site changing direction and orientation. With all these models the key noise source is the in-pit crusher. It is by far the noisiest component both in terms of the L_{Amax} and the L_{Aeq}.

Table 13: Equipment List for Noise Modelling Cases and L_{Amax} to L_{Aeq} correction

Equipment	L_{Amax} to L_{Aeq} Correction [dB]	Modelling Case 1, Out of Pit Overburden Dumping	Modelling Case 1, In Pit Overburden Dumping
Excavator 25 m^3	-5	1	1
Loader 998	-5	2	2
Dump truck	-8	4	4
D11 Dozer	-10	1	1
Rock drill	-2	1	1
Grader	-3	1	1
Haul truck	-3	3	3

The increase in tonnage is considered to be representative of the increase in the railway usage. Since the current rail loop currently handles approximately 12 million tonnes p.a. from the combined operations of Peak Downs and Millennium. After the expansion the expected maximum production rate is 12.5 million tonnes p.a. from the combined operations. This is likely to require a 4% increase in rail traffic on the rail loop. On the main rail line the increase will be insignificant.

Blasting
PEN3D also contains a blasting module that includes the effects of meteorology. The basic equation for blast overpressure is:

$$dBLin = 20\log_{10}({}^{3557}/_{0.00005}) - 20 * 1.26 * \log_{10}(Distance) + 20 * 1.268 * 3\log_{10}(MIC) + 3$$

For a Maximum Instantaneous Charge weight (MIC) of 500 kg the blast overpressure at 1000 m is 115 dB Lin peak.
For vibration the peak particle velocity is

$$v\,[mm\,s^{-1}] = 2000 * (Distance/MIC^{0.5})^{-1.6}$$

For a charge weight of 500 kg the peak vibration velocity at 1000 m is 4.6 mm/s.

This assessment is based on a maximum instantaneous charge weight of 500 kg. However, a doubling of the MIC would result in a 1 decibel increase in the peak noise level and a 75% increase in the vibration level.

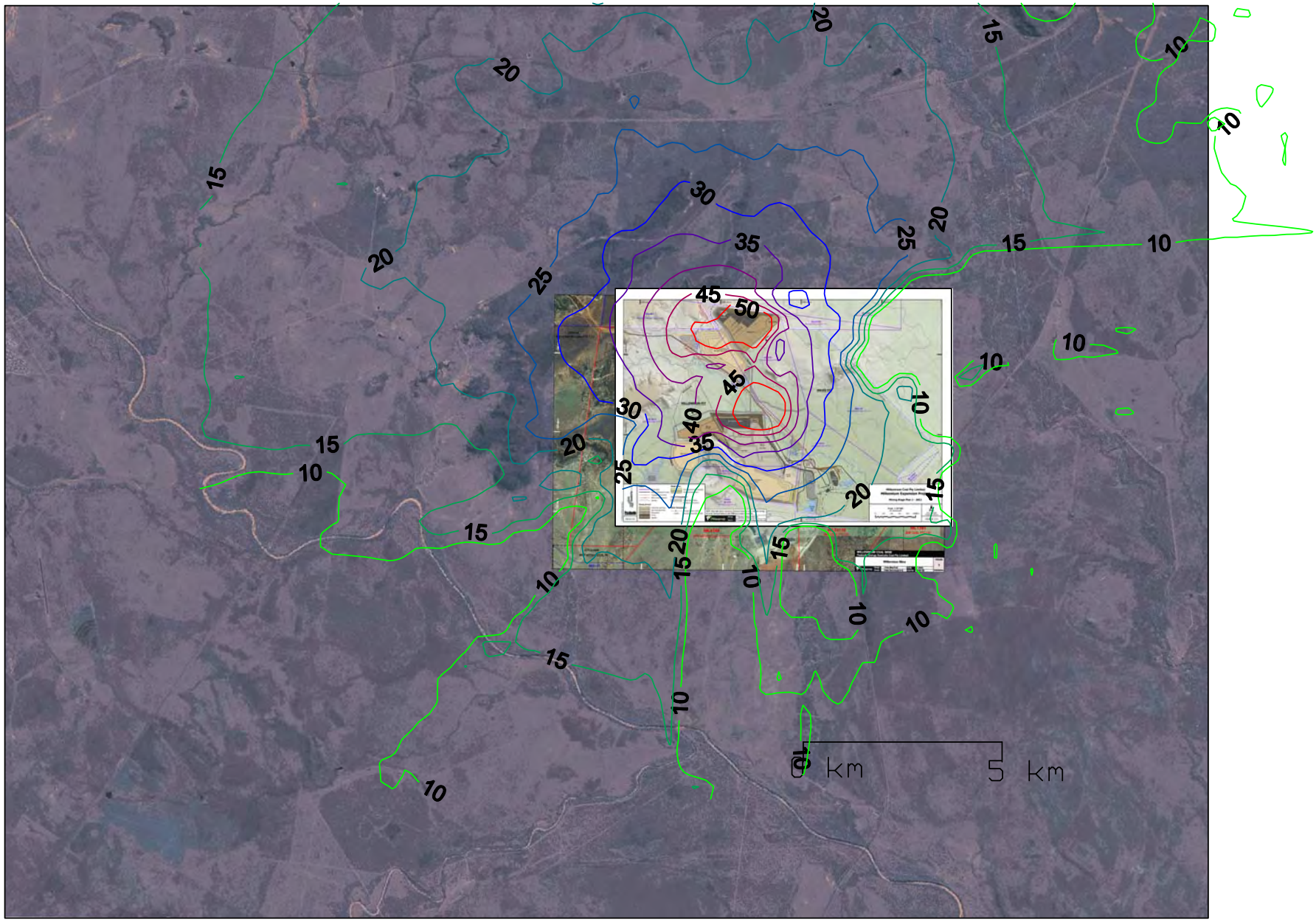
4.4 Noise Modelling Results

The noise models have been developed for the two mining stages (out of pit dumping and in pit dumping) for the fully operational MEP. It is assumed that all mine plant and equipment operate as described in Section 4.3 throughout the day and night.

The noise levels at each of the homesteads for each of the modelling cases are contained in Table 14 and Table 15 for out-of-pit and in-pit dumping phases respectively. The $L_{Aeq\ (1\ hour)}$ noise contours for the out-of-pit overburden dumping case are contained in **Figures 3, 4, 5** and **6** for the meteorological cases Day, Evening, Night and Night with Wind respectively (refer to Table 9). The $L_{Aeq\ (1\ hour)}$ noise contours for the in-pit overburden dumping case are contained in **Figures 7, 8, 9** and **10** for the meteorological cases Day, Evening, Night and Night with Wind respectively. The low frequency noise level predictions at night are contained in Table 16 for the in pit and out of pit dumping cases.
The effect of the south-easterly wind can be seen in the contours. The noise contours do not extend far in the south-east direction compared to the north-west. The night case, essentially an inversion case, has contours extending a similar amount in all directions. The highest noise levels at Burton Downs are under these conditions.

Table 14: Noise Level Goals from Mining in terms of $L_{Aeq(1\ hour)}$ for Out-of-Pit Dumping Phase

Homestead	**Calculated of $L_{Aeq(1\ hour)}$ Noise Level at Homestead in [dB(A)] for Meteorological Cases**			
	Day	**Evening**	**Night**	**Night with Wind**
Acoustic Quality Objective	**40**	**40**	**35**	**35**
Background Creep Goal For Winchester Downs and Broadlea	**37**	**35**	**32**	**32**
Background Creep Goal For Wotonga, Annandale and Moorvale	**41**	**30**	**29**	**29**
Winchester Downs	9	10	15	14
Wotonga	19	13	23	28
Broadlea	16	10	20	25
Annandale	18	18	24	27
Moorvale	18	18	24	27



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DATE	28 June 2010
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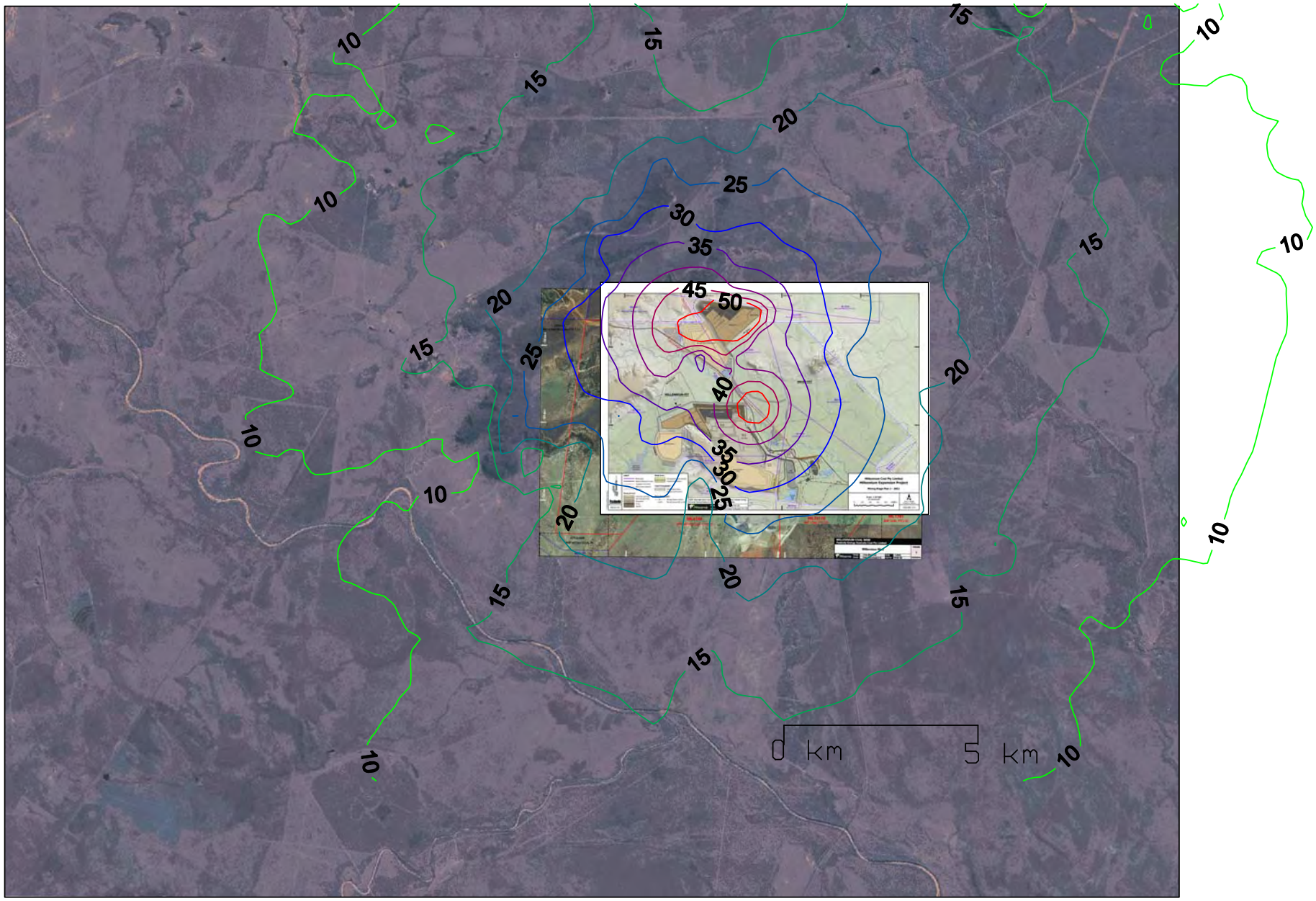
REVISION No:	1

Millennium Expansion

TITLE
LAeq Noise Contours
Day Meteorology
Case 1 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 03	A4



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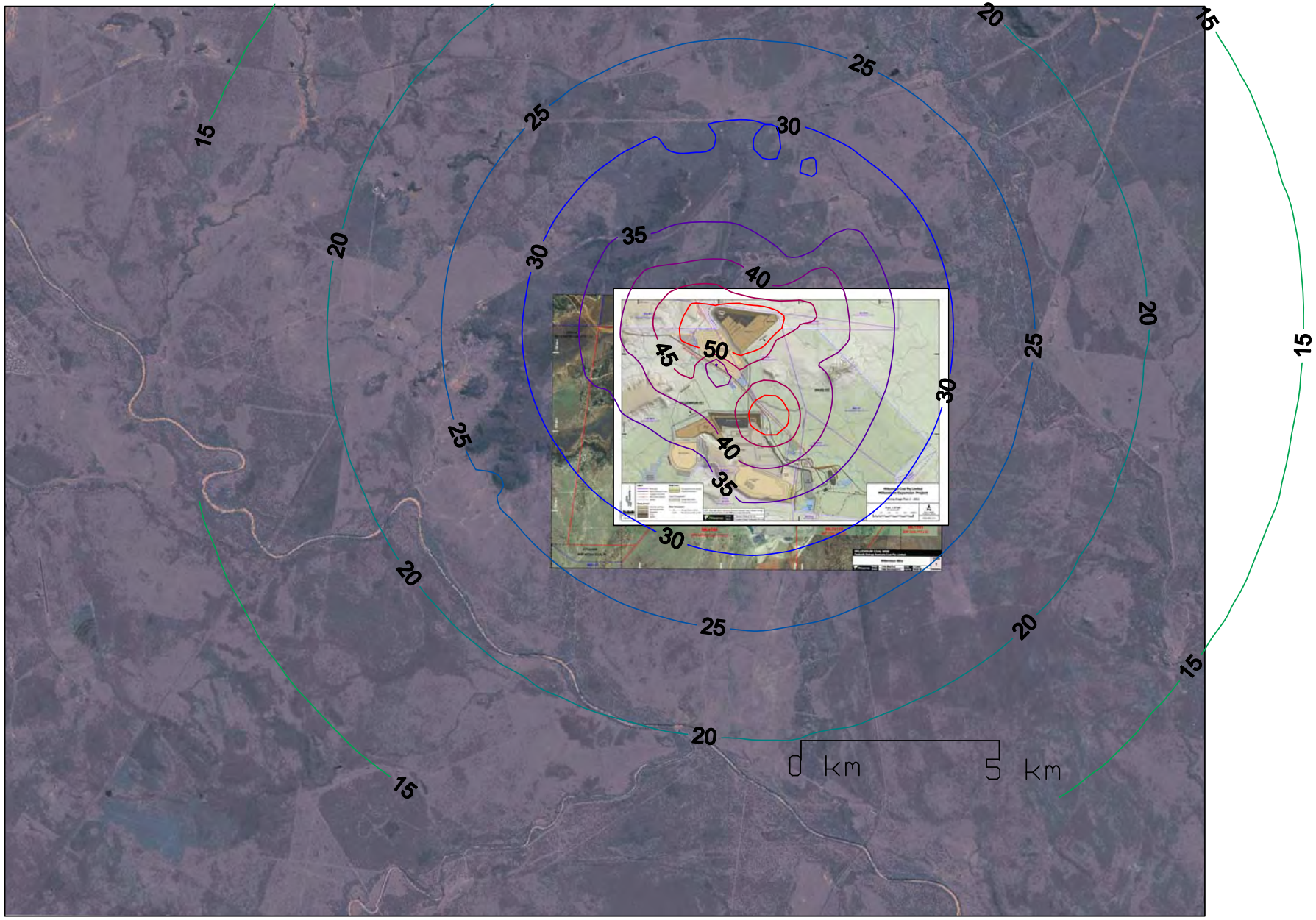
Millennium Expansion

TITLE
LAeq Noise Contours
Evening Meteorology
Case 1 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 04	A4



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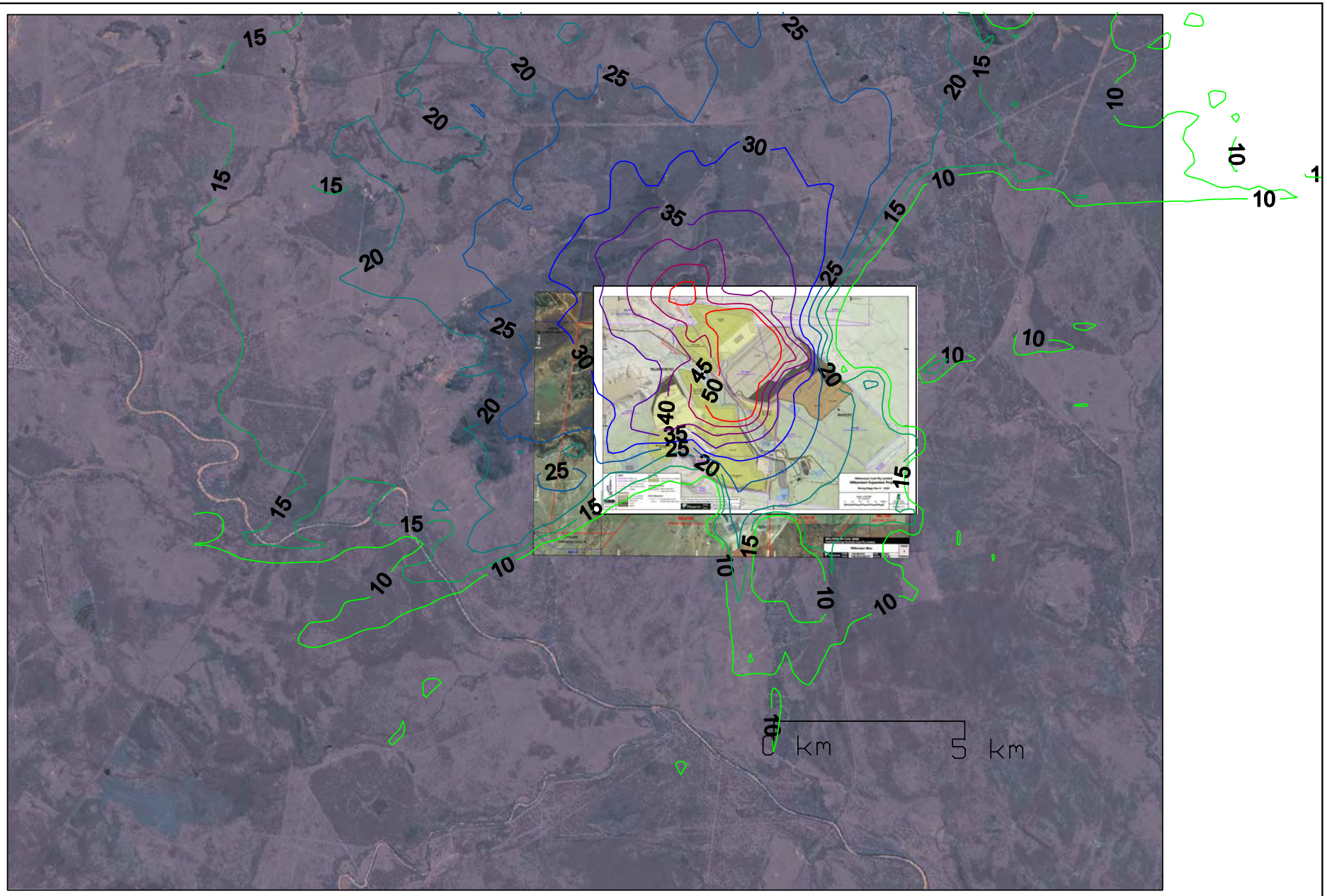
Millennium Expansion

TITLE
LAeq Noise Contours
Night Meteorology
Case 1 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 05	A4



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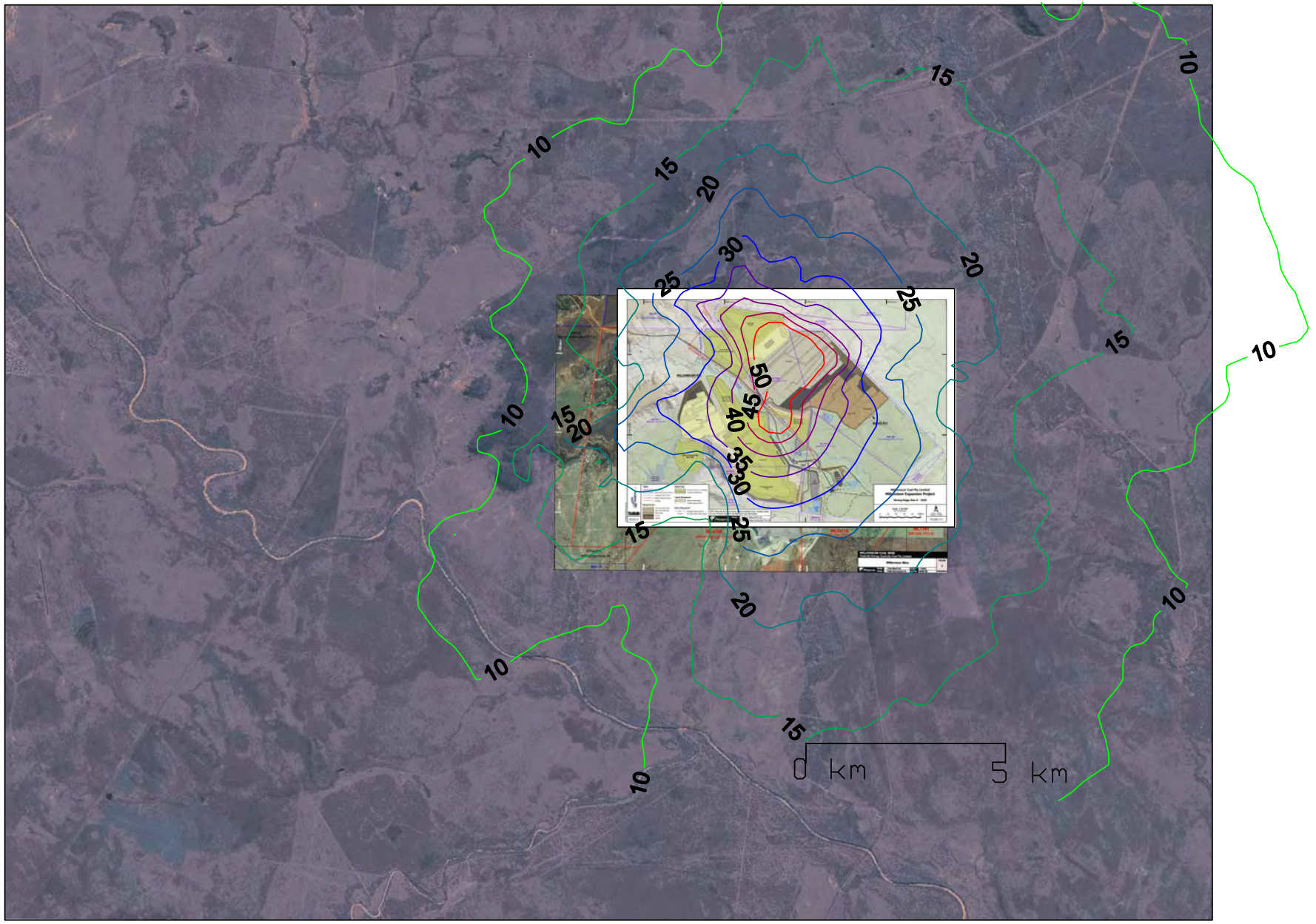
Millennium Expansion

TITLE
LAeq Noise Contours
Day Meteorology
Case 2 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 07	A4



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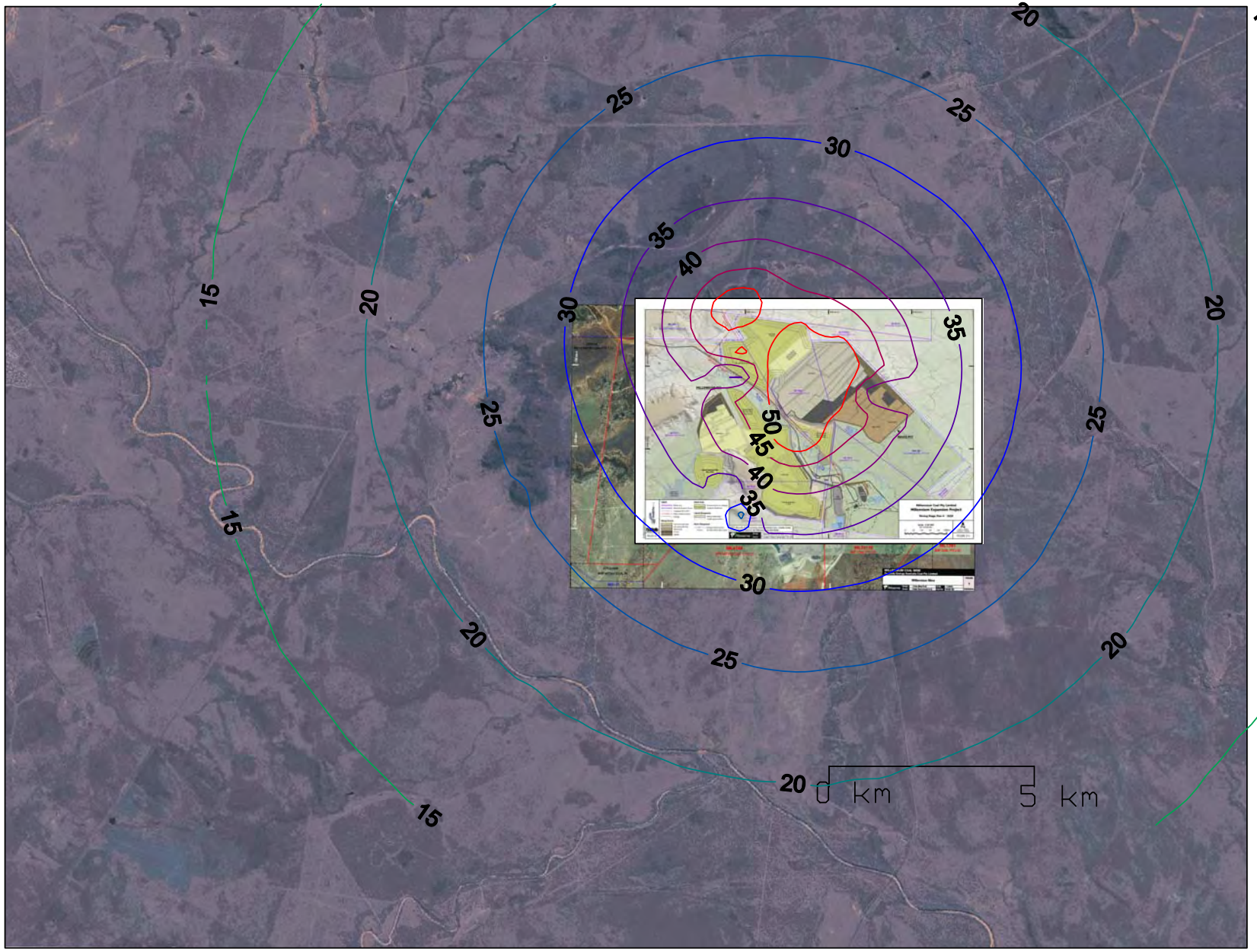
REVISION No:	1

Millennium Expansion

TITLE
LAeq Noise Contours
Evening Meteorology
Case 2 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 08	A4



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DATE	27/11/2010
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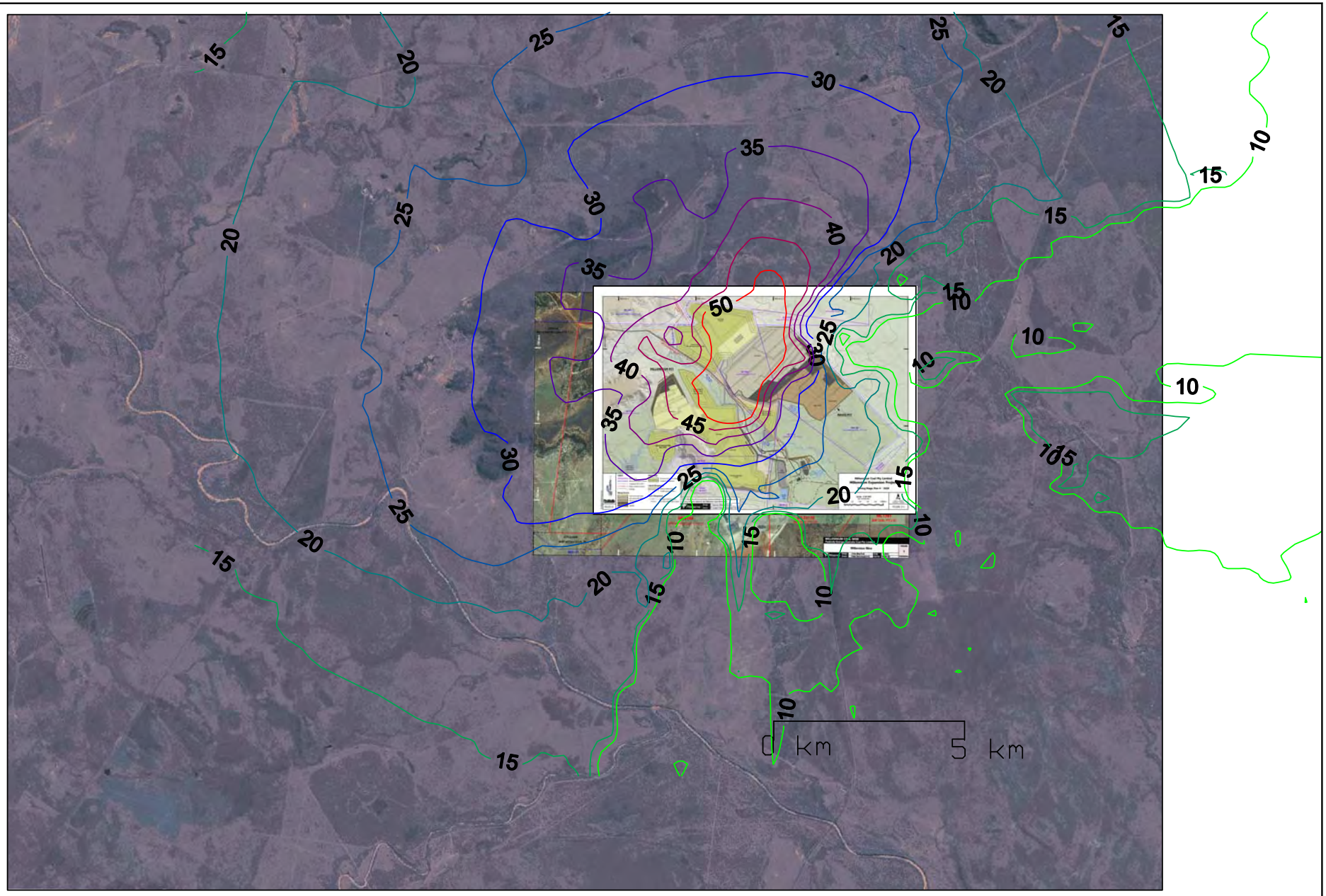
REVISION No:	1

Millennium Expansion

TITLE
LAeq Noise Contours
Night Meteorology
Case 2 in dB(A)

SCALE	DRAWING No.	
NTS	Figure 09	A4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30
35
40
45

Table 15: Noise Level Goals from Mining in terms of $L_{Aeq(1\ hour)}$ for In-Pit Dumping Phase

Homestead	**Calculated of $L_{Aeq(1\ hour)}$ Noise Level at Homestead in [dB(A)] for Meteorological Cases**			
	Day	**Evening**	**Night**	**Night with Wind**
Acoustic Quality Objective	**40**	**40**	**35**	**35**
Background Creep Goal For Winchester Downs and Broadlea	**37**	**35**	**32**	**32**
Background Creep Goal For Wotonga, Annandale and Moorvale	**41**	**30**	**29**	**29**
Winchester Downs	<thh	<thh	15	13
Wotonga	19	8	22	26
Broadlea	20	4	19	21
Annandale	24	16	24	29
Moorvale	24	16	24	29

Note: <thh are noise levels below the threshold of human hearing

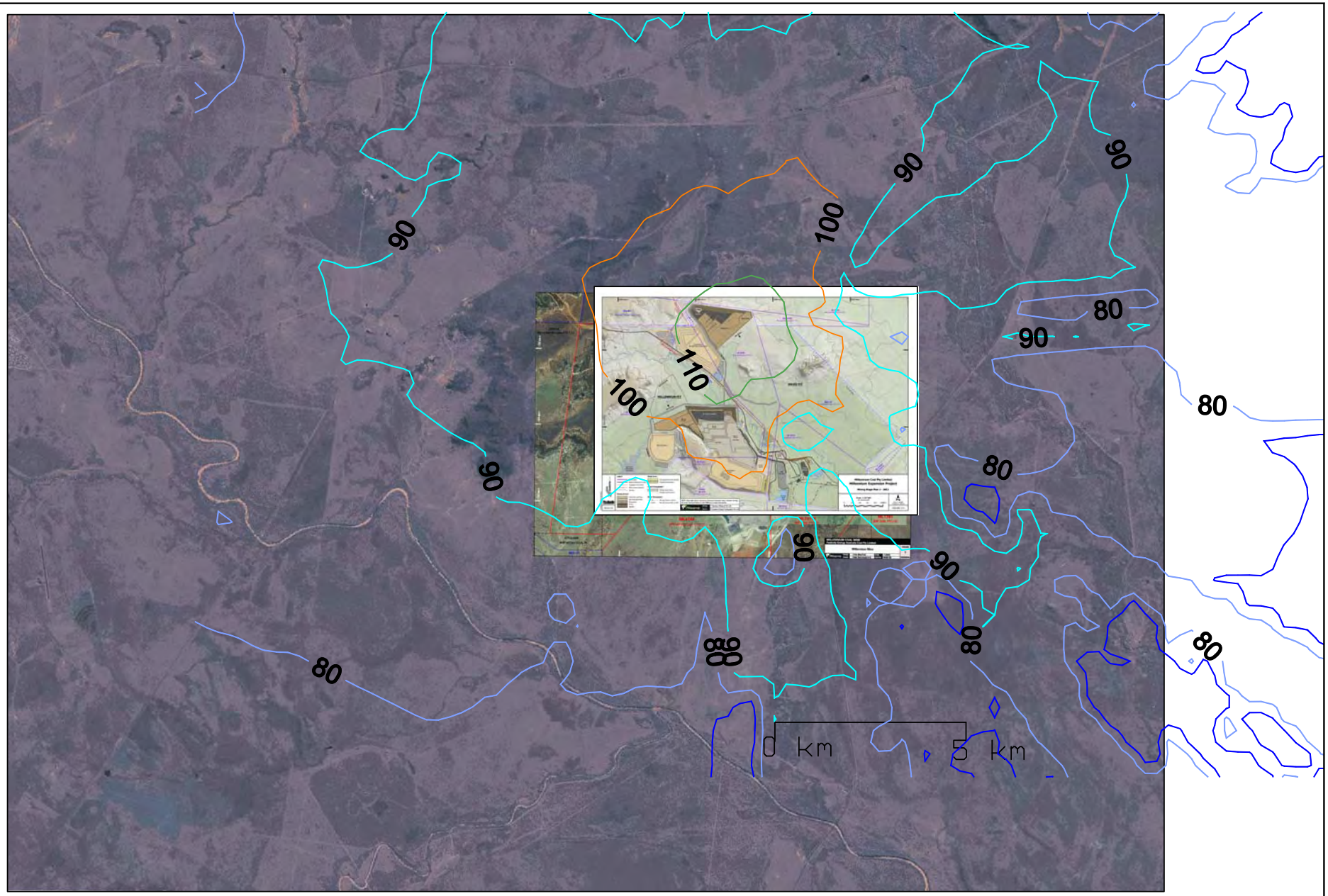
Table 16: Low Frequency Noise Levels at Night [dB(Lin)] for Out-of-Pit and In-Pit Overburden Dumping Phases of Mine

Homestead	***Low Frequency Noise Level $L_{Aeq(1\ hour)}$ [dB(Lin])***	
	Out-of-Pit Overburden Dump	***In-Pit Overburden Dump***
Goal	**50**	**50**
Winchester Downs	32	30
Wotonga	43	43
Broadlea	41	37
Annandale	42	42
Moorvale	42	42

Based on the increase in railway traffic the noise from the rail spur is expected to increase by 0.2 decibels. However, on the main line (to the east of Coppabella) the increase in noise is likely to be much less, almost imperceptible. It should be noted that there are no noise sensitive receptors close to the railway spur.

Based on the increase in staff numbers is likely to lead to a minor in traffic on Peak Downs Highway <5%. This will result in an increase in road traffic noise on Peak Downs Highway of much less than 1 decibel and almost imperceptible.

The blasting contours for a MIC of 500 kg are shown in **Figures 11,** and **12** for blast over pressure and vibrations respectively. For a MIC of 500 kg the blast overpressure is calculated to be 90 dB Lin peak at Moorvale and Annandale Homesteads.



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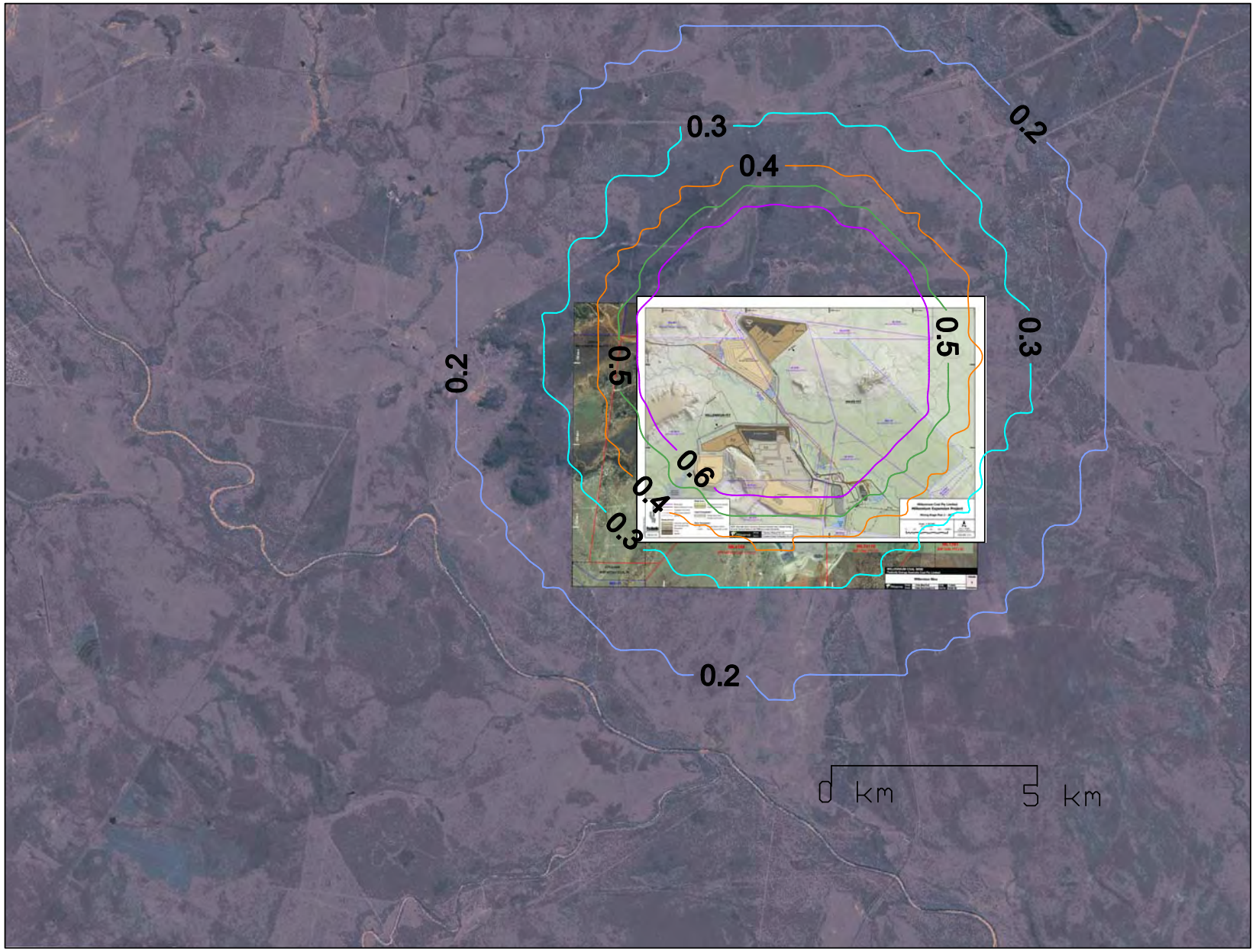
Millennium Expansion

TITLE: Bast Overpressure Noise Contours
Day Meteorology
in dB Lin Peak

SCALE	DRAWING No.	
NTS	Figure 11	A4



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Millennium Expansion

TITLE
Blast Vibration Contours
in mm/s

SCALE	DRAWING No.	
NTS	Figure 12	A4

4.5 Noise Assessment

The modelled noise levels from the MEP readily comply with the acoustic quality objective during the day, evening and night at all noise sensitive receptors. This implies that the health and well being of all residents living near the MEP are unlikely to be adversely affected. Thus the future noise levels from the MEP are predicted to maintain a suitable acoustic environment for individuals to sleep, study or learn, be involved in recreation, including relaxation and conversation and preserve the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

Furthermore the future noise levels are below the background creep noise goal. This ensures that the future noise levels from the MEP are expected to avoid intrusiveness into the receiving environment.

The low frequency noise level predictions at the residences readily comply with the low frequency noise level limit.

The increase in railway traffic noise from the rail loop is less than 1 decibels, compared with the goal of 3 decibels. However, on the main line the increase is likely to be much less than 1 decibel. It should be noted that there are no noise sensitive receptors close to the railway loop and the increase in railway traffic is unlikely to adversely impact at any noise sensitive receptor.

Noise from road traffic is not expected to adversely impact at any noise sensitive receptor.

The enHealth Council (2004) document provides a review of the health effects, other than hearing loss, of environmental noise and reviews measures aimed at the management of environmental noise. This document pre-dates the current Environmental Protection (Noise) Policy (2007) and the issues contained in the eNHealth (2004) document are addressed the EPP(Noise). The eNHealth (2004) document addresses annoyance and quality of life, sleep disturbance, performance and learning with school children, cardio vascular disease, mental health and neuro-physiological stress. The goals adopted in this report are based on the EPP(Noise) and comply with all aspects of the enHealth (2004) document. The assessment of future noise levels from the MEP has addressed health and wellbeing, sleep disturbance, low frequency noise and nuisance in accordance with the EPP(Noise) and by inference the enHealth (2004) guidelines.

The blasting contours vibration levels are likely to be met at all sensitive receptors for a MIC of 500 kg. A MIC of 500 kg is likely the blast overpressure is calculated to be 90 dB Lin peak at Moorvale and Annandale Homesteads, well below the goal of 115 db Lin Peak. Blasting has been ongoing at the existing Millennium Mine for some time and there is considerable information that would be transferrable to the new site to ensure the blasting noise and vibration goals are readily met, without compromising production.

5. Conclusion

Existing noise levels were measured at Winchester Downs homestead. The unattended noise monitoring was supplemented by attended measurements during the day, evening and night. It was established that mining noise is not currently a feature of the existing noise levels at the homesteads.

The EPP(Noise) was reviewed for applicability and it was determined that the acoustic quality objectives are suitable to apply. These objectives are designed to preserve health and wellbeing of the occupants of the homesteads. It was determined that an external $L_{Aeq\ (1\ hour)}$ noise level of 35 dB(A) would be a suitable noise level objective for the homesteads. In addition the noise goals to avoid background creep were also appropriate to apply. These goals are designed to avoid intrusiveness. It was noted that the noise goals to avoid background creep were similar to the goals to preserve health and well being during the critical night period.

The low frequency noise impact was also assessed. These limits are designed to protect health and amenity.

The likely noise levels from operations were modelled. The proposed pit and operational design is effective in controlling noise and limiting noise emissions beyond the lease boundary. The noise levels at distant homesteads are expected to be considerably less than the noise level goals.

The noise from the increase railway usage is likely to lead to an insignificant increase in railway noise. Furthermore there are no noise sensitive receptors near the rail route and therefore there are unlikely to be any adverse impacts.

The noise from road traffic is expected to lead to an insignificant (much less than 1 decibel) increase in road traffic noise levels on Peak Downs Highway.

Subject to the noise emissions from plant and equipment complying with the nominated noise emissions in this report, the proposed operations readily comply with all noise level and vibration goals.

Glossary of Acoustical Terms

$L_{A10,t}$	The L_{A10} is the "A"-weighted statistical noise level exceeded 10% of the time. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours. It is sometimes referred to as the average maximum noise level.
$L_{A90\ ,t}$	The L_{A90} is the "A"-weighted statistical noise level exceeded 90% of the time. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours. It is commonly referred to as the background noise level.
$L_{Aeq,\ t}$	The L_{Aeq} is the "A"-weighted energy average noise level over the time in question. It is the constant noise level containing the same energy as the actual fluctuating noise level. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours.
Day	Refers to the period between 6 am and 6 pm
Evening	Refers to the period between 6 pm and 10 pm
Night	Refers to the period between after 10 pm and before 6 pm
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Assessment background level (ABL)	The single-figure background level representing each assessment period–day, evening and night (i.e. three ABLs are determined for each 24 hour period of the monitoring period). ABL is a measure of background noise level in the absence of noise from the source. Determination of the ABL is by the tenth percentile method, i.e sort the recorded hourly LA90's into ascending order and select the are the lowest ten percentile level.
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). It is the median value of the ABL's.
Free field	A position where there are no reflecting surfaces, other than the ground, close enough to influence the sound pressure level. Taken as a minimum of 1.2 metres above ground level and 4m from the closest building façade.
Noise floor	The noise floor, inherent or 'self-noise' of sound level measuring equipment is the combination of the preamplifier's electrical noise and thermal noise from the microphone.
dB (linear) peak	the maximum reading in decibels (dB) obtained using the "P" time – weighting characteristic as specified in AS 1259.1 – 1990 with all frequency-weighted networks inoperative.
Maximum instantaneous charge (MIC)	the maximum amount of explosive in kg on any one specific delay detonator in any one blast hole.
Peak particle velocity (ppv)	is a measure of ground vibration magnitude and is the maximum instantaneous particle velocity at a point during a given time interval in mms-1. (Peak particle velocity can be taken as the vector sum of the three component particle velocities in mutually perpendicular directions).
octas	Is a rating system describing cloud cover. A clear sky is zero octas while full cloud cover is 8 octas.

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Appendix 1 Climate Data for Moranbah

Statistic Element	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Ann
Mean maximum temperature (Degrees C)	33.9	33.2	32.3	29.6	26.6	23.7	23.6	25.3	29.2	32.4	33.2	34	29.7
Highest temperature (Degrees C)	45	41.1	40.4	36	33.9	31.9	31	32.9	38	40.5	42.7	42.5	45
Lowest maximum temperature (Degrees C)	23.3	22	22	17.8	14.2	10.6	13.9	11	18.9	17.5	21	20	10.6
Mean number of days >= 30 Degrees C	27	23.7	25.5	12.9	2.3	0.3	0.1	1.7	11.3	24.5	25.1	26.7	181.1
Mean number of days >= 35 Degrees C	10.9	8.2	4.2	0.7	0	0	0	0	0.7	5.8	8.4	13	51.9
Mean number of days >= 40 Degrees C	0.6	0.2	0	0	0	0	0	0	0	0.1	0.4	0.7	2
Mean minimum temperature (Degrees C)	21.9	21.8	20.2	17.5	14.4	11.2	9.8	10.9	14.1	17.7	19.5	21.1	16.7
Lowest temperature (Degrees C)	14.9	15.5	14.3	6	5	1.1	0.2	3	5.9	11.2	11.9	15	0.2
Highest minimum temperature (Degrees C)	28.5	26.5	27	25.2	21.6	21.9	18	18.7	23.6	23.6	25.6	27.9	28.5
Mean number of days <= 2 Degrees C	0	0	0	0	0	0.1	0.2	0	0	0	0	0	0.3
Mean number of days <= 0 Degrees C	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean rainfall (mm)	102.1	98.3	47.3	37.4	36.8	23	19	23.1	8.1	37.1	68.4	97.3	597.7
Highest rainfall (mm)	315	347.4	268	271	196.6	170.3	103.6	247.3	39.4	146.6	220.3	318.2	1009.6
Lowest rainfall (mm)	9.4	0.3	0.2	0	0	0	0	0	0	0	0	4.6	280.7
Highest daily rainfall (mm)	120.4	150.8	164.8	143.8	58	43.4	60	150.8	20.4	73.8	86	116	164.8
Mean number of days of rain	8.4	7.7	4.8	4.2	3.8	3.3	2.6	2	2.1	4.2	6	7.2	56.3
Mean number of days of rain >= 1 mm	6.3	6.1	3.5	3	2.8	2.1	1.9	1.6	1.3	3.1	4.8	5.6	42.1
Mean number of days of rain >= 10 mm	2.9	2.6	1.2	1.2	1	0.7	0.6	0.7	0.3	1.2	2.1	2.5	17

Mean number of days of rain >= 25 mm	1.3	1.1	0.5	0.4	0.4	0.3	0.2	0.2	0	0.4	1.1	1.3	
Mean daily solar exposure (MJ/(m*m))	24.5	22.4	22.6	19.2	16.5	14.7	16.1	18.8	22.6	24.8	25.9	25.6	21.1
Mean number of clear days	5.3	4.1	7.8	10.2	11.5	13.6	16.8	17	17.2	14.3	10.1	7.2	135.1
Mean number of cloudy days	10.6	10.7	8.3	7.2	7.7	6.7	4.9	4.1	2.4	4.8	6.7	8.5	82.6
Mean daily evaporation (mm)	8.2	7.6	7.1	5.9	4.4	3.6	3.8	4.9	6.7	8.1	8.6	8.7	6.5
Mean 9am temperature (Degrees C)	26.4	25.8	24.7	22.1	18.9	15.4	14.6	16.5	20.5	24	25.2	26.4	21.7
Mean 9am wet bulb temperature (Degrees C)	22.3	22.3	20.9	18.8	16	12.8	11.7	13	15.7	18.7	20	21.5	17.8
Mean 9am dew point temperature (Degrees C)	20.2	20.4	18.7	16.6	13.5	10.2	8.5	9.4	11.5	14.8	16.5	18.6	14.9
Mean 9am relative humidity (%)	70	74	70	72	73	73	69	66	59	59	61	64	67
Mean 9am cloud cover (okas)	4.4	4.5	3.6	3.2	3.3	2.8	2.3	2	1.7	2.3	3.2	3.7	3.1
Mean 9am wind speed (km/h) for years 1986 to 2009	7.5	7.7	8.1	7.7	6.2	5.5	5.3	6.6	7.7	8.4	8.4	8.4	7.3
Mean 3pm temperature (Degrees C)	32.7	31.9	31.3	28.6	25.7	22.8	22.8	24.4	28.3	31.3	32.1	32.8	28.7
Mean 3pm wet bulb temperature (Degrees C)	22.9	23.1	21.6	19.8	17.8	15.6	14.8	15.4	17.2	19.5	20.8	22.2	19.2
Mean 3pm dew point temperature (Degrees C)	17.2	18	15.6	13.7	11.4	8.9	7	6.7	7.4	10.5	12.9	15.7	12.1
Mean 3pm relative humidity (%)	42	47	41	43	44	44	39	35	30	30	34	39	39
Mean 3pm cloud cover (oktas)	5	5.1	4.4	4.3	3.9	3.1	2.7	2.7	2.4	3.3	3.9	4.5	3.8
Mean 3pm wind speed (km/h) for years 1986 to 2009	8.7	9.6	9.4	8.8	6.8	6.5	6.9	7.6	8.4	8.4	8.9	8.8	8.2

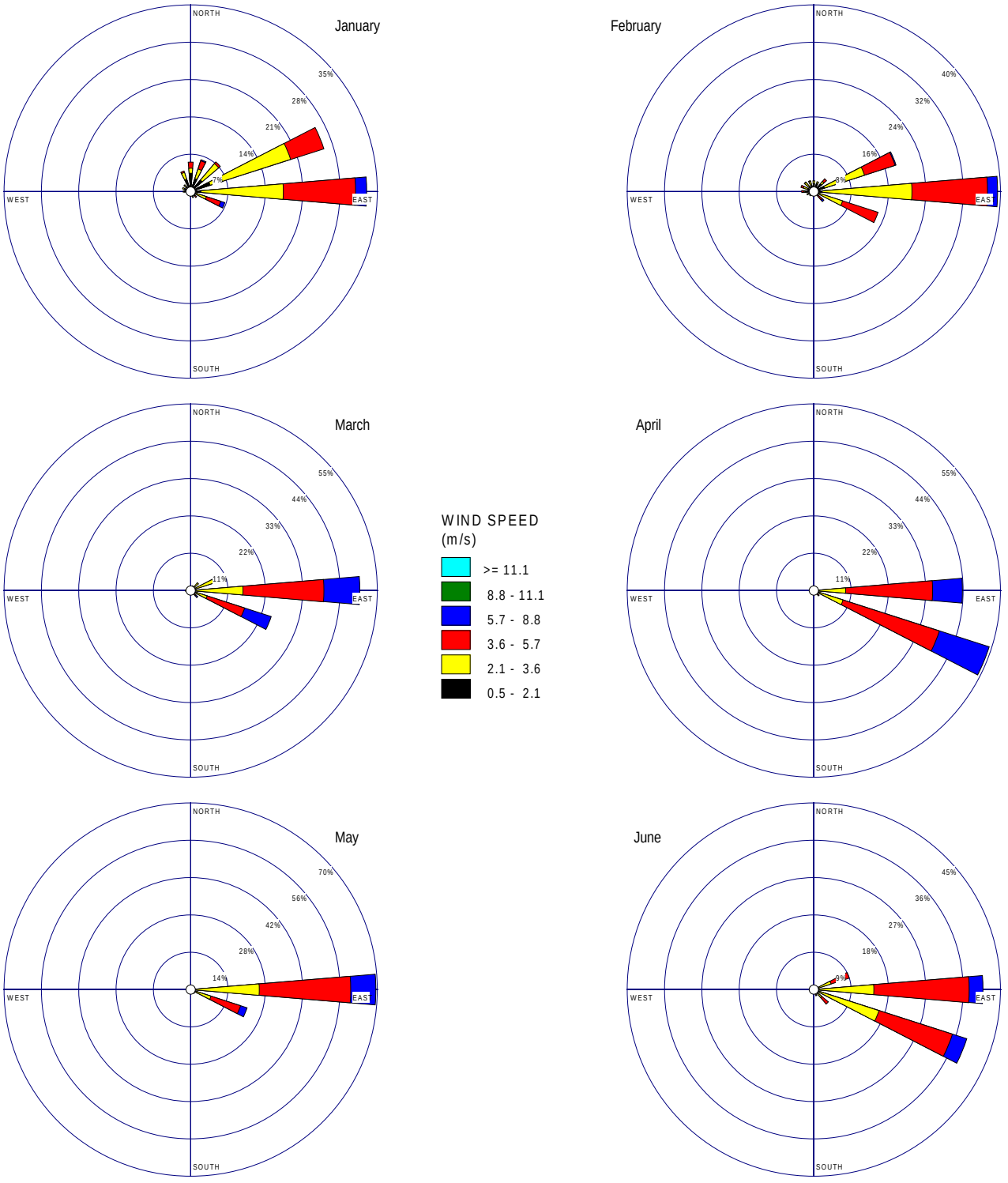
Appendix 2 Windroses For the Site

WIND ROSE PLOT:

Millenium Mine

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Roses for First Six Months

DATA PERIOD:

2004-2005
Jan 1 - May 31
00:00 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

Chris Simpson

NOISE MAPPING AUSTRALIA
SCALABLE CONSULTING SOLUTIONS

DATE:

6/08/2010

PROJECT NO.:

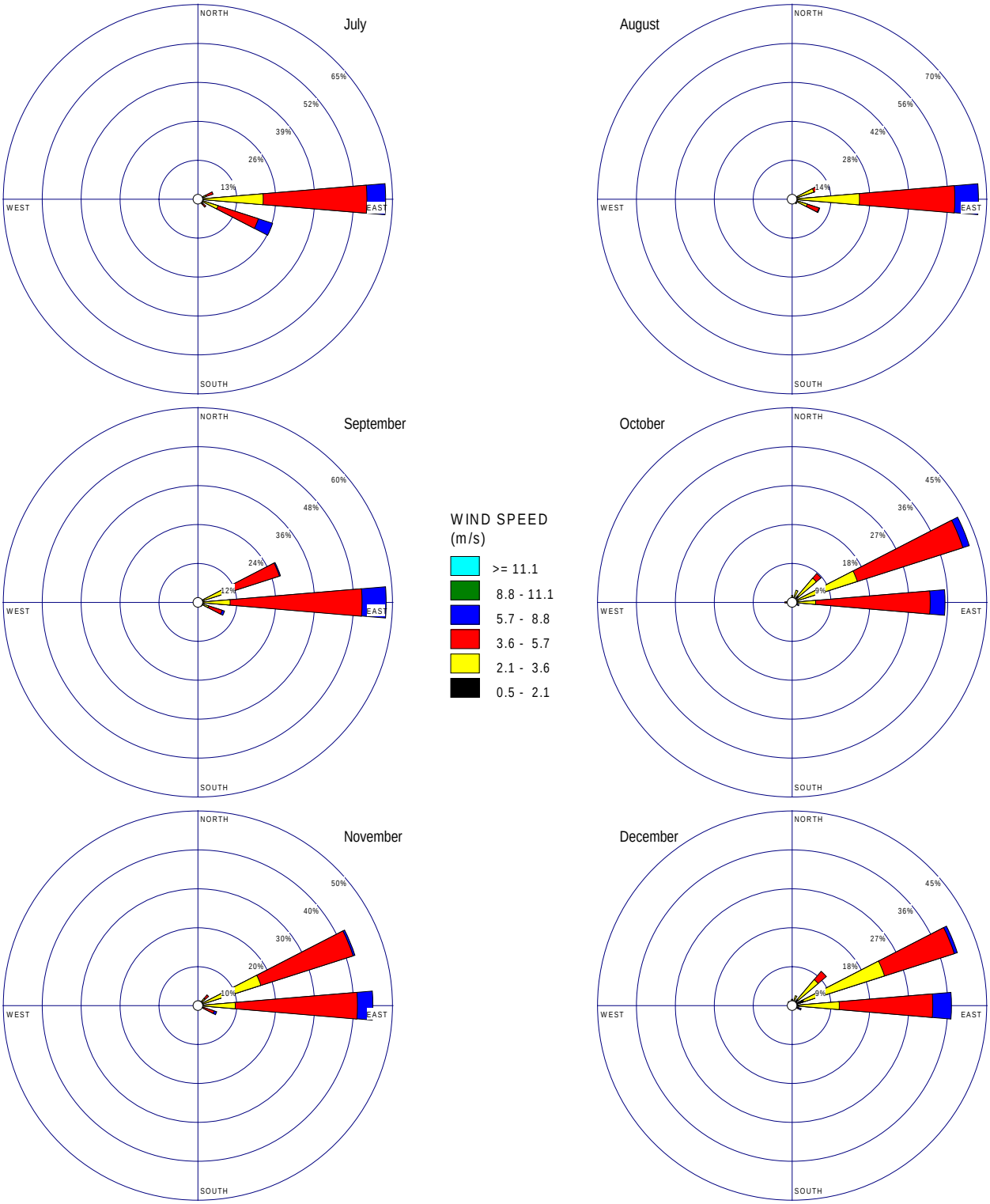
081021M

WIND ROSE PLOT:

Millenium Mine

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:

Wind Roses for Last Six Months

DATA PERIOD:

2004-2005
June 1 - December 31
00:00 - 23:00

COMPANY NAME:

Noise Mapping Australia

MODELER:

Chris Simpson

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DATE:

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PROJECT NO.:

081021M

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F7:

TERRESTRIAL ECOLOGY

TERRESTRIAL ECOLOGY ASSESSMENT

for

MILLENNIUM EXPANSION PROJECT

July 2009

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TABLE OF CONTENTS

1 SUMMARY 1
2 INTRODUCTION 2
2.1 LOCATION 3
2.2 TOPOGRAPHICAL AND WATER FEATURES 3
2.3 EXISTING LAND USE 3
2.4 PROPOSED ACTIVITIES 4
3 LITERATURE REVIEW AND GAP ANALYSIS 7
3.1 LITERATURE REVIEW 7
3.2 EXISTING KNOWLEDGE 8
3.2.1 Biodiversity planning assessment 8
3.2.2 Vegetation communities 10
3.2.3 EVR Flora and Vertebrate Species 13
3.2.3.1 EVR species from the local area 13
3.2.3.2 EVR species previously recorded from the MEP area 16
3.2.3.3 Migratory species 16
3.3 GAP ANALYSIS 17
4 FIELD ASSESSMENT METHODOLOGY 20
4.1 TERRESTRIAL FLORA 20
4.1.1 Survey design 20
4.1.2 Survey techniques 20
4.1.2.1 Desktop 20
4.1.2.2 Vegetation community descriptions 20
4.1.2.3 Condition assessment 20
4.1.2.4 Significant species searches 20
4.2 TERRESTRIAL VERTEBRATES 22
4.2.1 Survey design 22
4.2.2 Survey techniques 24
4.3 SURVEY TIMING AND CONDITIONS 24
5 FLORA RESULTS 25
5.1 VEGETATION COMMUNITY DESCRIPTIONS 25
5.1.1 Remnant vegetation communities (VM Act) 25
5.1.2 Non-remnant vegetation communities (VM Act) 27
5.1.3 Vegetation Communities and Regional Ecosystem Classification 27
5.1.4 Threatened Ecological Communities 41
5.2 SIGNIFICANT FLORA SPECIES 41
5.2.1 Observed and Potential EVR Species 41
5.2.2 Exotic Plants 42

6 VERTEBRATE RESULTS 43
6.1 VERTEBRATE HABITATS AND COMMUNITIES 43
6.1.1 Background 43
6.1.2 MEP Vertebrate Habitat and Communities 44
6.1.2.2 Exotic grasslands 44
6.1.2.3 Woodlands dominated by exotic grasses 46
6.1.2.4 Native understorey woodlands 47
6.1.2.5 Massive rock outcrops 49
6.1.2.6 Waterway habitats 51
6.2 EXISTING ECOLOGICAL CORRIDOR VALUES 51
6.3 SIGNIFICANT VERTEBRATE SPECIES 54
6.3.1 Confirmed and potential EVR vertebrates 54
6.3.2 Confirmed EVR Species 56
6.3.2.1 Brigalow Scaly-foot (Paradelma orientalis) 56
6.3.2.2 Little Pied Bat (Chalinolobus picatus) 56
6.3.3 Potential EVR Species 57
6.3.3.1 Ornamental Snake (Denisonia maculata) 57
6.3.3.2 Squatter Pigeon (Geophaps scripta scripta) 57
6.3.4 Non-EVR migratory vertebrates 58
6.4 PEST VERTEBRATES 59
7 POTENTIAL ECOLOGICAL IMPACTS AND MITIGATION RECOMMENDATIONS 60
7.1 VEGETATION LOSS 60
7.1.1 Vegetation loss for pits and dumps 60
7.1.2 Vegetation loss for associated infrastructure 63
7.1.3 Loss of vertebrate habitats and communities 63
7.2 EXOTIC PLANTS AND PEST VERTEBRATE SPECIES 64
7.2.1 Exotic Plants 64
7.2.2 Pest Vertebrates 65
7.3 IMPACTS ON EVR SPECIES 65
7.3.1 *Cerbera dumicola* (a shrub) 65
7.3.2 Brigalow Scaly-foot (*Paradelma orientalis*) 65
7.3.3 Ornamental Snake (*Denisonia maculata*) 66
7.3.4 Little Pied Bat (*Chalinolobus picatus*) 66
7.3.5 Squatter Pigeon (*Geophaps scripta scripta*) 66
7.3.6 Impacts on Migratory Species 66
7.4 ECOLOGICAL CORRIDORS 67
7.5 INAPPROPRIATE FIRE REGIMES 67
7.6 SUMMARY OF MITIGATION RECOMMENDATIONS 68

8 REFERENCES 70

APPENDICES

Appendix A BPA Mapping ..... A
Appendix B Literature And Database Results ..... B
Appendix C UNLIKLEY EVR SPECIES C
Appendix D MET SERVE Terrestrial Ecology survey species lists ..... D
Appendix E Systematic Vertebrate Sampling Site PHotos ..... E

PHOTOS

Photo 6-1 Exotic grasslands 45
Photo 6-2 Exotic grasslands were inhabited by Australian Pipits 45
Photo 6-3 Woodlands dominated by exotic grasses 46
Photo 6-4 Woodlands dominated by exotic grasses were inhabited by Brigalow Scaly-foot 47
Photo 6-5 Woodlands with native understorey 48
Photo 6-6 Woodlands with native understorey were inhabited by *Nephrurus asper* (Rough Knob-tailed Gecko) 49
Photo 6-7 Massive rock outcrop habitats 50
Photo 6-8 Massive rock outcrop habitats were inhabited by *Oedura monilis* (Australian Velvet Gecko) 50

FIGURES

Figure 2-1 Regional Location Plan 5
Figure 2-2 Proposed MEP Layout 6
Figure 3-1 Certified RE Mapping 12
Figure 3-2 Vegetation units identified by Smith (2003, 2006) 14
Figure 4-1 Vegetation Assessment Sites 21
Figure 4-2 Vertebrate sampling locations 23
Figure 5-1 Revised RE Mapping (RE Type) 28
Figure 5-2 Revised RE Mapping (Vegetation Management Act 1999 Status) 39
Figure 6-1 Effect of habitat diversity on movement rates through corridors 51
Figure 6-2 Potential local corridor movements 53
Figure 6-3 Records of EVR Vertebrates 55
Figure 7-1 Vegetation loss within proposed pit and spoil dump areas 62

TABLES

Table 3-1 Evaluation of Literature Sources 8
Table 3-2 BAMM results for Remnant Units within the MEP area 9
Table 3-3 Existing Regional Ecosystems (Smith 2003, 2006) 13
Table 3-4 Locally Known EVR Flora and Vertebrate Species 15
Table 3-5 Status of Potential Gaps in Existing Knowledge for the MEP area 18
Table 4-1 Sampling Locations and Habitats 22
Table 4-2 Terrestrial Vertebrate Sampling Techniques 24
Table 5-1 Vegetation Communities of the MEP Area 29
Table 5-2 Vegetation community and RE equivalency 40
Table 5-3 Threatened Ecological Communities within the MEP Area 41
Table 5-4 Habitat preferences for significant species known to occur within the vicinity 42
Table 5-5 Listed weed species that occur within the MEP area 42
Table 6-1 Vertebrate Diversity Comparison to Local Studies 43
Table 6-2 Likelihood of EVR vertebrates within the MEP area 54
Table 7-1 Areas of remnant vegetation designated for clearing for pit and spoil dumps 60

1 SUMMARY

Peabody Energy Australia Pty Ltd is planning to expand open-cut mining activities at Millennium Coal Mine near Moranbah, and is seeking to acquire the necessary environmental information pertinent to gaining approval for the Millennium Expansion Project (MEP). To this end, MET Serve Consulting reviewed previous flora and fauna surveys and relevant sources and found gaps in the knowledge of the ecological attributes of the site. To fill these gaps, MET Serve conducted a terrestrial ecology survey from the 23rd to the 31st (inclusive) of March 2009.

The conditions, at the time of the survey, were considered suitable for the detection of all terrestrial flora and vertebrate species possibly present, other than some frog species due to the lack of recent rainfall. Field assessments were conducted using best practice sampling and methodologies (e.g., DEC NSW 2004; Neldner *et al.* 2005), commensurate with the diversity, quality and spatial extent of habitats present. The aim of this approach was to yield data of high standard suitable for inclusion in an EIS to be reviewed by regulatory authorities.

Flora assessments consisted of surveys at 31 tertiary-level and 75 quaternary-level vegetation sites. These included recordings of floristics, structure and condition within all vegetation communities present, in addition to targeted searches for endangered, vulnerable and rare (EVR) plant species listed under relevant State and Federal legislation.

The project area contains 844 hectares (ha) of remnant vegetation. Of this, 668 ha was designated 'not of concern', 90 ha 'of concern' and 86 ha 'endangered'. Of the existing endangered Regional Ecosystems (RE), 87.3% (74.8 ha) consist of riparian vegetation associated with New Chum Creek. The remaining 11.2ha was made up of scattered small patches of Dawson Gum and Brigalow in the west of the MEP area.

Previous survey work within the MEP area by Smith (2003) identified the presence of *Cerbera dumicola* (a shrub), listed as Rare under the *Nature Conservation Act 1992* (NC Act). No EVR flora species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) were observed within the MEP area during the current or previous surveys.

Vertebrate sampling and data collection was undertaken at six survey sites which was supplemented by data collected at target locations. A total of 125 terrestrial vertebrate species have been identified from the MEP area, including five amphibians, 16 reptiles, 81 birds and 23 mammals. Two vertebrates listed as EVR under legislation have been identified within the MEP area:

- Brigalow Scaly-foot (*Paradelma orientalis*) — vulnerable under EPBC Act and NC Act; and
- Little Pied Bat (*Chalinolobus picatus*) — rare under NC Act.

The proposed mining activities may impact on at least 2.9 ha of Brigalow-dominated or co-dominated vegetation listed as endangered under the *Vegetation Management Act 1999* and EPBC Act (REs 11.9.1 and 11.9.5). All instances of endangered vegetation proposed to be cleared occur near the edges of a pit or spoil dump projections. Relatively minor alterations of mine plans to avoid clearing these areas are recommended if practicable. Other vegetation within proposed impact areas was found to consist of RE types listed as 'not of concern' and hence disturbance of these areas carries no legislative implications.

Notwithstanding other impeding factors, it is also recommended that the 480 m of the proposed site access road realignment and 96.6 m of 66 kV overhead powerlines that traverses remnant vegetation be modified to pass north-east of the remnant vegetation, through the non-remnant area west of the proposed northern drainage channel that flows into New Chum Creek.

Planning and design options for the MEP, as well as the construction phase, should minimize or preferably avoid impacting on the confirmed EVR species *Cerbera dumicola*, Brigalow Scaly-foot and Little Pied Bat, as well as the potentially present Ornamental Snake (*Denisonia maculata*). The relevant measures are outlined in *Section 7 – Potential ecological impacts and mitigation measures* below. Other environmental values potentially relevant to future assessments, for example the presence of exotic species and habitat quality, are also discussed. General and specific mitigation strategies recommended for implementation to reduce potential impacts arising from the MEP are summarised.

2 INTRODUCTION

The Millennium Coal Mine is an existing open-cut coal mine, operated by Millennium Coal Pty Limited (MCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Limited (Peabody). The Millennium Mine is comprised of the following tenements:

- Mining Lease (ML) 70312 'Millennium East';
- ML 70313 'Millennium West';
- ML 70344 'Mountain Pit';
- ML Application (MLA) 70401 'North Poitrel'; and
- Mineral Development Licence (MDL) 136 'Mavis Downs'.

Peabody proposes to extend the open-cut mining operation into ML Application 70401, MDL 136 and ML 70313. The proposed open-cut expansion is referred to as the Millennium Expansion Project (MEP).

In order to commence mining operations, Peabody is seeking to acquire the necessary environmental information and approvals for the MEP. Accordingly, Matrix Plus Consulting Pty Ltd (MET Serve) have been engaged to prepare a terrestrial ecology (flora and fauna) report of the Project site (the 'MEP area'). This report details the findings of ecological field investigations undertaken by MET Serve, as well as results from other studies.

To assist with this process, MET Serve undertook a literature review of existing documentation for the MEP area and surrounds. Once consolidated, the data was assessed to determine what, if any, gaps occur in existing field assessments or reporting. Priority species known from the local area, and identified knowledge gaps, were targeted in the subsequent field investigations.

Specifically, the aims of this assessment were to:

- review existing reports and studies pertaining to the terrestrial flora and vertebrate values within the MEP area;
- identify reliable information in existing reports which can be incorporated into future assessments;
- identify potential gaps within existing data and knowledge by comparison with standard best practice ecological requirements;
- undertake surveys to compliment previous assessments and, where necessary, attempt to fill knowledge gaps;
- document existing ecological values including vegetation communities, vertebrate habitats and ecological corridors;
- develop a inventory of all flora and vertebrates currently known from the MEP area;
- identify and discuss the occurrence and ecology of known and potential species listed under state and commonwealth regulations;
- identify potential impacts that the proposed activities may have on identified ecological values; and
- suggest recommendations that may alleviate the identified impacts.

Throughout this document, terrestrial ecological values listed as Critically Endangered, Endangered, Vulnerable or Rare under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the *Nature Conservation Act 1992* (NC Act) are referred to as Endangered, Vulnerable or Rare (EVR).

Nomenclature follows taxonomy accepted by the Queensland Herbarium and Queensland Museum. All flora species will be referred to by common names (where they exist), for ease of reference by non-specialists. Their scientific name will be stated in parentheses the first time they are introduced, to avoid confusion between common names. Most birds and mammals have widely recognised common names, which will be used in preference to scientific names. By contrast, many amphibians and reptiles are only known by their scientific names. These groups will be referred to by their scientific name and any known common names provided on first use.

2.1 LOCATION

The MEP is located approximately 22 kilometres (km) east of Moranbah and 16 km southwest of Coppabella in Central Queensland. The MEP lies south of the Peak Downs Highway and north of the Isaac River (**Figure 2-1**). It includes MLA 70401, MDL 136 and ML 70313 (collectively referred to as the MEP area) and is approximately centred on -22.015°E, 148.242°S.

2.2 TOPOGRAPHICAL AND WATER FEATURES

Topographic maps indicate that the project area is generally low-lying with only shallow topographical relief. However, several duricrust capped hills are located within the MEP. Duricrust are case-hardened soil crust formed in semiarid climates by precipitation of salts; this geology contains aluminous, ferruginous, siliceous, and calcareous material. In the Bowen Basin they are commonly referred to as Silcrete. Two such rises or hills occur on MLA 70401 and MDL 136. The largest, known as Red Hill, is found on the northern border of MDL 136 and rises approximately 50 m from the surrounding plains. The second rise, Poitrel Hill, is less significant and located to the west of Red Hill in the centre of MLA 70401.

Large mesa plateaux extend into the north-western and southern portions of ML 70313. The mesa located in the north-western corner features weathered slopes eroding into rocky screes with scattered large boulders. By contrast, the mesa located in the south has many cliff faces often rising 10–20 m in height. These cliffs contain a number of overhangs, fissures and crevices and contain habitat suitable for a variety of species.

Most surface water within the MEP area drains to the south, through ephemeral creeks and tributaries. These join to form New Chum Creek which flows south to join the Isaac River. However, the large duricrust plateau in the west separates surface flow in the southern portion of ML 70313, which enters directly into the Isaac River via a small creek line. Both creeks are ephemeral and only contain water after substantial rainfall. In addition, North Creek, which is fringed by riparian vegetation, is located approximately 5 km to the east of MDL 136 and some surface water on the eastern portion of the MDL is likely to drain into this waterway. Permanent water is stored in a large dam (West dam) on ML 70313.

2.3 EXISTING LAND USE

The project area and surrounds has historically been used for cattle grazing and as a result the bulk of the MEP area has been cleared and is now dominated by improved pasture grasses (e.g. Buffel Grass [*Pennisetum ciliare*[1]]).

In addition to grazing, the MEP area and surrounding land has been altered to facilitate mining activities. Nearby infrastructure includes pipelines, powerlines and a power substation, a rail loop and considerable disturbance associated with the existing Millennium Coal Mine and the adjacent Carborough Downs and Poitrel Coal Mines.

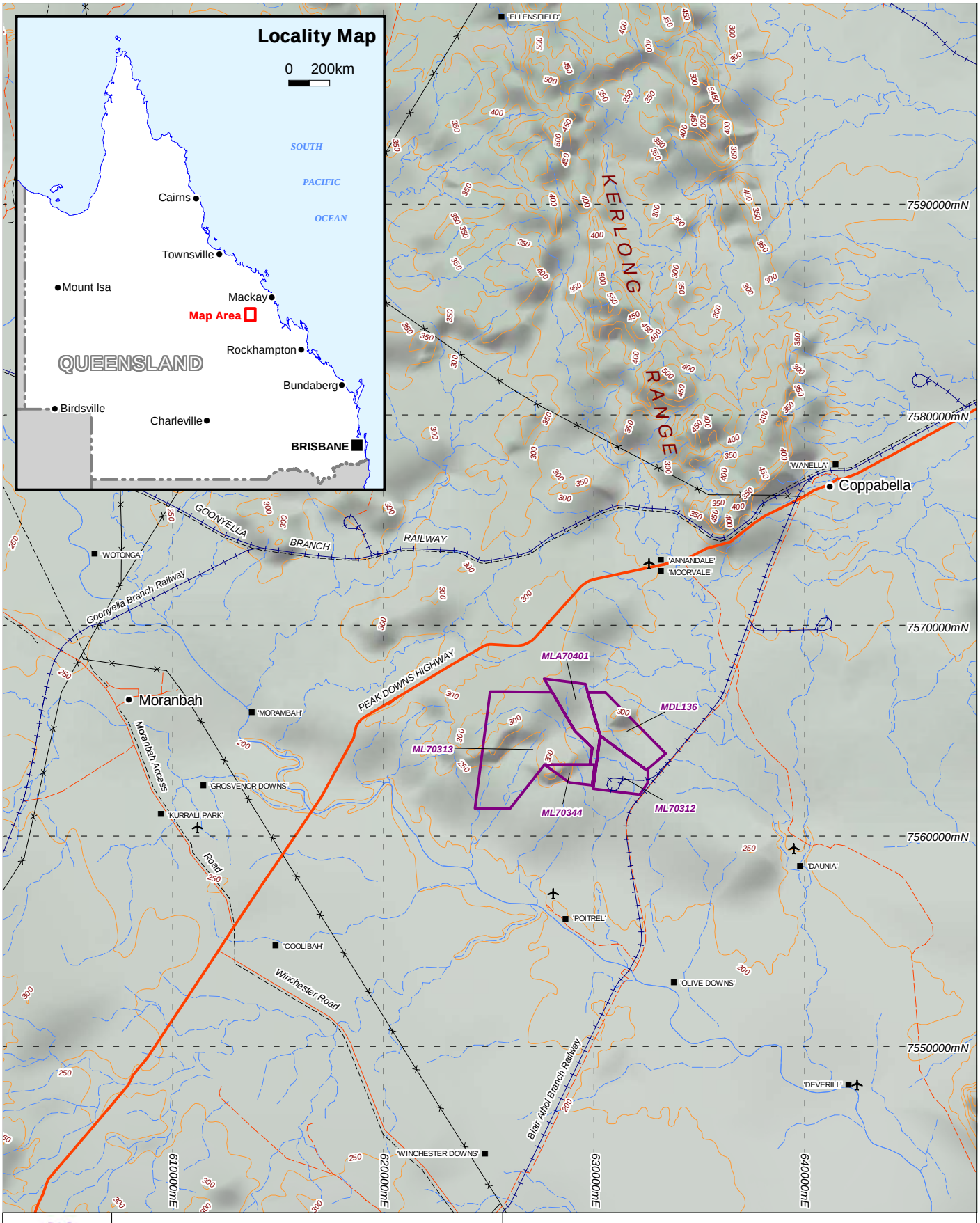
[1] This species has recently been transferred to a different genus. It was previously know as *Cenchrus ciliaris.*

2.4 PROPOSED ACTIVITIES

The proposed open-cut operation on the MEP is likely to consist of the following operational aspects:

- open-cut coal mining—to increase the existing ROM extraction rate from 2 Million tonnes per year (Mt/y) to 10 Mt/y. Mining involves clearing, salvage of topsoil, stripping of overburden, extraction of the coal, replacement of topsoil and revegetation. The average coal depth and quality varies throughout the project area. Coal mining will most likely be performed using open-cut truck and shovel terrace mining methods. Disturbed areas would be progressively rehabilitated;
- coal processing—mined coal will be transported to the processing area on ML 70312 via haul trucks. Coal fines and reject material will be produced as coal processing by-products. The washed coal will be conveyed and stockpiled for offsite transport via the existing rail network;
- disposal of coal fines and coarse rejects—existing facilities will be used. An option to utilise a final void will be investigated as part of the ongoing feasibility assessments;
- coal handling and preparation—the existing CHPP will be utilised along with the ROM and product coal stockpile areas. The CHPP is operated by the Red Mountain Joint Venture and is completely separate from the MEP approval process;
- other infrastructure—existing mine infrastructure area, workshops, administration facilities etc will be assessed and may be relocated to more effectively service the expanded mine footprint;
- water infrastructure—new water storage and treatment dams may be required to support increased extraction and processing works associated with the MEP;
- power—no additional transmission lines are currently proposed for the MEP. If operational processes change, a study will be performed to determine if additional transmission lines are required along existing power line easements (where possible) to accommodate any increase in electrical demand from new machinery;
- water supply—existing water supply will be utilised;
- coal transport infrastructure—existing rail and product load-out facilities will be utilised;
- main access road—the existing site access road will be utilised, but may be subject to re-alignment along a portion of its route;
- mine haulage roads—new roads to the expansion areas will be required as will a crossing over the New Chum Creek; and
- pit and waste dumps—new waste dump areas will be developed to service the new mining areas.

Figure 2-2 illustrates the existing and proposed features of the Millennium Coal Mine and the MEP.



MET SERVE

Peabody

LEGEND

- Highway
- Road
- Track
- Railway
- 50m Contour
- Isaac River
- Watercourse
- Powerline
- Pipeline
- MEP Tenement
- Town
- Homestead
- Aircraft

Data Source:
Topography - Geoscience Australia. Tenement - Peabody.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Regional Location Plan

0 5 10

Kilometres

Scale: 1:250,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 2-1

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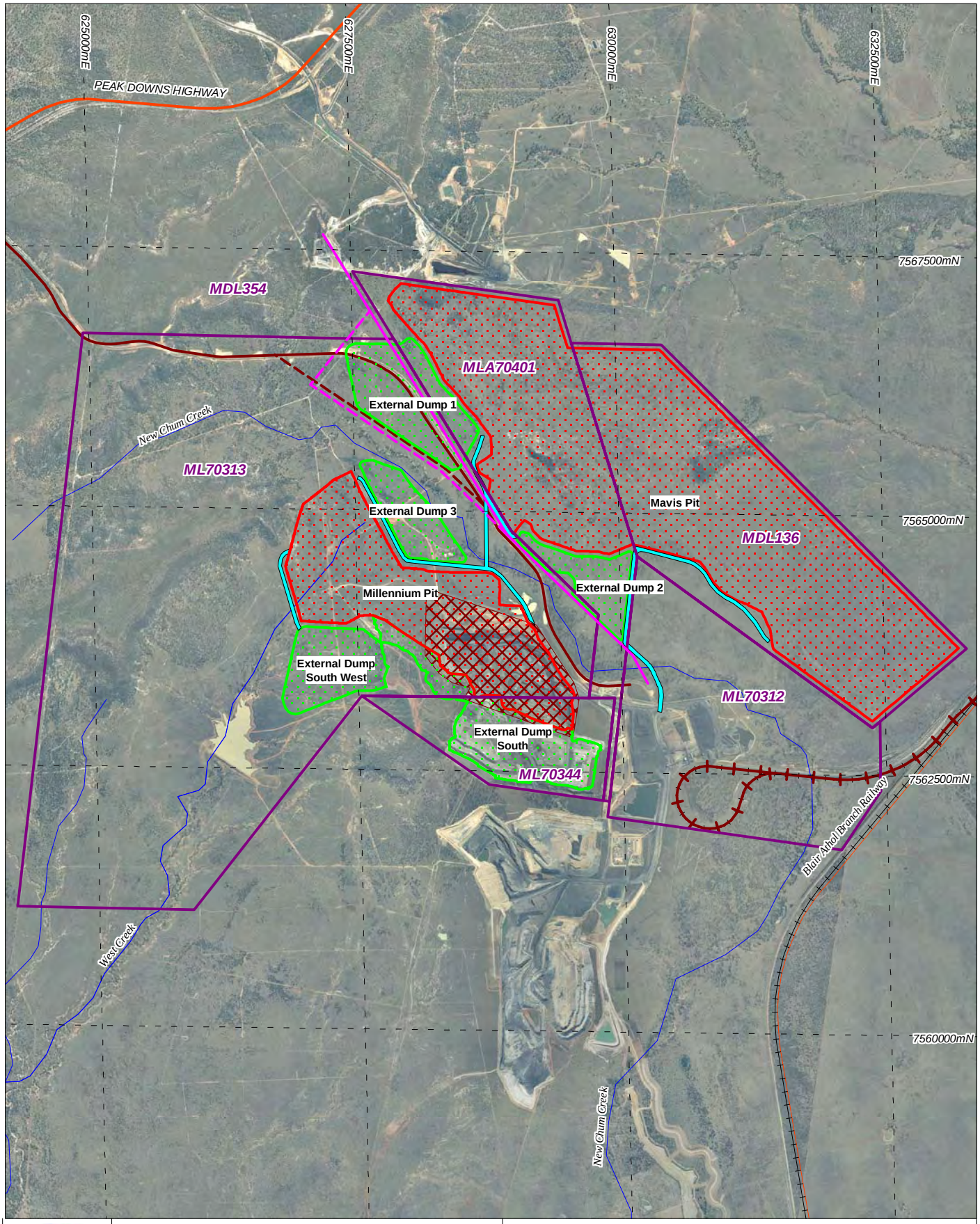

LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump
- MEP Haulroad
- Existing Mountain Pit
- Existing Mine Access Road
- MEP Road Realignment
- Existing Rail Loop
- Existing 66Kv Powerline
- MEP Powerline Realingnment

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.

MET SERVE

Peabody

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Proposed MEP Layout

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 2-2

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3 LITERATURE REVIEW AND GAP ANALYSIS

Gathering and reviewing existing information assisted in evaluating current knowledge of the ecological values within the MEP area. It also assisted in providing a local and regional context for the survey results and identified species and gaps that should be targeted during further field investigations.

3.1 LITERATURE REVIEW

Prior to undertaking field investigations, background data was gathered from a variety of sources including public databases, aerial photos and images, planning documents, Regional Ecosystem (RE) maps and previous studies. These sources, in addition to providing data pertaining to the MEP area, also allowed the results of studies to be placed in a regional setting. Some data, particularly database records, are valuable for predictive modelling purposes, assisting in the design of field surveys and as an indication of previous vertebrates and plants within the local area.

However, to ensure that the data was appropriately considered, existing information sources were critically assessed in terms of what they could contribute to the study. This critical assessment considered the following (DEC NSW 2004):

- date of the record—old records are less reliable than recent records;
- survey method—was the data collected systematically or opportunistically. Systematic studies provide considerable information regarding less obvious cryptic (i.e. difficult to find) species and usually include trapping techniques suitable for all vertebrate groups;
- survey effort—short on-off surveys tend to inadequately sample rare or cryptic species;
- survey timing and conditions—many flora and vertebrate species are more readily detected during particular climatic conditions. For example, frogs and reptiles are more active during warm summer months and are largely absent during winter sampling;
- taxonomy—taxonomy is in a constant state of flux and some studies, particularly older studies, may use out-dated taxonomy. For example, a study may document a species that has been split into two, both of which occur in the same or overlapping area. In such a case it is not possible to determine to which of the two species the report is referring;
- location accuracy—some records may have insufficient specific location details rendering the record less valuable; and
- identification accuracy—some observers have greater specialist knowledge of species identification and are less likely to include errors.

In general, these factors revolve around two criteria: the *reliability* of the record and the *relevance* of the record. Reliability refers to the accuracy of the study and identifications therein. Relevance refers to where the study was conducted. Studies that included sampling within the target area were considered to be more relevant than studies based on a broader area.

Sources reviewed as part of this assessment are listed in **Table 3-1**. The table includes an evaluation of the relevance and reliability of the sources. It should be noted that the evaluation is provided as a guide only as some studies may have a high reliability and relevance for some ecological values, but be low for others. For example, a study may have highly reliable amphibian, reptile and bird records, but extremely poor bat records due to the lack of adequate sampling techniques. These gaps and omissions will be considered in more detail in Section 3.3.

Table 3-1 Evaluation of Literature Sources

Data Source	Reliability	Relevance
Wildlife Online (DERM wildlife database)	Moderate/high	Moderate
Birds Australia Atlas (1998–2008)	High	Moderate
EPBC Online database search	Low	Low/moderate
Queensland Museum Database	High	Moderate
Smith, A.N. (2003) Millennium Coal Project—flora, fauna and regional ecosystem survey. Report prepared for Millennium Coal Pty Ltd by ANSAR Environmental Pty Ltd	High	High
Smith, A.N. (2004) Millennium Coal—Moranbah coal project extension area: flora, fauna and regional ecosystem survey. Report prepared for Millennium Coal Pty Ltd by Environmental Placement Services	High	High
Smith, A.N. (2006). Mavis Downs—North Poitrel Coil Area Flora, Fauna and Regional Ecosystem Survey. Report prepared for Millennium Coal Pty Ltd by Environmental Placement Services	High	High
BHP Billiton Mitsubishi Alliance (2008) Daunia Coal Mine Project: Environmental Impact Statement, November 2008	Moderate/high	High
DERM regional ecosystem Maps	Moderate/high	High
Biodiversity Planning Assessment: Brigalow Belt (version 1.3, 22 Sept 2008)	Moderate/high	High

3.2 EXISTING KNOWLEDGE

3.2.1 Biodiversity planning assessment

The Queensland Department of Environment and Resource Management (DERM) has developed the Biodiversity Assessment and Mapping Methodology (BAMM) to provide a consistent approach using vegetation mapping data to assess biodiversity values at the landscape scale in Queensland. The methodology has been used by the DERM to generate Biodiversity Planning Assessments (BPAs) for each of Queensland's Bioregions. The BPAs are used by government regulators, local councils and other stakeholders to provide advice on a range of planning or decision-making processes.

The methodology is used for the identification of areas with various levels of biodiversity related significance. The mapping is based on RE maps generated or approved by the Queensland Herbarium, which may at times include some errors. Accordingly, BPAs should be used as a biodiversity assessment tool to place areas of vegetation and habitat into a regional context. They should not be used as a conservation assessment tool in its broadest sense and they have no regulatory requirements or implications.

The BAMM uses seven diagnostic criteria (A–G—refer to **Table 3-2**) plus three supplementary criteria, (H–J) to determine the Biodiversity Significance of an area. Each remnant vegetation unit is ranked as Low, Medium, High or Very High for each of the criteria. Once a rating has been assigned to each of the diagnostic criteria, an overall Biodiversity Significance is evaluated by integrating the seven diagnostic criteria. As a result, the remnant may be rated as 'State significant', 'Regionally significant' or 'Locally Significant and/or Other Values'.

The most recent BPA for the Brigalow Belt North bioregion, in which the MEP area lies, is version 1.3, released 22 September 2008. The level of significance for each BAMM diagnostic criteria (A–G) and supplementary criteria (H–J) for the MEP area is outlined in **Table 3-2**. Relevant maps are provided in **Appendix A**.

Table 3-2 BAMM results for Remnant Units within the MEP area

BAMM Criteria		Description	Discussion	Figure Ref.
DIAGNOSTIC CRITERIA				
D1.	**Criterion A** Habitat for EVR taxa	This criterion brings together information on EVR taxa using buffering of recorded sites in the absence of Habitat Suitability Maps (HSM) for species.	Most of the vegetation on the MEP area rates as LOW. However, the north-west portion of the site also contains areas ranked as MEDIUM and HIGH.	A-1
D2.	**Criterion B** State Ecosystem Value	This criterion combines a number of elements including the Biodiversity Status of REs, the presence of poorly conserved REs, the presence of significant wetlands, and areas of national importance such as World Heritage Areas and Ramsar Sites.	Vegetation associated with the duricrust outcrops and New Chum Creek is rated as VERY HIGH. Most vegetation in the north-western corner is ranked as MEDIUM, HIGH or VERY HIGH.	A-2
D3.	**Criterion C** Tract Size	This criterion is a measure of the relative size of tracts of vegetation in the landscape.	Vegetation in the north-west corner, which adjoins larger patches of habitat, is considered to be HIGH. Other areas of habitat, including along New Chum Creek are mapped as LOW. ML 70313 in the west of the site contains tracts of land that are either LOW, MEDIUM, or HIGH.	A-3
D4.	**Criterion D** State Relative Size of RE	This criterion classifies the relative size of each example of an RE. Patches are compared with all other occurrences of the same RE.	All vegetation within the MEP area is rated as LOW, except for two areas which are part of the contiguous tract that extends north-west of the MEP area. The larger one within the MEP area consists of the interior portion of the westernmost mesa within ML 70313. Only a small portion of the second area extends into the MEP area, and it is located in the north-westernmost section of ML 70313. Both these areas are ranked as MEDIUM.	A-4
D5.	**Criterion E** Condition	This criterion represents the quality of remnants judged by the extent to which they resemble their natural condition.	All vegetation within the ML is afforded a VERY HIGH rating under this criterion.	A-5
D6.	**Criterion F** Ecosystem Diversity	This criterion reflects the degree to which REs are 'packed' within an area. That is, an area with high Ecosystem Diversity will have relatively many REs and ecotones.	Vegetation associated with Red Hill and New Chum Creek is rated as HIGH. The bulk of vegetation in the west and north-west corner is mapped as HIGH, although some VERY HIGH and MEDIUM vegetation also occurs. Vegetation on the duricust hill within the North Poitrel MLA is mapped as MEDIUM, as is one small patch in the north-west. One very small area of VERY HIGH vegetation may encroach into the MEP area in the mid-north. Located in the mid-south is HIGH and VERY HIGH vegetation.	A-6
D7.	**Criterion G** Context and Connection	This criterion represents the extent to which a Remnant Unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems, and the degree to which a Remnant Unit is connected to other vegetation.	VERY HIGH and HIGH status vegetation occurs in the north-west corner of the MEP area, along with some LOW and MEDIUM areas. Other areas associated with the duricrust hills and along New Chum Creek are mapped as MEDIUM or LOW. The mid-south of the site contains MEDIUM and VERY HIGH areas, while the south-east contains LOW areas.	A-7

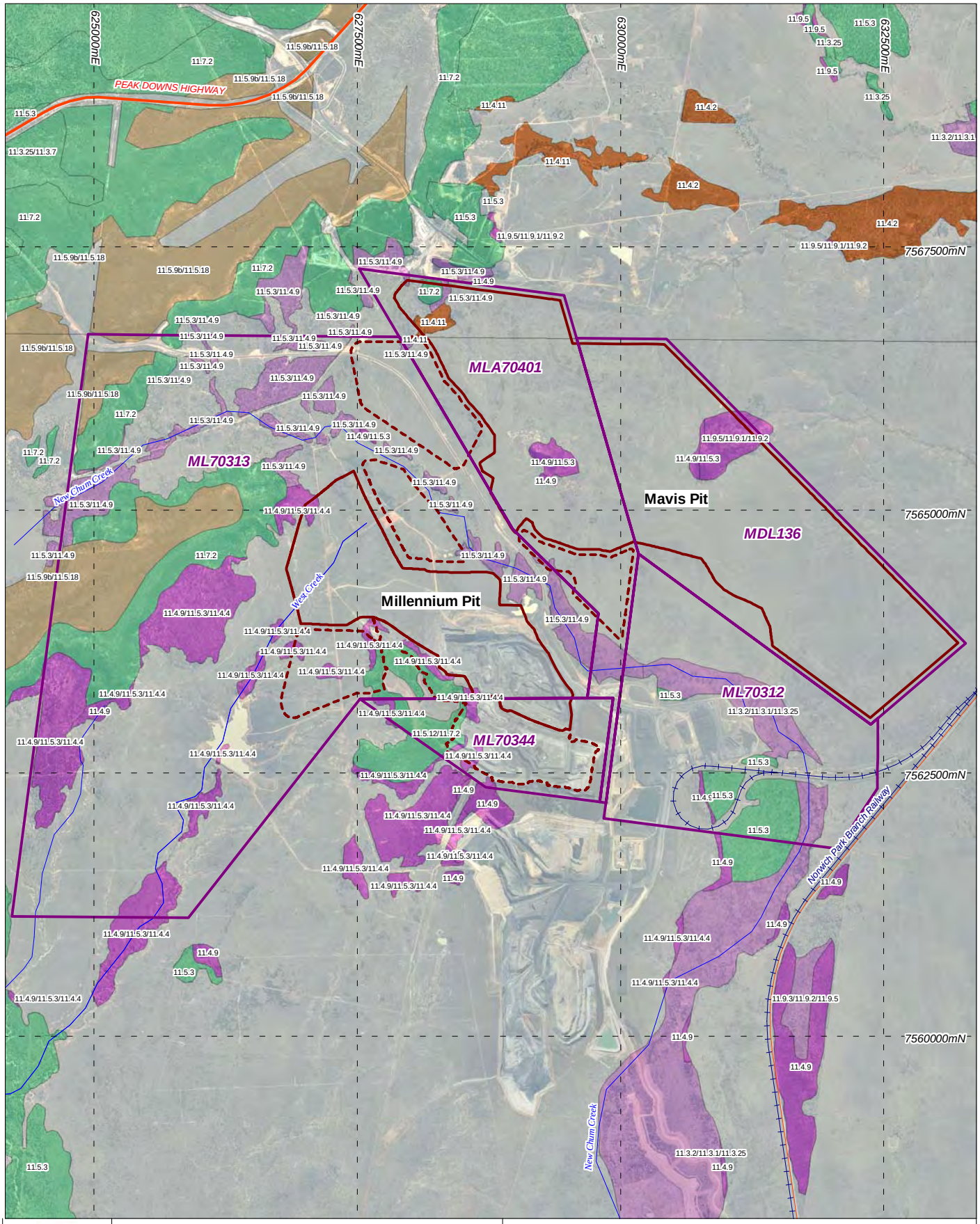
BAMM Criteria		Description	Discussion	Figure Ref.
SUPPLEMENTARY CRITERIA				
S1	**Criterion H** Essential and general habitat for priority taxa	This criterion can be used to identify Essential and General Habitat for EVR and other Priority Taxa in addition to that derived under Diagnostic Criterion A. Information sources include expert and local knowledge, technical reports and papers, and modelled maps of Essential and General Habitat.	No areas of habitat within the MEP area are mapped as habitat for priority taxa.	A-8
S2	**Criterion I** Special biodiversity values	Areas with Special Biodiversity Values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment.	No areas of special biodiversity value are mapped on the MEP area.	A-9
S3	**Criterion J** Corridors	Areas identified under this criterion qualify because they are either existing vegetated corridors important for contiguity including regrowth, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".	No areas of vegetation within the ML are mapped as having corridor value.	A-10
SUMMARY	**Biodiversity Significance**	**The overall biodiversity significance of remnant units evaluated by integrating diagnostic criteria (A-G).**	**Vegetation associated with the duricrust hills on MDL 136 (Red Hill) and on MLA 70401 (Poitrel Hill) are mapped as STATE significant. Vegetation along New Chum Creek is also mapped as STATE significant. Small pockets of STATE vegetation also occur in the mid- north of the MEP area (ML 70131), however most of this vegetation has REGIONAL or LOCAL significance.** **ML 70313 contains scattered areas of STATE significant vegetation. In the mid-south, areas of LOCAL OR OTHER VALUES occur. The north-west corner of ML 70313 contains large areas assessed as being STATE, REGIONAL or LOCAL/OTHER significant vegetation.**	**A-11**

3.2.2 Vegetation communities

Existing RE maps for the MEP area indicate that twelve REs may be present throughout the MEP area. Most significantly, the RE map indicates that vegetation on Red Hill (MDL 136) is a heterogeneous polygon consisting of RE 11.9.5, 11.9.1 and 11.9.2 (60/30/10% respectively) (**Figure 3-1**). Furthermore, vegetation along New Chum Creek is mapped as a mixed community of RE 11.5.3 and 11.4.9 (50/50%). Both REs 11.9.5 and 11.9.1 are Brigalow (*Acacia harpophylla*) communities which are awarded an endangered status under the *Vegetation Management Act 1999* (VM Act) and the EPBC Act. While the VM Act is generally not applicable for mining operations, it is relevant in relation to Category B Environmentally Sensitive Areas (ESA) under the *Environment Protection Regulation 1998*. ML 70313 is mapped as having large areas of endangered and of concern vegetation, some of which are contiguous with habitat external to the project boundaries. Endangered communities within ML 70313 refer to Brigalow vegetation (RE 11.4.9) while of concern vegetation relates to *Micromyrtus capricornia* shrubland (RE 11.5.18).

Smith (2003, 2006) lists nine REs as present within the MEP area (**Table 3-3**). RE maps often lack ground-truthed data and may therefore present erroneous results. By contrast, data presented by Smith (2003, 2006) are based on field investigations and are therefore considered to be more accurate for the area that was surveyed. Smith (2003, 2006), identified REs 11.4.8 and 11.4.9 within the MEP area, both of which are listed as endangered under the VM Act. These REs are also contained within the description for the Brigalow endangered ecological community (EEC) under the EPBC Act. No discussion is provided within Smith (2003, 2006) in regards to the condition of endangered or of concern vegetation.

The identity, extent and condition of revised vegetation communities, ground-truthed by the MET Serve team, are discussed in Section 5.



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

RE Mapping

- Endangered (dominant)
- Endangered (sub-dominant)
- Of Concern (dominant)
- Of Concern (sub-dominant)
- Not of Concern

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.
RE Mapping - DERM

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Certified RE Mapping

0 1 2

Kilometres

Scale: 1:50,000 (A4)

04/06/2010

Datum: GDA94
Projection: MGA55

FIGURE 3-1

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Table 3-3 Existing Regional Ecosystems (Smith 2003, 2006)

RE	Short Description (Regional Ecosystem Description Database)	Status	
		VM Act	EPBC
Landzone 3: Alluvial plains			
11.3.2	*Eucalyptus populnea* woodland	OC	OC
Landzone 4: Gently undulating clay			
11.4.2	*Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains	OC	–
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	E	E
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	E	E
Landzone 5: Uniform sand plains			
11.5.3	*Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces	NC	–
11.5.9	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests	NC	NC
11.5.12	*Corymbia clarksoniana* woodland and other *Corymbia* spp. and *Eucalyptus* spp. on Cainozoic sand plains/remnant surfaces	NC	NC
Landzone 7: Duricrusts and footslopes			
11.7.1	*Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on lateritic duricrust	NC	–
11.7.2	*Acacia* spp. woodland on lateritic duricrust. Scarp retreat zone	NC	–

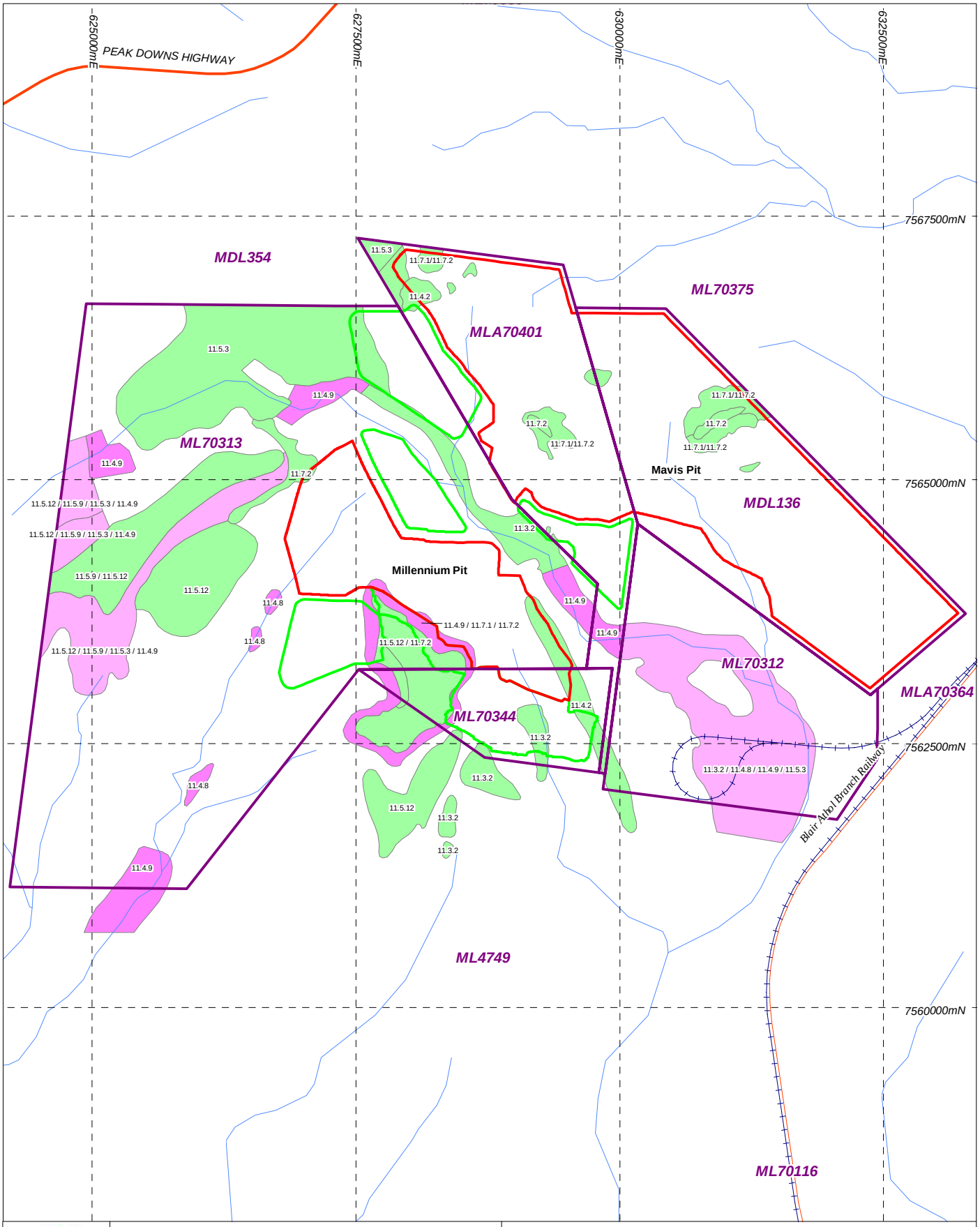
Status abbreviations as follows:
E = Endangered; **OC** = Of Concern; **NC** = Not Of Concern

Figure 3-2 shows the vegetation units identified by Smith (2003, 2006).

3.2.3 EVR Flora and Vertebrate Species

3.2.3.1 EVR species from the local area

The literature review and database inspection (**Appendix B**) identified 21 EVR species within the local area including six flora species and 15 vertebrate species (**Table 3-4**). It should be noted that the EPBC Online database includes predictive records and may therefore include species that have not been located nearby. **Appendix C** provides an assessment of EVR animal species considered unlikely to occur, while **Table 3-4** assesses the likelihood of occurrence for EVR plant species. As no EVR invertebrate species were identified from the literature review and database inspection, this faunal group was not considered further in the gap analysis or targeted in the subsequent field assessment.



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

Vegetation Mapping

- Endangered (dominant) - Brigalow
- Endangered (sub-dominant) - Brigalow
- Not Listed

Data Source:
Topography - Geoscience Australia. Infrastructure, Tenement - Peabody.
Vegetation Mapping - Smith (2003, 2006)

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Preliminary Ground Truthed Endangered Ecological Communities

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 3-2

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Table 3-4 Locally Known EVR Flora and Vertebrate Species

Scientific Name Common Name	Status		Source							
	NCA	EPBC	QM	WO	BA	ERT	Smith (2003)	Smith (2004)	Smith (2006)	BMA (2008)
FLORA										
Desmodium macrocarpum	R			X						
Bertya pedicellata	R			X						
Capparis humistrata	E			X						
Dichanthium setosum	R	V		X						
Cerbera dumicola	R						X			
Graptophyllum ilicifolium	V	V		X						
VERTEBRATES										
Rheodytes leukops Fitzroy River Turtle	V	V				X				
Egernia rugosa Yakka Skink	V	V				X				
Paradelma orientalis Brigalow Scaly-foot	R	V				X				
Pseudechis colletti Collett's Snake	R									X
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose	R	M			X					
Rostratula australis Australian Painted Snipe	V	V				X				
Erythrotriorchis radiatus Red Goshawk	E	V				X				
Ephippiorhynchus asiaticus Black-necked Stork	R			X	X					
Geophaps scripta scripta Squatter Pigeon (Sthn)	V	V		X	X	X				X
Melithreptus gularis Black-chinned Honeyeater	R				X					X
Neochmia ruficauda ruficauda Star Finch (Sthn)	E	E				X				
Chalinolobus picatus Little Pied Bat	R			X			X	X	X	X
Dasyurus hallucatus Northern Quoll	LC	E				X				
Nyctophilus timoriensis Eastern Long-eared Bat	V	V				X				
Taphozous troughtoni Troughton's Sheathtail Bat	E	E		X						

Acts: **VMA** = *Vegetation Management Act 1999*; **EPBC** = *Environment Protection and Biodiversity Act 1999*

Status: **EPBC Act** — E = Endangered; V = Vulnerable; M = Migratory; **NC Act** — E = Endangered; V = Vulnerable; R = Rare; LC = Least Concern

Databases: **QM** = Queensland Museum Database; **WO** = DERM Wildlife Online Database; **BA** = Birds Australia Database; **ERT** = DEWHA Environmental Reporting Tool; **Smith (2004), Smith (2006), BMA (2008)** = See **References**

Several species including *Rheodytes leukops*, *Pseudechis colletti* and the Australian Painted Snipe are considered highly unlikely to occur due to the lack of suitable habitat within the MEP area or surrounding areas. Three other species, Star Finch, Northern Quoll (*Dasyurus hallucatus*) and Troughton's Sheathtail Bat (*Taphozous troughtoni*) are extremely uncommon within the region and also not likely to occur (**Appendix C**).

Other species have the potential to occur dependant on suitable habitat characteristics. They should be targeted during future surveys.

3.2.3.2 EVR species previously recorded from the MEP area

Previous survey work within the MEP area by Smith *et al.* (2003, 2006) has identified the presence of *Cerbera dumicola* (a small understorey shrub) and Little Pied Bat (*Chalinolobus picatus*). Both these species are listed as Rare under the NC Act.

Smith (2003) reports that the occurrence of *C. dumicola* was restricted to ML 70313. Several individuals were located along New Chum Creek, and many individuals were located on the slope of the western hill, where plants were aggregated over an area of at least one hectare.

Smith (2006) does not indicate specifically where Little Pied Bats have been recorded, but given the number of habitats in which the species is known to occur, it may inhabit any areas of remnant vegetation that occur within the MEP area. Furthermore, vegetation within the northern portions of ML 70313 and MLA 70401 are mapped as Essential Habitat for this species (DEM essential habitat mapping—VM Act).

3.2.3.3 Migratory species

The EPBC Act adopts the definition of a migratory species under the Convention for the Conservation of Migratory Species (CMS—The Bonn Convention). This definition states that a migratory species *"means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries"* (DEWHA, pers. comm. 17 September 2008).

Since the inception of the EPBC Act, taxonomic revision of Australian birds has been undertaken by Christides and Boles (2008). This revision has resulted in the splitting of some species (previously considered to occur outside of Australia) into two or more species, one of which is endemic to the Australian continent. However, since the list of migratory species under EPBC Act has not been updated to reflect the new taxonomy, the old taxonomy still appears and is indicated by *s. lato* (*sensu lato* – "in the broad sense"). As the old taxonomic name applies to species no longer occurring in Australia and the new species is endemic, it should not be considered migratory.

A literature review and database inspection has identified a total of 16 migratory bird species from the local area. The majority of species appeared only in the EPBC Online database, which is largely predictive.

Field surveys by Smith (2006) have identified Rainbow Bee-eaters (*Merops ornatus*) as the only migratory species currently known from the MEP area. The Rainbow Bee-eater is a common bird throughout Queensland and Australia. It is likely to be widely distributed within the region and no significant or important populations are likely to occur within the project area. The species is listed as Least Concern under the NC Act.

Nearby surveys for the Daunia Coal Project (BMA 2008) recorded the Great Egret (*Ardea ibis s. lato*), Cattle Egret, Black-faced Monarch, Satin Flycatcher, Rufous Fantail and Rainbow Bee-eater.

3.3 GAP ANALYSIS

Prior to undertaking further field assessments, the existing data must be assessed against the broad aims of the study. In this instance, the data should be thorough and of a high standard for inclusion in an EIS to be reviewed by regulatory authorities. Existing data and collection techniques should thereby conform to best practice guidelines commensurate to the values present and have particular reference to valuable ecological features or processes (e.g., significant flora or vertebrate species or their habitats).

The gap analysis highlights areas requiring further research and forms the basis for new work. It should be noted that in many cases the important information may not be gained without years of detailed survey work. In such cases, the precautionary principle should be followed, consistent with the principles of ecologically sustainable development and biodiversity conservation.

Identification of potential gaps in the existing flora and vertebrate knowledge for the Millennium Expansion Project has been modified from guidelines provided in the 'NSW Department of Environment and Conservation Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft 2004' (DEC NSW 2004).

As such, a number of gaps were reviewed:

- spatial gaps where part of the study area may have less existing information or has never been surveyed;
- taxonomic gaps where, for example, previous surveys have concentrated on birds, mammals or vegetation but omitted amphibians and reptiles;
- ecological gaps where, for example, previous surveys have concentrated on forests but not native grasslands or heathlands;
- topographic gaps where, for example, surveys have concentrated on flat areas and ridges at the neglect of steep slopes or gullies;
- temporal and climatic gaps where, for example, studies have focused on surveys during a particular season at the omission of other conditions;
- climatic gaps where, for example, previous studies have been conducted during dry or wet conditions but not both; and
- reporting gaps and inconsistencies such as lack of discussion of potential impacts or species abundance, etc.

Due to the intrinsic nature of short-duration surveys, many gaps are likely to be identified. Identified gaps must be considered with the overall aims of the study and limitations associated with costs and time.

Table 3-5 documents the performance of the existing data and knowledge in relation to each type of gap reviewed. The table also indicates what measures may be required to instigate the filling of identified gaps.

Table 3-5 Status of Potential Gaps in Existing Knowledge for the MEP area

Gap type	Comments	Future Direction
Spatial gap	Database searches are based on a broad area. Results are unlikely to include records directly from the MEP area. However, previous surveys (Smith 2003, 2006) have covered the full extent of the current Project.	No work required for spatial gaps.
Taxonomic gap	There is no feasible way of establishing the exact location of database records and hence this data should be used for predictive purposes only. There are no obvious taxonomic gaps within current knowledge for vegetation communities or flora species. Previous fauna surveys on or near the MEP area (Smith 2003, 2004, 2006) did not make significant use of systematic survey methods, such as harp trapping, pitfall trapping or Elliott/cage trapping. Consequently, several groups of vertebrates are likely to be inadequately represented within the current vertebrate inventory. Threatened species that are difficult to detect without using adequate survey methods include: • Ornamental Snake (*Denisonia maculata*) • Brigalow Scaly-foot (*Paradelma orientalis*) • Northern Quoll (*Dasyurus hallucatus*)	Standard trapping techniques should be used to systematically survey areas of high-quality habitat. Particular priority should be given to areas of potential for significant species or contiguous habitat.
Ecological gaps	Previous work undertaken by Smith (2003, 2006) included most areas of non-remnant and remnant vegetation.	No work required for ecological gaps.
Topographic gaps	Smith (2003, 2006) assessed all areas within ML 70313, MDL 136 and MLA 70401 including jump-up areas, scree slopes and low-lying flood plains.	No work required for topographical gaps.
Temporal and climatic Gaps	The survey efforts of Smith (2006) was conducted during the wet season (February 2006) however, there are no details regarding the weather conditions leading up to, or during, the assessment. Two other assessments within or adjacent to the MEP area have been conducted during the dry season (Smith 2003) from June and October (Smith 2004). It is therefore difficult to identify potential climatic gaps. Given the paucity of amphibian species in previous assessments (only three common species found in Smith 2006), it is unlikely that significant rainfall was experienced within close proximity to the assessments. This may have affected not only the vertebrate inventory, but also the likelihood of the detection of those flora species (e.g., *Dicanthium* spp.) which are more obvious in favourable conditions. February is generally considered to be a good survey period as it usually coincides with high plant growth, increased reptile and amphibian activity and the presence of summer migrant birds.	Future survey work should attempt to coincide with recent rainfall or favourable conditions (e.g., February).

Gap type	Comments	Future Direction
Reporting gaps and inconsistencies	Previous assessment reports detailing the ecological significance of the MEP area are provided by Smith (2003, 2006). Generally, these reports are of a satisfactory standard with regard to reporting. They do, however, omit some important details including: • the meteorological conditions experienced during the survey, including any exceptional circumstances (e.g. prolonged drought); • descriptions of the identified REs, including any comments regarding their condition; • assessments of the potential distribution of EVR species (e.g., Little Pied Bat) or where EVR species were located during the survey; • assessment of potential EVR vertebrate species that might occur on site but were not detected during the survey; • vertebrate habitats present within the MEP area and their current condition; and • the importance of ecological processes such as corridors, weed invasion etc. The vegetation map provided in Smith (2003) differs from the RE map obtained from DERM. Whilst this is not an uncommon result (i.e., ground truthing an area is almost always more reliable than desktop data obtained from analysis of aerial photographs), the maps provided by Smith (2003) are not supported by survey data to justify the disparities between the DERM maps and Smith maps. Most significantly, the Smith (2003) map lacks a large area of Endangered vegetation in the south-western corner of the MEP area, while additional Endangered vegetation has been included in the mid-south of ML 70313. Changes to Endangered vegetation illustrated in the DERM maps should be supported by data, but is lacking within the reports. The north-west corner of the vegetation map by Smith (2003) lacks sufficient clarity to enable comparison with DERM mapping.	Future reports should address the identified reporting gaps. Field assessment for data collection (as detailed above) is considered necessary to achieve this goal and satisfy the requirements of the Terms of Reference for the Project EIS. The downgrading of an area that is currently mapped as Endangered by the DERM requires the collection of field data. As such, an on-site vegetation survey will need to be conducted to enable the generation of a current RE map for the whole of the MEP area.

4 FIELD ASSESSMENT METHODOLOGY

Field assessment methods have been specifically formulated to fill existing knowledge gaps and target terrestrial EVR flora and vertebrate species known from the local area. Field surveys were undertaken between the 23rd to the 31st (inclusive) of March 2009.

4.1 TERRESTRIAL FLORA

4.1.1 Survey design

Over a period of five (5) days, a targeted assessment of the existing vegetation communities across the MEP area was conducted. This assessment included recordings of the floristics, structure and condition of all vegetation communities present, including targeted searches for significant species.

4.1.2 Survey techniques

4.1.2.1 Desktop

High resolution colour aerial photography, certified RE mapping and geology maps were interrogated in order to delineate vegetation boundaries prior to the MEP area inspection. Unique Mapping Areas (UMAs) were produced for each distinct vegetation photo-pattern for ground-truthing.

Habitat preferences and species profiles were developed for EVR species known to be present within the locality. This information was used to target on-ground searches for EVR species and is included in **Table 5-5**.

4.1.2.2 Vegetation community descriptions

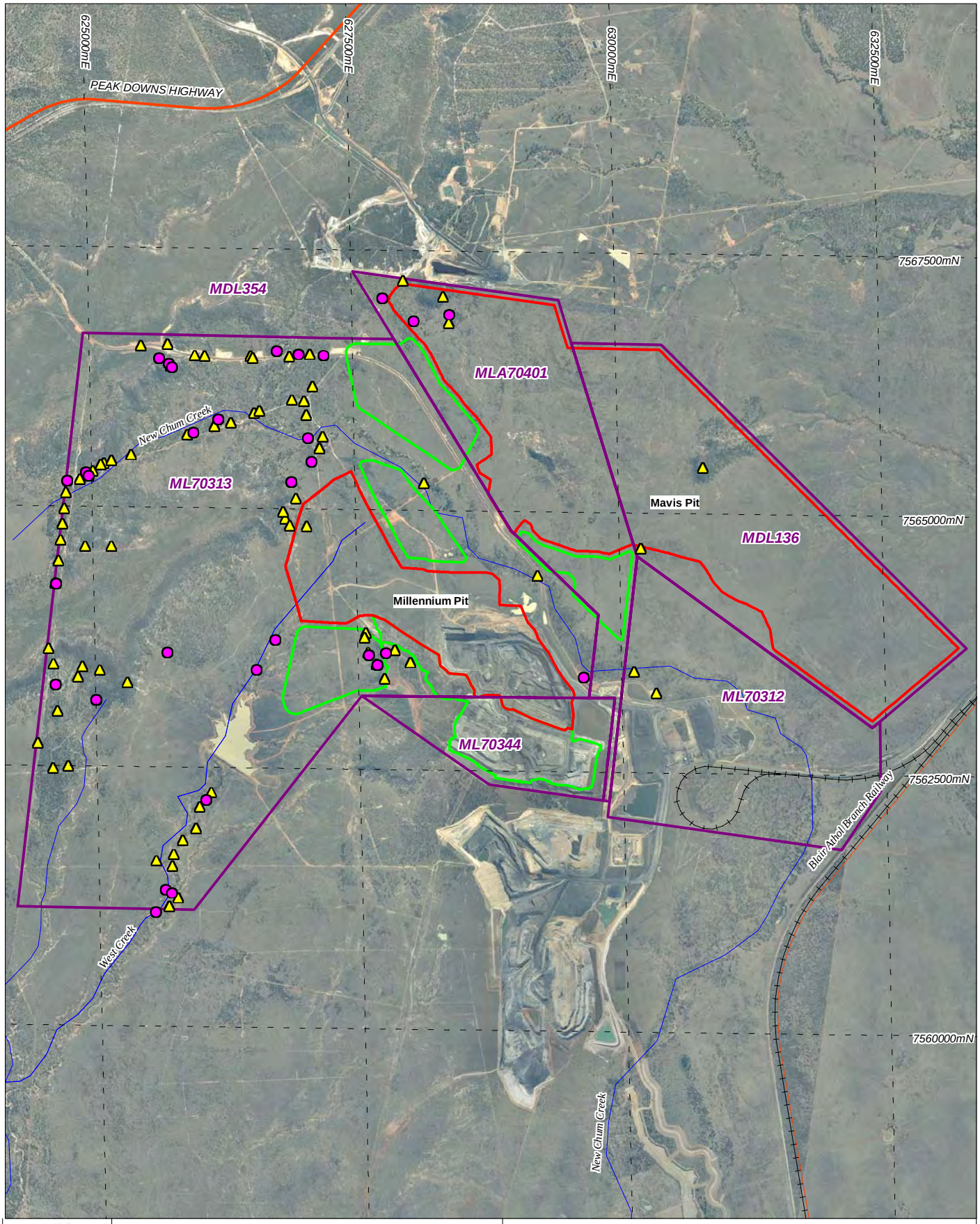
Field records of dominant and commonly occurring flora species within each vegetation stratum were recorded from representative UMAs across the MEP Area. Structure and floristics of the ecologically dominant layers (EDLs) were used to characterise individual communities. The community descriptions were derived from transects based on Herbarium Sheet F and D (Neldner *et al*. 2005). Community assessments were based on 31 tertiary-level and 75 quaternary-level assessments (Neldner *et al.* 2005) (**Figure 4-1**). Notes were also made on evidence of disturbance, weed infestations and general vegetation condition. Land zones for each UMA were ascribed in accordance with the DERM Regional Ecosystem Description Database (REDD). Regional Ecosystem equivalents were assigned to UMAs using site floristic data, observations on soil type, geological mapping and remnant/non-remnant status of the vegetation.

4.1.2.3 Condition assessment

Condition assessment was conducted using an adapted methodology based on '*Biocondition: A Terrestrial Vegetation Condition Assessment Tool for Biodiversity in Queensland Field Assessment Manual'* (Eyre *et al*. 2006). This methodology is primarily driven by assessment along set transect lines. In this instance, parameters from this methodology were assessed on a plot-less basis whilst traversing approximately 100 metres.

4.1.2.4 Significant species searches

Flora species considered to be Endangered, Vulnerable or Rare under either the EPBC Act or the NC Act that are known to occur within the vicinity were sourced from Wildlife Online and Environmental Reporting Tool searches. Habitat preferences were defined for these species in order to determine the likelihood of occurrence and to target areas for on-ground searches. On-ground searches for these species were undertaken specifically in areas of likely habitat and during vegetation mapping.



LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

Survey Site

- Quaternary Site
- Tertiary Site

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.

MET SERVE

Peabody

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Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Vegetation Assessment Sites

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 4-1

4.2 TERRESTRIAL VERTEBRATES

4.2.1 Survey design

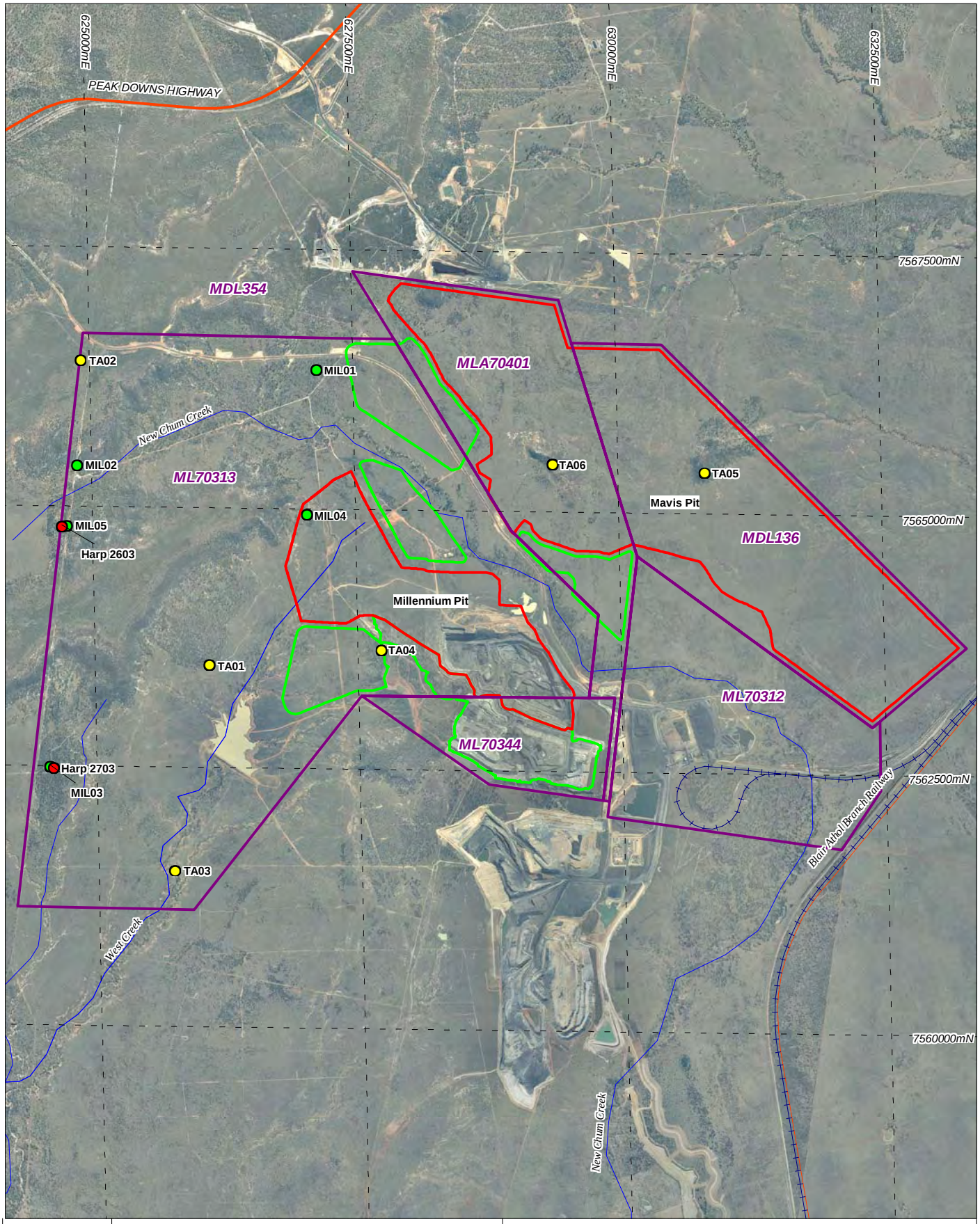
Vertebrate sampling and data collection was undertaken primarily at six systematic quadrats in general accordance with recommendations in DEC NSW (2004). The locations of systematic sites were selected through consideration of the identified gaps and a broad visual inspection of the MEP area (**Table 4-1**). Visual inspection allowed the consideration of factors such as access, spatial distribution, habitat types, habitat condition and the potential for EVR species.

Due to the size of MEP area, access limitations and the number of vegetation communities, data collected from the survey sites were supplemented by data collected at target locations. The inclusion of target sites allows the collection of data in spatially separate areas, ensuring the bulk of the MEP area is considered. Furthermore, the inclusion of data from target sites increases the overall vertebrate inventory. **Table 4-1** indicates the location of systematic sampling sites and all other sampling locations. Their locations are spatially represented in **Figure 4-2**.

Photos depicting habitat features at each systematic transect (survey sites) are provided in **Appendix C**.

Table 4-1 Sampling Locations and Habitats

Site	Latitude	Longitude	Habitat Type/characteristics	RE
Systematic Quadrats				
MIL01	-22.00111	148.23289	Woodland dominated by exotic grasses: Narrow leaved Ironbark canopy with some shrubs. Thick Buffel Grass ground cover.	11.5.2
MIL02	-22.00981	148.21078	Woodland with native understorey: Woodland with native understorey: Lancewood with emergent Eucalypts. Shrubs and dense grass cover interspersed by open patches.	11.7.2
MIL03	-22.03613	148.20801	Woodland dominated by exotic grasses: Mallee Box and Poplar Box canopy with scattered shrubs. Ground strata dominated by a mosaic of Buffel and native grasses.	11.5.2 (re-growth)
MIL04	-22.01373	148.23188	Woodland dominated by exotic grasses: Brigalow woodland with few shrubs and ground strata dominated by Buffel Grass	11.9.5
MIL05	-22.01513	148.20975	Woodland with native understorey: Mallee Box canopy with abundant shrubs. Ground cover includes native grasses and patches of open ground. Fallen debris is common.	11.7.3
Target Areas				
TA01	-22.03376	148.22178	Aquatic habitat (open permanent dam) surrounded by grasslands	Non-rem
TA02	-22.00066	148.21121	Scrubland with native understorey: Short mixed Acacia scrub.	Non-rem
TA03	-22.04494	148.21936	Creekline fringed by degraded Brigalow. Ground strata heavily infested with Buffel Grass.	11.9.10
TA04	-22.02539	148.23861	Rock outcrops with cliffs, rock fissures, crevices and overhangs. Canopy included Lancewood, *Corymbia*, *Eucalypt* and *Ficus* species. Native grass understorey.	11.5.9/ 11.7.2
TA05	-22.00938	148.26853	Woodland with native understorey: Eucalypt and Lancewood canopy with shrubs and native grasses. Broken rocky slopes with large boulders.	11.7.2
TA06	-22.00888	148.25455	Exotic Grassy Woodland: Eucalypt and Lancewood canopy with shrubs and native grasses. Large rock cliffs with fissures and overhangs.	11.7.2



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Disturbance
- MEP Waste Dump

Site Type

- Harp Trap
- Systematic Transect
- Target Area

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Vertebrate Sampling Sites

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 4-2

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While sampling at the systematic quadrats was repeated over the duration of the survey, sampling at each targeted location was restricted to one, or rarely two, sampling events and included only observational survey techniques such as searches, bird surveys and habitat assessment. Occasionally, harp trapping, Anabat call detection and spotlighting was included at target sites.

While this assessment attempted to survey and assess all REs, systematic sampling of each vegetation community is unwarranted for vertebrate surveys. Vertebrate species, and therefore vertebrate community compositions, are closely related to habitat structure and physical features (presence of rocks, fallen timber, shrub layer density, canopy density, etc) rather than canopy composition. Hence, vertebrate communities may overlap several RE types.

4.2.2 Survey techniques

Standard observational and capture techniques recommended for impact assessment and designed to sample all vertebrate groups were used during the survey (**Table 4-2**). While sampling aimed to provide a comprehensive terrestrial vertebrate inventory, it should be recognised that these results reflect a 'snap-shot' of community composition. Species that are rare, cryptic or move over large distances (e.g., migratory or nomadic species) may not be represented within the results. The final vertebrate inventory is likely to be larger than detected during this single survey event.

Table 4-2 Terrestrial Vertebrate Sampling Techniques

Method	Target Group/Species	Effort/Notes
Elliott A traps	Small mammals, some reptiles	Approximately 20 per systematic site for four nights
Pitfall traps	All small terrestrial vertebrates	Five buckets at each systematic site for five nights
Funnel traps	Some small and medium terrestrial vertebrates, predominantly reptiles	Four at each systematic site for five nights
Harp traps	Low flying microchiropteran (insectivorous) bats	Two traps for two nights—used only along potential flyways (two locations)
Anabat call detection	All microchipteran bats	Used at four locations
Diurnal bird surveys	All bird species	20 minutes/systematic site on two mornings
Spotlighting	Nocturnal vertebrates	20 minutes/systematic site + 30 minutes at TA04 + vehicle spotlighting (total 10 hrs)
Specific searches	Small terrestrial vertebrates	Effort commensurate with physical features. Used opportunistically throughout survey

Throughout the survey, habitats were assessed with relevance for vertebrate communities and EVR vertebrates. This included noting habitat factors such as the vegetation species present, hollow size and abundance, vegetation layer density and substrate type. Digital photos were extensively collected for later reference.

Opportunistic records of all vertebrate species were collected throughout the survey, particularly while traversing the MEP area.

4.3 Survey Timing and Conditions

The MEP survey was conducted during the end of the summer wet season from the 23rd to the 31st of March 2009 (inclusive). Temperatures ranged from low 30°C (average 31.8°C) during the day to mid-high teens (average 17.5°C) at night.

No rain fell during the survey and only 2.8 mm occurred during the month of March. Heavy rainfall occurred during February (238 mm) and surface water was still present in deeper sections of creeklines and waterways. Grass growth was prolific in response to the favourable conditions.

These conditions are considered suitable for the detection of all terrestrial flora and vertebrate species. However, some frog species are detectable only during rainfall. Such species are likely to be poorly represented in the survey results.

5 FLORA RESULTS

5.1 VEGETATION COMMUNITY DESCRIPTIONS

Vegetation community descriptions are provided in **Table 5-1** using data derived from site for dominant species within each structural layer, community condition, weed invasion, and approximate areas occupied by individual communities. The distribution of these communities across the MEP is shown in **Figure 5-1**.

At a scale of approximately 1:15,000, the MEP area contains 19 discrete vegetation communities (**Table 5-1**). Of these vegetation communities, 15 are remnant as defined under the provisions of the VM Act (Section 5.2), and equate to 11 different RE types.

The dominant vegetation community within the MEP area is pasture grasses on sands. This community is non-remnant under the VM Act and is not analogous to any threatened (endangered) ecological community as defined under the provisions of the EPBC Act. This vegetation community does however contain some areas where Brigalow and/or Poplar Box is regrowing within the pasture. Given sufficient canopy development, such areas may eventually be classified remnant vegetation. However, these regrowth areas are at an early stage of development, featuring generally low and sparse woody vegetation. Patches are not easily separated out from the surrounding pasture matrix.

5.1.1 Remnant vegetation communities (VM Act)

The north-western region of the MEP area is dominated by mesas comprised of residual laterite. The tops of these jump-ups have weathered to form deep, red earths of moderate to low fertility (land zone 5) supporting sparse woodlands dominated by Clarkson's Bloodwood (*Corymbia clarksoniana*). A similarly formed and vegetated mesa occurs in the south of the MEP area immediately adjacent to the over-burden dumps of the existing Millennium mining operation. This vegetation community is described here as '*Clarkson's Bloodwood tall woodland on red earths*' and is analogous to RE 11.5.9 (veg com 1; **Table 5-1**).

The steep sides of these mesas are characterised by skeletal soils and rocky scarps (land zone 7) dominated by Lancewood (*Acacia shirleyi*) open forest with occasional Queensland Peppermint (*Eucalyptus exserta*) and Napunyah (*Eucalyptus thozetiana*) as emergents. Several small jump-ups also occur in the eastern portion of the site with associated scree slopes. However, these jump-ups do not have deep red earth plateaux, but are narrow and covered by skeletal soils (land zone 7). These areas are again dominated by Lancewood open forests with occasional emergent eucalypts. This vegetation community is described here as '*Lancewood tall open forest on laterite and colluvium*' and is analogous with RE 11.7.2 (veg com 2; **Table 5-1**).

Due partially to inaccessibility and unsuitability for grazing, vegetation communities within these higher areas have not experienced past clearing or thinning and cattle grazing impacts are low. However, rabbit scats were prevalent and the understorey appears heavily modified by rabbit grazing. Regardless, native shrub and ground layers persist and consequently these vegetation communities are in better condition compared to others within the MEP area.

The mesa in the western portion of ML 70313 is skirted by colluvial scree slopes and narrow valley flats whose soils originate from colluvial materials (land zone 7). These shallow soils give rise to tall woodlands of Mallee Box (*Eucalyptus persistens*) and/or Brigalow woodlands described here as '*Mallee Box tall woodland on colluvium*' (veg com 3) and '*Brigalow tall woodland on colluvium*' (veg com 4). These communities are analogous to RE 11.7.3 and RE 11.7.1 respectively (**Table 5-1**). The Mallee Box community occurs within an exclusion area fenced from cattle and consequently has good native sub-canopy, shrub and ground layers. The Brigalow tall woodlands associated with the southern mesa are in poor condition as the sub-canopy, shrub and ground layers have been cleared for, and impacted by, grazing.

Deeply weathered sediments forming clayey sands (land zone 5) occur in a belt from the west of the MEP, extending around the southern margins of the mesas in the north-west and out to the north. These soils support tall woodlands dominated by Poplar Box (*Eucalyptus populnea*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). The understorey and ground layers of these communities have been cleared in the past for pasture improvement and are consequently in poor condition, dominated by

rank pasture grasses, notably Buffel Grass (*Pennisetum ciliare*). These vegetation communities are described here as '*Poplar Box tall woodland on deeply weathered sediments'* (veg com 5) and '*Narrow leaved ironbark tall woodland on deeply weathered sediments*' (veg com 6). These are analogous to RE 11.5.3 and RE 11.5.2, respectively (**Table 5-1**).

Riparian vegetation associated with New Chum Creek bisects the MEP in a north–south direction. In the north, the canopy of this vegetation community is dominated by emergent Dawson Gum (*Eucalyptus cambageana*) with a sub-canopy of Brigalow, Yellowwood (*Terminalia oblongata*) and Queensland Ebony (*Lysiphyllum carronii*) on deeply weathered sands (Land zone 5). This vegetation community is described here as '*Tall riparian open forest on deeply weathered soils*' (veg com 7) and is analogous with RE 11.5.3. This narrow linear community exhibits well developed native sub-canopy and shrub layers, however ground layers are impacted by cattle grazing and weed invasion.

In the central plains this community is associated with primary sandy clays emanating from Triassic arenite mudrock (land zone 9). In this region the Dawson Gum forms a dominant open forest canopy with Moreton Bay Ash (*Corymbia tessellaris*), River Red Gum (*Eucalyptus camaldulensis*) and Narrow-leaved Ironbark occasional throughout. This vegetation community is described here as '*Dawson Gum tall riparian open forest on sands*' (veg com 8) and is analogous with RE 11.9.1. The sub-canopy of a small patch of this community is dominated by Brigalow and as such has been delineated and described as '*Brigalow tall riparian open forest on sands'* (veg com 10). This vegetation community is analogous to RE 11.9.1. This narrow linear community exhibits well developed native sub-canopy and shrub layers, however ground layers are impacted by cattle grazing and some weed invasion.

In the south of the MEP area New Chum Creek cuts through tertiary alluvial soils (land zone 3) and in this region the dominant canopy trees change to River Red Gum. The community is described here as '*Tall riparian open forest on alluvial soils'* (veg com 9) and is analogous to RE 11.3.25. There are some alluvial flats associated with New Chum Creek at the very south of the MEP area. These flats are dominated by Poplar box woodland and described here as '*Poplar Box tall woodlands on alluvial soils'* (veg com 11). This community is analogous to RE 11.3.2.

A very narrow band of vegetation associated with the creek line draining from the west dam forms woodland dominated by Poplar Box, Brigalow, Yellowwood and White-flowered Bauhinia (*Lysiphyllum hookeri*). Again this creek line is cutting through the original surface and shows no sign of sediment deposition (land zone 9). This vegetation is highly disturbed and, in places, extremely narrow. However, it is visible from aerial photography and generally greater than 35 m wide and should be considered 'remnant' according to the VM Act (Neldner *et al*. 2005: p. 33). This vegetation community is described here as '*Tall riparian woodland on sands*' (veg com 12) and analogous to RE 11.9.10.

Two very small patches of large mature Dawson Gum remain immediately north of the west dam on clayey sands formed from Triassic arenite mudrock (land zone 9). All other native vegetation associated with these canopy trees have been removed for pasture improvement. However again there is a sufficient area of these trees to be regarded as 'remnant' according to the VM Act (Neldner *et al*., 2005: p. 33). This vegetation community is described here as '*Dawson Gum tall woodland on sands*' (veg com 13) and is analogous to RE 11.9.1.

Two patches of remnant Brigalow woodland occur on sands derived from Triassic arenite mudrock at the base of the north mesa. These two patches have been cleared of sub-canopy, shrub and ground layers, with the ground flora being dominated by Buffel grass. This vegetation community is described here as *'Brigalow tall woodland on sands*' (veg com 14) and analogous to RE 11.9.5.

One small patch of Mountain Coolabah (*Eucalyptus orgadophila*), persists in the far north of the project area. Occurring on clayey sands originating from sandstone rocks, this vegetation community is described here as "*Mountain Coolabah on tall woodland on sands*" (veg com 15) and analogous to RE 11.9.3.

5.1.2 Non-remnant vegetation communities (VM Act)

The deep red earth (land zone 5) on the northwestern-most plateau on the MEP area has been cleared in the past and now supports a dense stand of Catkin Wattle (*Acacia julifera*) at a near uniform height. This area is described here as '*Catkin Wattle regrowth on red earths'* (veg com 16). This community should not be considered remnant.

An area of deeply weathered sediments in the northern-most portion of the site has been cleared in the past and now supports young regrowth dominated by a mixture of eucalypt species with a diverse range of species in the sub-canopy and shrub layers. This vegetation community is described here as '*Ironbark–Dawson gum regrowth on sands*' (veg com 17). Due to past clearing, it is considered to be non-remnant.

Dominated by young Mallee Box and Poplar box, this area of regrowth occurs on deeply weathered sands. Some mature individual Mallee Box, Poplar Box and Leichhardt Bean *(Cassia brewsteri*) are scattered throughout. The shrub layer and is very sparse whilst the ground layer is dominated by Buffel Grass. This community is described here as '*Mallee Box–Poplar Box regrowth on deeply weathered sands*' (veg com 18).

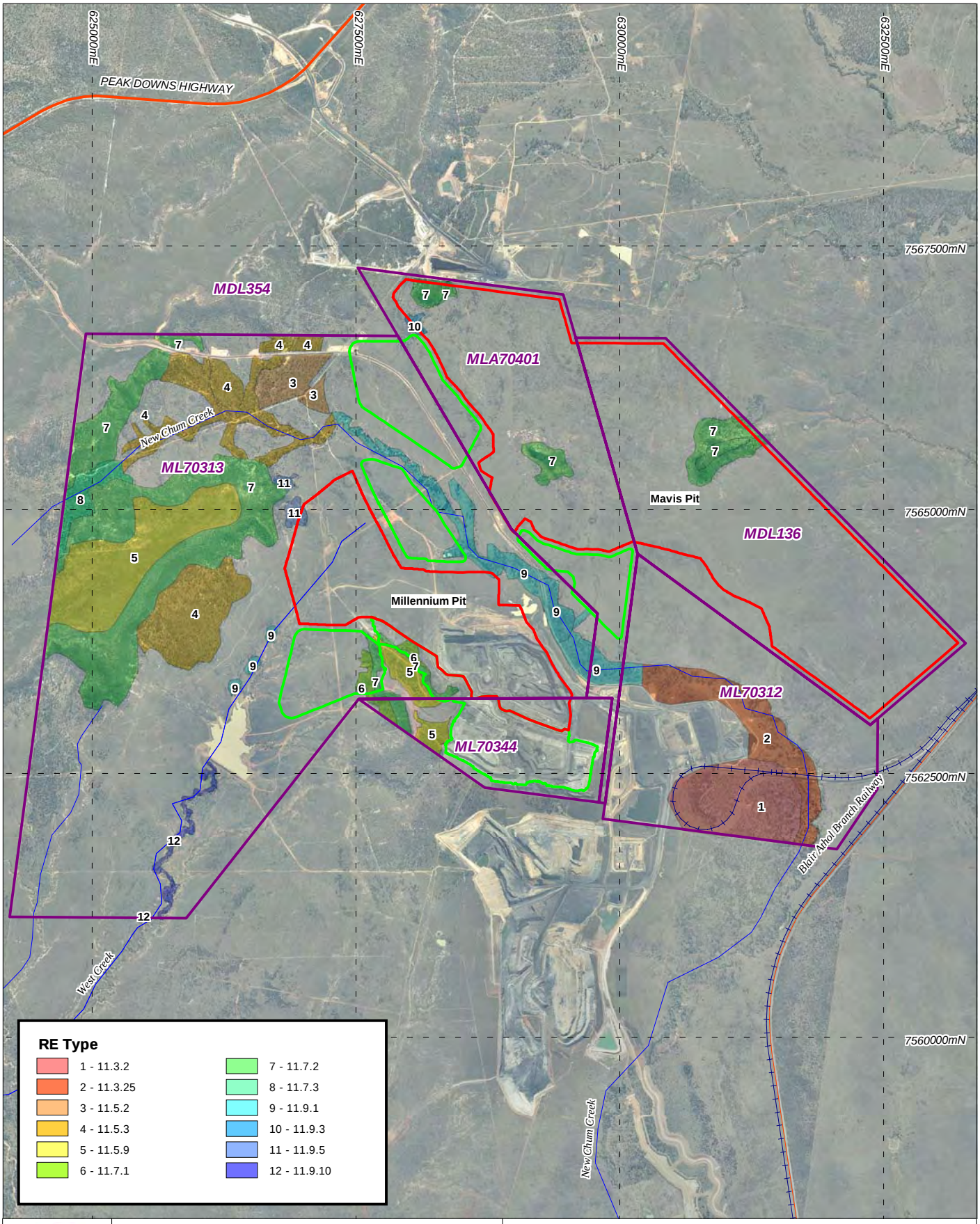
The majority of the MEP area is dominated by clayey sand flats and Permian sandstones (land zone 9). These flats have been extensively cleared for pasture and are now a mosaic of Buffel Grass pasture and patches of low regrowth dominated by Poplar Box and/or Brigalow. This vegetation community is described here as '*Pasture grasses on sands*' (veg com 19).

5.1.3 Vegetation Communities and Regional Ecosystem Classification

Table 5-2 assigns RE equivalents to the extant vegetation communities using site floristic data, observations on soil type, geological mapping and remnant/non-remnant status of the vegetation. A summary of the areas of individual regional ecosystems and their VM Act status is also provided in **Table 5-2**. A map showing the distribution of these REs according to their VM Act status is presented in **Figure 5-2**.

In summary, 844 ha of vegetation within the MEP area is remnant. Of this 668 ha is considered to be Not of Concern, 90 ha is Of Concern and 86 ha is Endangered (**Table 5-2**).

Of the extant endangered REs within the MEP, 87.3% (74.8 ha) is assigned to the riparian vegetation associated with New Chum Creek. The remainder is assigned to scattered small patches of Dawson Gum and Brigalow in the west.



LEGEND

- MEP Tenement
- MEP Pit
- Highway
- MEP Dump
- Road
- Railway
- Watercourse

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.
Revised RE Mapping - BAAM.

MET SERVE

Peabody

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Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Revised RE Mapping (RE Type)

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 5-1

Table 5-1 Vegetation Communities of the MEP Area

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
1	**Clarkson's Bloodwood tall woodland on red earths** Height of EDL*: **24 m** Canopy Cover: **43%** Area of community within Project Boundary: **126 ha**	11.5.9 (Not of Concern)	Emergent: Absent Canopy (T1): **(20–28 m; av. 24 m**) The sparse canopy is dominated by a mix of *Corymbia clarksoniana*, *C. dallachiana*, and *Eucalyptus crebra* with all species locally dominating to forms stands of patches. Sub-Canopy (T2): **(4–14 m; av. 9 m)** The sparse to mid-dense sub-canopy is dominated by a mix of *Corymbia tessellaris*, *Alphitonia excelsa*, *Petalostigma pubescens*, *Melaleuca viridiflora* with all species locally dominating to form stands or patches. Shrub Layers: **(0.5–4 m; 2 m)** The sparse to mid-dense shrub layer is dominated by *Trema tomentosa*, *Acacia leiocalyx* and *Petalostigma pubescens*. Ground Layer: **(0–1.5 m; 0.9)** Ground strata generally in good condition, native grasses dominate including *Aristida calycina, Enteropogon acicularis*, and *Eragrostis brownii*. *Melinis repens* has invaded in patches. Notes: Occurs on large flat plains on top of mesas. This community has been less impacted by cattle grazing and clearing for improved pastures. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Bertya pedicellata*.	
2	**Lancewood tall open forest on laterite and colluvium** Height of EDL: **13 m** Canopy Cover**: 37%** Area of community within Project Boundary: **269 ha**	11.7.2 (Not of Concern)	Emergent: **24 (20 – 28 m)** where present the emergent layer is dominated by *Eucalyptus thozetiana* and *E. exserta* Canopy (T1):.**13 (10 – 24 m)** Almost entirely dominated by *Acacia shirleyi* Sub-Canopy (T2): **7 (2 – 11 m)** Where present the sparse sub-canopy is dominated by *Acacia shirleyi*, *Alphitonia excelsa* and *Alstonia constricta*. Shrub Layers: **1.6 (0.5 – 3 m)** The sparse to mid-dense shrub layer is dominated by *Acalypha eremorum*, *Geijera parviflora, Bertya oleifolia, Phebalium glandulosum* and *Erythroxylum australe.* Ground Layer: **0.4 (0 – 1.4 m)** The patchy ground layer is dominated by areas of skeletal soils and rocks interspersed with native grasses, including *Enteropogon acicularis, Tragus australianus, Paspalidium distans, Aristida lapathifolia, Calyptochloa gracillima* and *Aristida caput-medusae*. Where present, herbs are dominated by *Enchylaena tomentosa, Sida retusa* and *Hibiscus sturtii*. Notes: The remote, inaccessible nature of this vegetation community means that impacts from clearing and grazing are minimal. The ground layers are predominantly native and fallen woody debris is abundant. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Cerbera dumicola* is known to occur in the MEP area within this vegetation type. *Bertya pedicellata* has the potential to be present.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
3	**Mallee Box tall woodland on colluvium** Height of EDL: **18 m** Canopy Cover: **35%** Area of community within Project Boundary: **19 ha**	11.7.3 (Not of Concern)	Emergent: Absent Canopy (T1): **18 (12 – 28 m)** The mid-dense canopy is dominated by *Eucalyptus persistens* with very occasional *E. cambageana* and *Terminalia oblongata* associated with creek lines. Sub-Canopy (T2): **9 (6 – 12 m**) The mid-dense sub-canopy is dominated by *Eucalyptus persistens* with patches of *Acacia harpophylla* and *Terminalia oblongata* locally dominant along creek lines. Shrub Layers: **2.2 (0.5 – 4 m)** Sparse to mid-dense shrub layer characteristically includes *Alectyon diversifolius, Alstonia constricta, Breynia oblongifolia, Carissa ovata, Acalypha eremorum* and *Grewia latifolia*. Ground Layer: **0.9 (0 – 2 m)** Notes: This community occurs on colluvial/deeply weathered sediments between the two jump-ups in the north of the site. Much of it occurs within a fenced area and subsequently has well developed shrub and native ground layers. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Bertya pedicellata*.	
4	**Brigalow tall woodland on colluvium** Height of EDL:**15.5 m** Canopy Cover: **37%** Area of community within Project Boundary: **10 ha**	11.7.1 (Not of Concern)	Emergent: Absent Canopy (T1):.**15.5 (12 – 20 m)** the sparse canopy is dominated by *Acacia harpophylla* with occurrences *of Eucalyptus thozetiana or Eucalyptus persistens* (in the north of the MEP area). Sub-Canopy (T2): **10 (8 – 12m)** The sparse to very sparse sub-canopy is dominated by *Acacia harpophylla* and *Terminalia oblongata.* Shrub Layers: **1 (0.5 - 1.5 m)** The sparse to very sparse shrub layer is dominated by *Eremophila mitchellii, Carissa ovata* and *Enchylaena tomentosa*. Ground Layer: **0.6 (0 – 1.2 m)** The mid-dense ground layer is a mosaic of stony bare earth and patches of grasses including *Pennisetum ciliare, Aristida lapathifolia* and *Megathyrsus maximus.* Notes: occurs on lower slopes of jump-ups on colluvial scree Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Bertya pedicellata*.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
5	**Poplar Box tall woodland on deeply weathered sediments** Height of EDL: **18 m** Canopy Cover: **53%** Area of community within Project Boundary: **85 ha**	11.5.2 (Not of Concern)	Emergent: Absent Canopy (T1):.**18 (12 – 24 m)** dominated by *Eucalyptus populnea*, *E. crebra* is often present. Sub-Canopy (T2): **8.8m (1.5 – 16 m)** Where present, the sparse sub-canopy is dominated by *Alphitonia excelsa*, *Acacia harpophylla*, *Cassia brewsteri* and *Eucalyptus persistens* on margins of this community. Shrub Layers: **0.8m (0.4 – 6 m)** The upper shrub layer varies between very sparse to mid-dense being dominated by *Alphitonia excelsa*, *Breynia oblongifolia*, *Bursaria spinescens*, *Grewia latifolia* and *Carissa ovata*. Ground Layer: **0.6m (0 – 1.5 m)** The mid-dense to dense grassy understorey is dominated by *Pennisetum ciliare*, with occurrences of *Heteropogon contortus*, *Sida retusa* and *Hibiscus sturtii*. Notes: The shrub and ground layers have been cleared and grazing pressure and pasture improvement has led to the dominance of *Pennisetum ciliare*. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Desmodium macrocarpum*.	
6	**Narrow-leaved Ironbark tall woodland on deeply weathered sediments** Height of EDL: **15 m** Canopy Cover: **43%** Area of community within Project Boundary**: 27 ha**	11.5.3 (Not of Concern)	Emergent: Absent Canopy (T1):.**15 (6 – 26 m)** dominated by *Eucalyptus crebra*, *Corymbia clarksoniana* and *C. dallachiana* are occasionally present in the canopy. Sub-Canopy (T2): **4.5 (2 -12m)** where present, the sparse sub-canopy is dominated by *Acacia leiocalyx*, *Alphitonia excelsa* and *Petalostigma pubescens*. Shrub Layers: **1.8 (0.3 – 4m)** The sparse to very sparse shrub layer is dominated by *Carissa ovata*. Ground Layer: **0.7 (0 – 1.2m)** The mid-dense to dense grassy understorey is dominated by *Pennisetum ciliare* with occurrences of *Heteropogon contortus*, *Sida retusa, Stylosanthes scabra* and *Hibiscus sturtii*. Notes: The shrub and ground layers have been cleared and grazing pressure and pasture improvement has led to the dominance of *Pennisetum ciliare*. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Desmodium macrocarpum*..	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
7	**Tall riparian open forest on deeply weathered soils** Height of EDL: **15 m** Canopy Cover: **63%** Area of community within Project Boundary: **59 ha**	11.5.3 (Not of Concern)	Emergent: Absent Canopy (T1): **15 (12 – 22 m)** The sparse to mid-dense canopy is dominated by *Eucalyptus cambageana, Eucalyptus populnea* and patches of *Acacia harpophylla.* Sub-Canopy (T2): **8 (6 – 12 m)** The sparse sub-canopy is dominated by a mixture of *Terminalia oblongata, Lysiphyllum caronii, Acacia leiocalyx* and patches of *Acacia harpophylla*. Shrub Layers: **1.7 (1 -3 m)** The very sparse to sparse shrub layer is dominated by *Alstonia constricta* and *Hovea longipes.* Ground Layer: **0.6 (0 – 1.5 m)** The dense ground layer is dominated by the exotic grass *Megathyrsus maximus* and the native grass *Heteropogon contortus*. Notes: This community is an extension of the Dawson Gum tall riparian open forest that dominates New Chum Creek. In this area, however, it occurs on deeply weathered sediments (land zone 5). Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely observed.	
8	**Dawson Gum tall riparian open forest on sands** Height of EDL: **22 m** Canopy Cover**: 53%** Area of community within Project Boundary: **132 ha**	11.9.1 (Endangered)	Emergent: Absent Canopy (T1): **22 (18 – 28 m)** The sparse to mid-dense canopy is dominated by *Eucalyptus cambageana* with occurrences, some locally dominant, of *E. populnea, Corymbia tessellaris* and *E. camaldulensis.* Sub-Canopy (T2): **13 (10 – 16 m)** The sparse sub-canopy is dominated by juvenile eucalypts characteristic of the canopy and *Lysiphyllum caronii* and *Terminalia oblongata*. Shrub Layers: **3 (0.5 – 6 m)** The sparse to mid-dense shrub layer is dominated by a mixture of *Lysiphyllum caronii, Alstonia constricta* and *Acalypha eremorum*. The lower shrub layer is dominated by *Breynia oblongifolia*. Ground Layer: **0.6 (0 – 1.5 m)** Herbs and forbs within this layer include *Ludwigia octovalvis* and *Cyperus exaltatus*, whilst the grasses are dominated by *Megathyrsus maximus* and *Brachiaria decumbens*. Notes: This community has not been thinned and is structurally and floristically in good condition. Some degradation has occurred through cattle accessing water. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
9	**Tall riparian open forest on alluvial soils** Height of EDL: **24 m** Canopy Cover: **<60%** Area of community within Project Boundary: **70 ha**	11.3.25 (Not of Concern)	Emergent: Absent Canopy (T1):.**24 (22 – 28 m)** The sparse canopy is dominated by *Eucalyptus camaldulensis* with occurrences of *E. cambageana* and *Corymbia tessellaris*. Sub-Canopy (T2): Not present Shrub Layers: **3 (2 – 6 m)** The mid-dense shrub layer is dominated by *Hovea longipes, Diospyros humilis, Ehretia membranifolia, Eremophila* sp. and *Cyclophyllum coprosmoides*. Ground Layer: **1 (0 – 1.75 m** The dense ground layer is dominated by *Megathyrsus maximus* with occurrences of *Bothriochloa bladhii*. Notes: The alluvial soils that support this community are relatively fertile and some agricultural weeds such as *Megathyrsus maximus* dominate the ground layer. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	
10	**Brigalow tall riparian open forest on sands** Height of EDL:**14 m** Canopy Cover: **45%** Area of community within Project Boundary:**11 ha**	11.9.1 (Endangered)	Emergent: Absent Canopy (T1): **14 m (12 – 18 m)** The sparse canopy is dominated by *Eucalyptus cambageana*. There are occurrences of *Corymbia tessellaris*. Sub-Canopy (T2): **8 (6 – 11 m)** The mid-dense sub-canopy is dominated by *Acacia harpophylla* with occurrences of *Lysiphyllum caronii* and *Terminalia oblongata*. Shrub Layers: **2 (1 – 4 m)**. The mid-dense shrub layer is dominated by *Geijera parviflora* and *Lysiphyllum caronii.* Ground Layer: **0.5 (0 – 0.8)** the mid-dense to sparse ground layer is dominated by *Pennisetum ciliare*. Notes: This vegetation community exhibits a local dominance in *Acacia harpophylla* within the sub-canopy, and is actually a sub-community of the Dawson gum tall riparian open forest. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
11	**Poplar Box tall woodlands on alluvial soils** Height of EDL**: <16 m** Canopy Cover: **<40%** Area of community within Project Boundary: **79 ha**	11.3.2 (Of Concern)	Emergent: Absent Canopy (T1): The sparse canopy is dominated by *Eucalyptus populnea.* Sub-Canopy (T2): the very sparse sub-canopy is dominated by *Eucalyptus populnea* with occurrences of *Terminalia oblongata* and *Lysiphyllum caronii*. Shrub Layers: very sparse Ground Layer: the dense ground layer is dominated by *Pennisetum ciliare* with patches of *Megathyrsus maximus*. Notes: Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: *Desmodium macrocarpum*	
12	**Tall riparian woodland on sands** Height of EDL: **8 m** Canopy Cover: **37%** Area of community within Project Boundary: **11 ha**	11.9.10 (Of Concern)	Emergent: **24 (20 – 25 m)** Where present, *Eucalyptus populnea* dominates the emergent layer Canopy (T1): **8 (6 – 12 m)** The sparse to very sparse canopy is variously dominated by *Eucalyptus populnea, Acacia harpophylla* and *Terminalia oblongata*. Sub-Canopy (T2): The sub-canopy is generally absent Shrub Layers: **2 (1 – 3 m)** The very sparse to sparse shrub layer is dominated by *Lysiphyllum caronii* and *Terminalia oblongata*. Ground Layer: **0.5 (0 – 1 m)** The dense ground layer is dominated by *Pennisetum alopecuroides, Megathyrsus maximus* and *Pennisetum ciliare*. Notes: This community is confined in its entire length to within the bed and banks of the creek line. Past clearing has removed all remnant vegetation to the top-of-bank. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

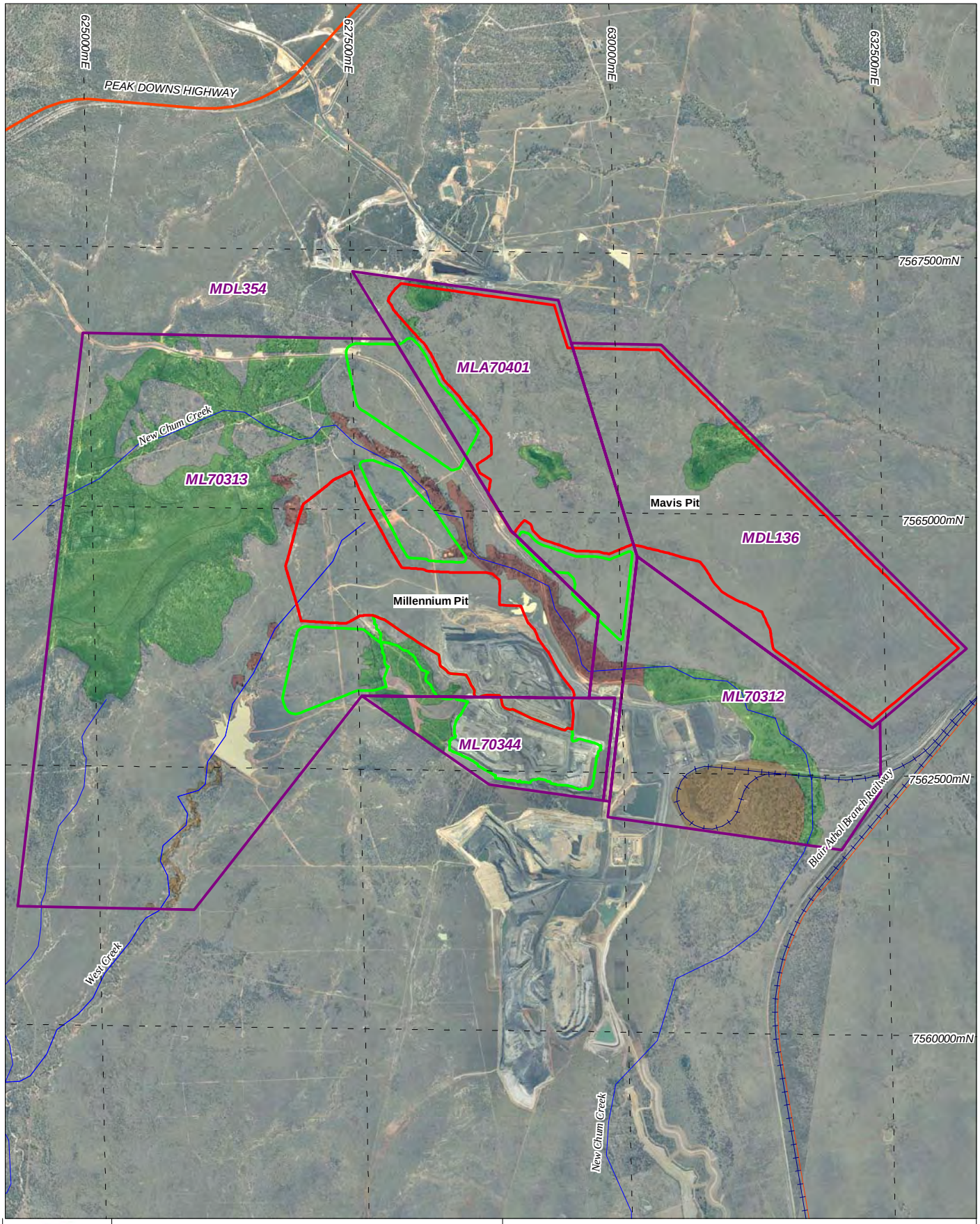
No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
13	**Dawson Gum tall woodland on sands** Height of EDL: **19.5 m** Canopy Cover: **39%** Area of community within Project Boundary: **4 ha**	11.9.1 (Endangered)	Emergent: Absent Canopy (T1): **19 (15 – 25 m)** The sparse canopy is entirely dominated by *Eucalyptus cambageana*. Sub-Canopy (T2): **6 (3 – 8 m)** The very sparse sub-canopy where it occurs is dominated by *Eucalyptus cambageana* and *Acacia harpophylla*. Shrub Layers: **1.5 (1 – 2 m)** The very sparse shrub layer where it occurs is dominated by regrowth *Eucalyptus cambageana* and *Acacia harpophylla.* Ground Layer: **0.5 (0 – 1 m)** The dense ground layer is dominated by *Pennisetum ciliare*. Notes: Essentially this community consists of patches of remnant canopy trees. All other native vegetation has been cleared from this community for pasture improvement. Weeds of Concern: No weeds of immediate concern within this community. Possible EVR Species: None likely	
14	**Brigalow tall woodland on sands** Height of EDL: **16 m** Canopy Cover: **57%** Area of community within Project Boundary: **7 ha**	11.9.5 (Endangered)	Emergent: Absent Canopy (T1): **16 (14 – 18 m)** *Acacia harpophylla* Sub-Canopy (T2): Absent Shrub Layers: Absent Ground Layer: The dense ground layer is dominated by *Pennisetum ciliare*. Notes: This community has been cleared of sub-canopy and shrub layers to improve pastures. However, the canopy structure remains. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
15	**Mountain Coolabah tall woodland on sands** Height of EDL: **15 m** Canopy Cover: **<40%** Area of community within Project Boundary**: 2 ha**	11.9.3 (Not of Concern)	Emergent: Absent Canopy (T1): **15 (12 – 20 m)** The sparse to mid-dense canopy is dominated by *Eucalyptus orgadophila*. Sub-Canopy (T2): absent Shrub Layers: **1.6 (0.5 – 2 m)** The very sparse shrub layer is dominated by *Alstonia constricta* and *Carissa ovata.* Ground Layer: **0.5 (0 – 0.8 m)** the dense ground layer is dominated by *Pennisetum ciliare* with occurrences of *Stylosanthes scabra* and small patches of the native grass *Dichanthium sericeum*. Notes: This small patch of remnant trees has lost all other native elements through clearing for grazing. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	
16	**Catkin Wattle regrowth on red earths** Height of EDL: **4 m** Canopy Cover: **<70%** Area of community within Project Boundary: **31 ha**	Non-remnant	Emergent: Absent Canopy (T1): **4 m (2 – 6 m)** *Acacia julifera* Sub-Canopy (T2): Absent Ground Layer: The dense grass understorey is dominated by native grass species including *Eragrostis speciosa, E. leptocarpa,, E. brownii* and *Aristida calycina*. Notes: This community is a near monoculture of evenly aged Acacias and is a response to broad-scale clearing. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
17	**Ironbark–Dawson Gum regrowth on sands** Height of EDL: **8 m** Canopy Cover: **<20%** Area of community within Project Boundary: **17 ha**	Non-remnant	Emergent: Absent Canopy (T1): **8 (6 – 10 m)** The sparse canopy is dominated by an even mix of *Eucalyptus crebra*, *E. cambageana* and *Acacia harpophylla* with occurrences of *Corymbia clarksoniana*. Sub-Canopy (T2): **3 (2 – 5 m)** The sparse sub-canopy is dominated by *Alphitonia excelsa* and *Acacia leiocalyx* with occurrences of *Petalostigma pubescens*. Shrub Layers: **0.5 (0.3 – 1 m)** The very sparse shrub layer is dominated by *Carissa ovata* and *Stylosanthes scabra*. Ground Layer: **0.5 (0 – 0.8 m)** The dense ground layer is dominated by *Pennisetum ciliare*. Notes: There is a complete absence of large, mature, 'remnant' trees within this community. Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	
18	**Mallee Box–Poplar box regrowth on deeply weathered sands** Height of EDL: **6 m** Canopy Cover**: < 20%** Area of community within Project Boundary**: 61 ha**	Non-remnant	Emergent: **22 (20 – 24 m)** very occasional mature *Eucalyptus persistens* or *E. populnea* Canopy (T1): **8 (6 – 10 m)** *Eucalyptus persistens* or *E. populnea*. This canopy is very patchy and ranges from very sparse to mid-dense. Sub-Canopy (T2): absent Shrub Layers: 1 **(0 – 2 m)** The very sparse shrub layer includes *Carissa ovata* and *Breynia oblongifolia*. Ground Layer: Dense ground cove dominated by *Pennisetum ciliare* Notes: Weeds of Concern: No weeds of immediate concern observed within this community. Possible EVR Species: None likely.	

No	Description	Analogous RE (VM Act status)	Dominant Species	Photograph
19	**Pasture grasses on sands** Height of EDL: **0.5 m** Canopy Cover**: >70%** Area of community within Project Boundary**: 2,220 ha**	Non-remnant	Emergent: Absent Canopy (T1): Absent Sub-Canopy (T2): Absent Shrub Layers: Where present, the shrub layer can be sparse to mid-dense and between 0.5 and 6 m in height. *Eucalyptus populnea* and *Acacia harpophylla* either co-occur or individually dominate the shrub layer. Ground Layer: The dense ground layer is dominated by *Pennisetum ciliare* with very occasional patches of native grasses such as *Dichanthium sericeum, Bothriochloa decipiens* and *Eragrostis brownii.* Notes: Weeds of Concern: No weeds of immediate concern within this community. Possible EVR Species: None likely	

* EDL = Ecologically Dominant Layer



LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

VM Act Status

- Endangered
- Of Concern
- Not of Concern

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.
Revised RE Mapping - BAAM.

MET SERVE

Peabody

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Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Revised RE Mapping (VM Act Status)

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 5-2

Table 5-2 Vegetation community and RE equivalency

No	Description	Underlying Geology	Land Zone	Analogous RE (VM Act Status)	Area (ha)
1	Clarkson's Bloodwood tall woodland on red earths	Arenite Mudrock (Colluvium)	5	11.5.9 (Not of Concern)	126.1
2	Lancewood tall open forest on laterite and colluvium	Arenite Mudrock (Colluvium)	7	11.7.2 (Not of Concern)	269.8
3	Mallee Box tall woodland on colluvium	Arenite Mudrock (Colluvium)	7	11.7.3 (Not of Concerns)	19.0
4	Brigalow tall woodland on colluvium	Arenite mudrock (Colluvium)	7	11.7.1 (Not of Concern)	10.3
5	Poplar box tall woodland on deeply weathered sediments	Arenite Mudrock (unconsolidated sediments)	5	11.5.2 (Not of Concern)	85.4
6	Narrow leaved ironbark tall woodland on deeply weathered sediments	Arenite Mudrock (unconsolidated sediments)	5	11.5.3 (Not of Concern)	26.8
7	Tall riparian open forest on deeply weathered soils	Arenite Mudrock (unconsolidated sediments)	5	11.5.3 (Not of Concern)	58.9
8	Dawson gum tall riparian open forest on sands	Sedimentary Rock	9	11.9.1 (Endangered)	63.4
9	Tall riparian open forest on alluvial soils	Tertiary – Quaternary Alluvials (Herbarium pers. comm.)	3	11.3.25 (Not of Concern)	69.7
10	Brigalow tall riparian open forest on sands	Sedimentary Rock	9	11.9.1 (Endangered)	11.4
11	Poplar box tall woodlands on alluvial soils	Tertiary – Quaternary Alluvials (Herbarium pers. comm.)	3	11.3.2 (Of Concern)	79.1
12	Tall riparian woodland on sands	Arenite Mudrock	9	11.9.10 (Of Concern)	10.6
13	Dawson gum tall woodland on sands	Arenite Mudrock	9	11.9.1 (Endangered)	4.0
14	Brigalow tall woodland on sands	Arenite Mudrock	9	11.9.5 (Endangered)	6.8
15	Mountain Coolabah tall woodland on sands	Arenite Mudrock	9	11.9.3 (Not of Concern)	2.3
16	Catkin wattle regrowth on red earths	Arenite Mudrock (Colluvium)	5	Non-remnant	31.3
17	Ironbark–Dawson gum regrowth on sands	Arenite Mudrock	9	Non-remnant	17.2
18	Mallee Box regrowth on deeply weathered sands	Arenite Mudrock (unconsolidated sediments)	5	Non-remnant	60.9
19	Pasture grasses on sands	Arenite Mudrock/ Sedimentary Rock	9	Non-remnant	2,084.5

5.1.4 Threatened Ecological Communities

Vegetation communities listed in **Table 5-3** are considered to be the endangered ecological community (EEC) 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' (EPBC Act). This community occupies approximately 85.7 ha. The distribution of the EEC across the MEP Area corresponds to the total of those REs identified as endangered under the VM Act in **Table 5-2**.

Table 5-3 Threatened Ecological Communities within the MEP Area

No	Description	Analogous RE (VM Act Status)	Threatened Ecological Community (EPBC Act 1999)	Area (ha)
8	Dawson gum tall riparian open forest on sands	11.9.1 (Endangered)	Brigalow (*Acacia harpophylla* dominant and co-dominant.	63.4
10	Brigalow tall riparian open forest on sands	11.9.1 (Endangered)	Brigalow (*Acacia harpophylla* dominant and co-dominant	11.4
13	Dawson gum tall woodland on sands	11.9.1 (Endangered)	Brigalow (*Acacia harpophylla* dominant and co-dominant	4.0
14	Brigalow tall woodland on sands	11.9.5 (Endangered)	Brigalow (*Acacia harpophylla* dominant and co-dominant	6.8
Total area				**85.7**

5.2 SIGNIFICANT FLORA SPECIES

5.2.1 Observed and Potential EVR Species

Previous survey work within the MEP area by Smith (2003) identified the presence of *C. dumicola.* This species is listed as rare under the NC Act. No EVR flora species under the EPBC Act were observed within the MEP area during the current or previous surveys. The habitat preferences for the seven EVR plants known to occur within the local area are presented in **Table 5-4**. Field observations of the habitats types have been used to predict the likelihood of these species occurring within the MEP. This exercise reveals that two other species—Large-podded Trefoil (*Desmodium macrocarpum*) and *Bertya pedicellata*—could possibly occur, whilst it is very unlikely that the other four are present.

Table 5-4 Habitat preferences for significant species known to occur within the vicinity

EVR Species	NC Act	EPBC	Habitat Preference	Likelihood of Occurrence
Desmodium macrocarpum	R		Known from Poplar Box woodland with sparse shrub layer, often associated with *Carissa ovata* and *Grewia retusifolia*.	Possible—habitat for this species occurs within Vegetation Communities 5, 6 and 11 Regional Ecosystems; 11.5.2, 11.5.3 and 11.3.2
Bertya pedicellata	R		Grows on escarpments and ranges on sandy or gravely soils. Known from low ranges near Coppabella.	Possible—habitat for this species occurs within Vegetation Communities; 1, 2, 3, and 4 Regional Ecosystems; 11.5.9, 11.7.1, 11.7.2, and 11.7.3
Capparis humistrata	E		Occurs predominantly on soils derived from serpentinite from Marlborough to Rockhampton.	Unlikely—no suitable habitat or soils types
Dichanthium setosum	R	V	Occurs on heavy, black cracking clay soils in native grass grasslands.	Unlikely—no suitable habitat or soils types
Cerbera dumicola	R		Occurs in mixed eucalypt woodland to open forests often along creeks and marshy areas with permanent water.	Known to occur within vegetation communities 11.7.2, and riparian vegetation on site (Smith 2003)
Graptophyllum ilicifolium	V	V	Occurs in semi-evergreen vine thickets in rocky areas and along ephemeral creeks.	Unlikely—no suitable habitat or soils types
Paspalidium scabrifolium	R		Inhabits eucalypt woodlands on the lower and mid slopes of hills and ranges on volcanic derived soils.	Unlikely—no suitable habitat or soils types

5.2.2 Exotic Plants

Of the 195 flora species identified as present within the MEP, 33 (17%) were non-native (**Appendix D**). Of the 33 non-native flora species observed within the project area, three are listed under the Land Protection (Pest and Stock Route Management) Regulation 2003 (LP Reg.) as requiring management (**Table 5-5**). No unlisted environmental weeds were observed to be reaching nuisance proportions across the project area. Many of these species can, however, proliferate in disturbed areas and can act to degrade the condition of native vegetation communities.

Table 5-5 Listed weed species that occur within the MEP area

Species	Class—*Land Protection (Pest and Stock Route Management) Act 2002*	Management requirements
Harrisia cactus (*Harrisia martinii*)	Class 2	Control of declared pests is required by landholders
Prickly Pear (*Opuntia stricta*)	Class 2	Control of declared pests is required by landholders
Lantana (*Lantana camara*)	Class 3	May require removal from environmentally significant areas

6 VERTEBRATE RESULTS

A total of 125 terrestrial vertebrate were been identified in the MEP area, including five amphibians, 16 reptiles, 81 birds and 23 mammals (**Appendix D**). Amphibian, reptile and mammal diversity within the MEP is consistent with the diversity of vertebrate communities found during similar studies in the local area (**Table 6-1**).

Table 6-1 Vertebrate Diversity Comparison to Local Studies

Study (Source)	Amphibians	Reptiles	Birds	Mammals	Total
Carborough Downs–Dec 2004 (EIS) (Matrix+ 2007)	7	25	66	9	107
Carborough Downs–Jul 2004 (EIS) (Matrix+ 2007)	0	13	49	15	77
Daunia 1996 (BMA 2008)	11	28	102	23	164
Daunia 2004 (BMA 2008)	0	8	74	16	98
Daunia 2008 (BMA 2008)	9	5	69	16	99
Millennium Expansion Project (this study)	5	16	82	14	116

The composition of vertebrate communities within the MEP area varied according to habitat structure. Vertebrate habitats and corresponding communities are discussed in **Section 6.1** below. Representative photos of the habitats surveyed using systematic methods are provided in **Appendix E**. Photos Observed and Potential EVR species are considered in **Section 6.3.1**.

6.1 VERTEBRATE HABITATS AND COMMUNITIES

6.1.1 Background

The classification of vertebrate habitats and communities is based predominantly on canopy composition. Vertebrate communities are typically associated with the vegetation structure rather than composition and may not be strongly associated with individual REs. Rather, the same vertebrate community may occur in a range of REs or may be restricted to a small portion of the RE that contains a particular physical feature (e.g. rock outcrops). It is therefore necessary to describe vertebrate habitats within an area.

Research has found that ground-dwelling vertebrates typically select habitats based on the structure of the ground cover and shrub layer (horizontal complexity). Reptiles, for example, are abundant in habitats that have a mosaic of sheltering locations (rocks, dense grasses, logs) and open areas allowing the segregation of foraging zones and thermoregulatory control (Pianka 1969; Morton and James 1988). Mammals, which do not require thermoregulation, select habitats with dense horizontal complexity where sheltering opportunities are abundant (Knight and Fox 2000; Monamy and Fox 2000; Fox and Fox 2000).

In contrast to ground-dwelling vertebrates, bird species are more abundant in habitats that have complex shrubs, sub-canopy and canopy layers with both open and dense areas (vertical complexity). This provides sheltering opportunities, but also allows bird communities to partition foraging resources using different foraging methods and substrates (Holmes and Recher 1986; Recher and Davies 1997).

A significant portion of Australian vertebrates are hollow obligates, requiring suitable hollow-bearing trees for nesting or roosting (Gibbons and Lindenmayer 2002). Many other species regularly use hollows and therefore the presence of hollows can significantly impact community composition. In particular, habitats with abundant hollows are more likely to support diverse communities of arboreal mammals, insectivorous bats and hollow nesting birds.

These factors should be considered when classifying vertebrate habitat types. While many vertebrates have broad ecological niches and therefore are able to occur in a variety of habitats, other species are specialists. It is the presence/absence or relative abundance of these specialists that typically distinguish vertebrate communities.

It should also be noted that vertebrate communities may be detrimentally affected by ecological processes such as edge effects and fragmentation (Andren and Anglestam 1988; Andrews 1990; Bragg *et al.* 2005). These impacts are particularly severe in small patches of vegetation and may cause an area of otherwise suitable habitat to become inhabited by large aggressive 'increaser' species at the expense of 'decreaser' species (Ford *et al.* 2001). As a result, vertebrate communities may be homogeneous, despite noticeable habitat differences.

6.1.2 MEP Vertebrate Habitat and Communities

Habitat characteristic and vertebrate diversity suggests that five subjective habitat and corresponding vertebrate community groups occur in the MEP area:

- Exotic grasslands;
- Woodlands dominated by exotic grasses;
- Native understorey woodlands;
- Massive rock outcrops; and
- Waterway habitats.

These are discussed in detail below.

6.1.2.2 Exotic grasslands

Exotic grassland dominated by Buffel Grass is the dominant habitat within the MEP area. These areas may or may not include a moderately thick cover of 1–2 m high shrubs, typically regrowth species from the original canopy. Hollows are absent and fallen debris is scarce.

Without important structural components, these habitats are very simple and provide fewer faunal resources, foraging opportunities and sheltering sites than native habitats. As a result, vertebrate diversity is typically poor (Maron and Lill 2005).

Common bird species within these communities included Pied Butcherbird, Torresian Crow, Australian Magpie, Australian Pipit, Black-faced Woodswallow, Nankeen Kestrel and Brown Falcon. These species respond positively to land clearing ('increaser' species) and can exclude smaller species which are negatively effected by this disturbance ('decreaser' species) from the edges, and within fragments, of remnant vegetation (Ford *et al.* 2001; Woinarski *et al.* 2004; Maron 2005).

Photo 6-1 Exotic grasslands

Photo 6-2 Exotic grasslands were inhabited by Australian Pipits

Terrestrial vertebrate communities are considerably less abundant in open grassy areas. Common terrestrial species included *Pogona barbata* (Eastern Bearded Dragon), *Antaresia maculosa* (Spotted Python), Eastern Grey Kangaroo (*Macropus giganteus*), feral dogs/dingoes (*Canis lupus familiaris/ Canis lupus dingo*) and European Rabbit (*Oryctolagus cuniculus*).

The threatened Squatter Pigeon (*Geophaps scripta scripta*) may occur in exotic grasslands. However, the thick dense ground cover inhibits movement and provides limited foraging opportunities. When birds are observed in these types of habitats they are generally restricted to roadways and tracks where grass growth is reduced.

6.1.2.3 Woodlands dominated by exotic grasses

Woodlands dominated by exotic grasses were more abundant on low-lying undulating plains. They include remnant vegetation dominated by both eucalypt species and Brigalow. In both cases, the canopy is sparse and shrubs are scattered, separated by expansive areas of Buffel grass. This grass species has formed thick monocultures and little bare ground, rock outcrops or fallen timber is exposed. Where the canopy is dominated by eucalypts, small to medium sized hollows are present. However, hollows are largely absent from Brigalow dominated woodlands.

Vertebrate communities within woodlands dominated by exotic grasses are unlikely to include any unique species. The altered habitat favours species that have broad habitat requirements and are therefore likely to be found in other habitats. In particular, species within these habitats are likely to be much more abundant in woodlands with a native understorey. It is the absence of any unique species from woodlands dominated by exotic grasses that distinguishes the community.

Photo 6-3 Woodlands dominated by exotic grasses

Photo 6-4 Woodlands dominated by exotic grasses were inhabited by Brigalow Scaly-foot

Commonly observed bird species within these communities included Striated Pardalote, Pale-headed Rosella, Singing Honeyeater, Noisy Friarbird, Red-backed Fairy-wren, Peaceful Dove, Double-barred Finch and Weebill.

Small terrestrial vertebrate communities were comparatively poor. Observed species included *Platyplectrum ornatum* (Ornate Burrowing Frog), *Ctenotus robustus, Menetia greyii, Lerista fragilis* and *Carlia pectoralis*.

Microchiropteran (insectivorous) bat distribution tends not to be influenced by ground strata and bats are likely to be common in both woodlands dominated by exotic grasses and woodlands with native understoreys. Bats observed in woodlands included Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*C. morio*), Hoary Wattled Bat (*C. nigrogriseus*), Little Pied Bat (*C. picatus*), Gould's Long-eared Bat (*Nyctophilus gouldi*) and Eastern Cave Bat (*Vespadelus troughtoni*).

Two EVR species were recorded from Woodlands dominated by exotic grasses: Brigalow Scaly-foot (*Paradelma orientalis*) (Section 6.3.2.1) and Little Pied Bat (Section 6.3.2.2). In addition, the Squatter Pigeon (*Geophaps scripta scripta*) is likely to be found along tracks and roads where grass growth is reduced and *Denisonia maculata* (Ornamental Snake) is possible in these habitats along New Chum Creek.

6.1.2.4 Native understorey woodlands

Woodlands not infested by exotic grasses were predominantly restricted to the escarpments and lower slopes. Within these areas, the ground strata consisted of a mosaic of open ground, grass patches, fallen timber and in some locations small rocks. This provided a complex habitat for ground vertebrates allowing abundant foraging, sheltering and basking opportunities. As a result, terrestrial vertebrates were also more diverse and abundant within these habitats. Species unique to these

habitats included *Ctenotus strauchii, Diplodactylus conspicillatus, Nephrurus asper* (Rough Knob-tailed Gecko) and *Cryptophis boschmai* (Carpentaria Snake).

Native shrubs species such as Leichhardt Bean (*Cassia brewsteri*) and Currant Bush (*Carissa ovata*) were common, occurring in patches or scattered throughout the vegetation. The increase in vertical complexity favoured Variegated Fairy-wren, Buff-rumped Thornbill, Inland Thornbill and Grey-crowned Babblers. Grey-crowned Babblers are listed as Near Threatened in the Action Plan for Australian Birds (Duncan *et al.* 1999) due to local extinctions from fragmented habitats in the south of their range (NSW and Victoria).

Photo 6-5 Woodlands with native understorey

Photo 6-6 Woodlands with native understorey were inhabited by *Nephrurus asper* (Rough Knob-tailed Gecko)

Dominant canopy species varied but typically included Clarkson's Bloodwood, Queensland Peppermint and Napunyah as well as areas of Lancewood (*Acacia shirleyi*). Where eucalypts were present, small and medium hollows were abundant. Hollow-dependant species such as Australian Owlet Nightjar, a number of microchiropteran bats and Common Brushtail Possum (*Trichosurus vulpecula*) were more common in these habitats.

6.1.2.5 Massive rock outcrops

Several features mark this type of habitat as distinct from all other habitats within the MEP area. The most obvious is the presence of large rock cliffs and boulders complete with abundant fissures, cracks, exfoliating rocks and overhangs. Ground-dwelling species will readily inhabit these areas, taking advantage of the ideal sheltering, foraging and basking opportunities. Opportunities for arboreal species also abound on the large cliffs, particularly for small species such as *Gehyra dubia, Oedura monilis* and *Cryptoblepharus* skinks. Unadorned Rock-wallabies (*Petrogale inornata*) were recorded within the rocky areas and are unlikely to be distributed away from these habitats.

Photo 6-7 Massive rock outcrop habitats

Photo 6-8 Massive rock outcrop habitats were inhabited by *Oedura monilis* (Australian Velvet Gecko)

In addition, large fruiting Rusty Figs (*Ficus rubiginosa*) were found only in these locations. Frugivorous species are likely to be restricted or substantially more abundant in these habitats. Their presence in the area is likely to fluctuate in response to fruiting events. Typical species could include flying-foxes, Southern Figbird, Channel-billed Cuckoo and Eastern Koel.

Hollows within Eucalypts at the base and on top of the cliffs provide habitat for a number of hollow-obligate species. Anabat activity was exceptionally high adjacent to the rock cliffs and is likely to reflect abundant sheltering sites for this group, both within tree hollows and rock crevices.

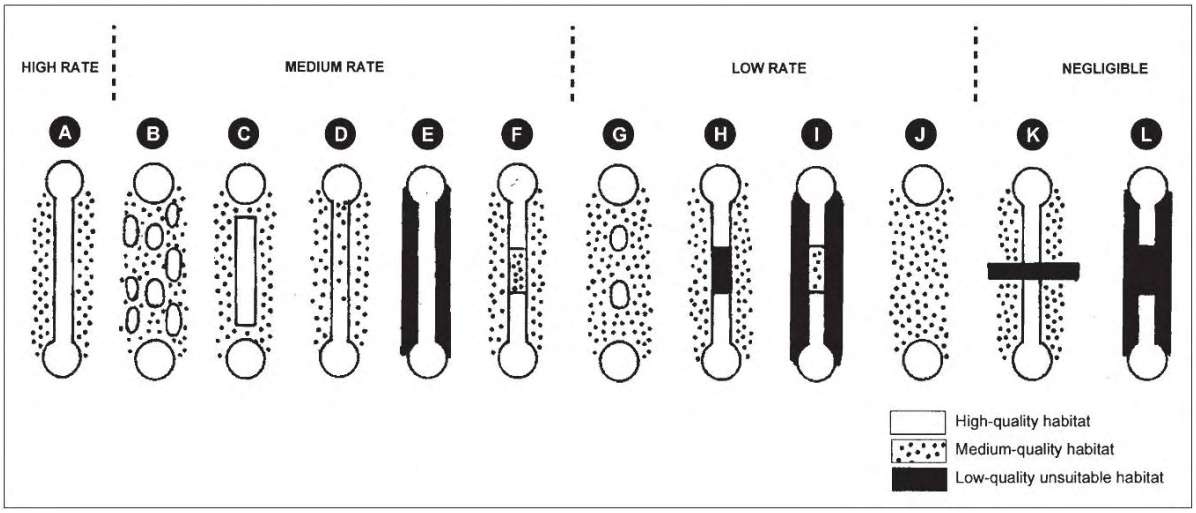
6.1.2.6 Waterway habitats

Permanent water resulting from human activity is located at the western dam. This dam is affected by mine discharge and has only poor aquatic habitat values. No emergent or floating aquatic vegetation is present for smaller aquatic species and only common aquatic bird species are likely. Species noted during the survey included Grey Teal, Australian Wood Duck, Pacific Black Duck, Royal Spoonbill, Darter and Eastern Great Egret. All these species are abundant in the local area.

6.2 EXISTING ECOLOGICAL CORRIDOR VALUES

Corridors facilitate the movement, dispersal and genetic flow of both plants and animals from one area of habitat to another. They are a crucial component of meta-population dynamics and maintain both local and regional biodiversity values by ensuring repopulation, genetic diversity and maintaining population numbers.

The ecological importance of a corridor is influenced by the quality and diversity of vegetation and habitats within the corridor (**Figure 6-1**). Those corridors with higher diversity are generally more successful in facilitating a connection for a wider suite of species. Edge effects, such as weed invasion, predation and competition, also play an important role and therefore the wider the corridor the greater its ecological value. In addition, the corridor may be of higher significance if it connects two areas of important vegetation, even if the corridor itself is highly degraded.



Source: QDMR 2000

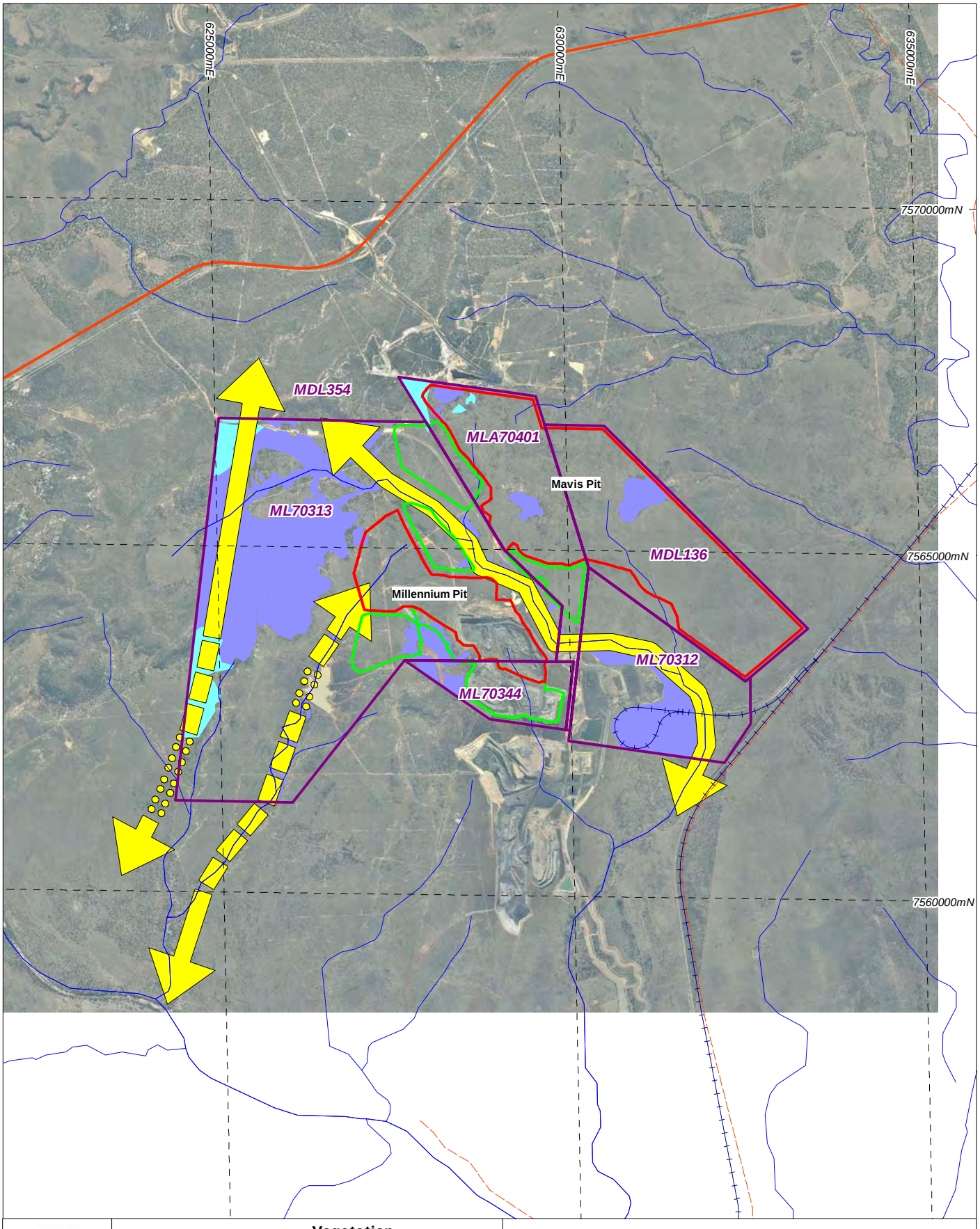
Figure 6-1 Effect of habitat diversity on movement rates through corridors

Corridors usually refer to linear strips of vegetation that remain in a landscape subject to broadscale clearing. However ecological corridors may also occur where a particular habitat or vegetation type is restricted to a narrow area within the larger habitat matrix (e.g., riparian vegetation).

BPA mapping of corridors (Criteria J—**Appendix A**) suggests that no areas of remnant vegetation constitute a potential corridor in a state or regional context. However, at a local scale, vegetation within and connecting to the MEP area is likely to be important for local movements. In particular, vegetation along New Chum Creek may facilitate movement of fauna in a north–south direction between vegetation to the north and vegetation along the Isaac River (**Figure 6-3**).

Vegetation associated with the mesa outcrop in the south of ML 70313 is not directly connected to other remnant vegetation. However, this area, with its high-quality habitat values, may be acting as a stepping stone for more mobile species such as bats, birds and large terrestrial species (e.g., macropods).

Where possible, mining activities and plans should be sympathetic to existing corridor values, particularly along New Chum Creek.



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track
- Railway
- Watercourse
- MEP Pit
- MEP Dump

Vegetation

- Regrowth
- Remnant

Habitat Corridor Quality

- High
- Madium
- Low

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Potential Local Corridor Movements

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 6-1

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6.3 SIGNIFICANT VERTEBRATE SPECIES

6.3.1 Confirmed and potential EVR vertebrates

Short-duration surveys are never sufficient to completely sample all components of a vertebrate community (Thompson *et al.* 2003). Cryptic and rare species are often overlooked, but should not be omitted from the assessment process. Accordingly, an assessment based on the recorded habitat values within the MEP for locally known EVR vertebrates has been conducted.

Two vertebrates listed as EVR under legislation have been confirmed by site surveys to be within the MEP area, while a further two are identified as possible or likely (**Table 6-2**).

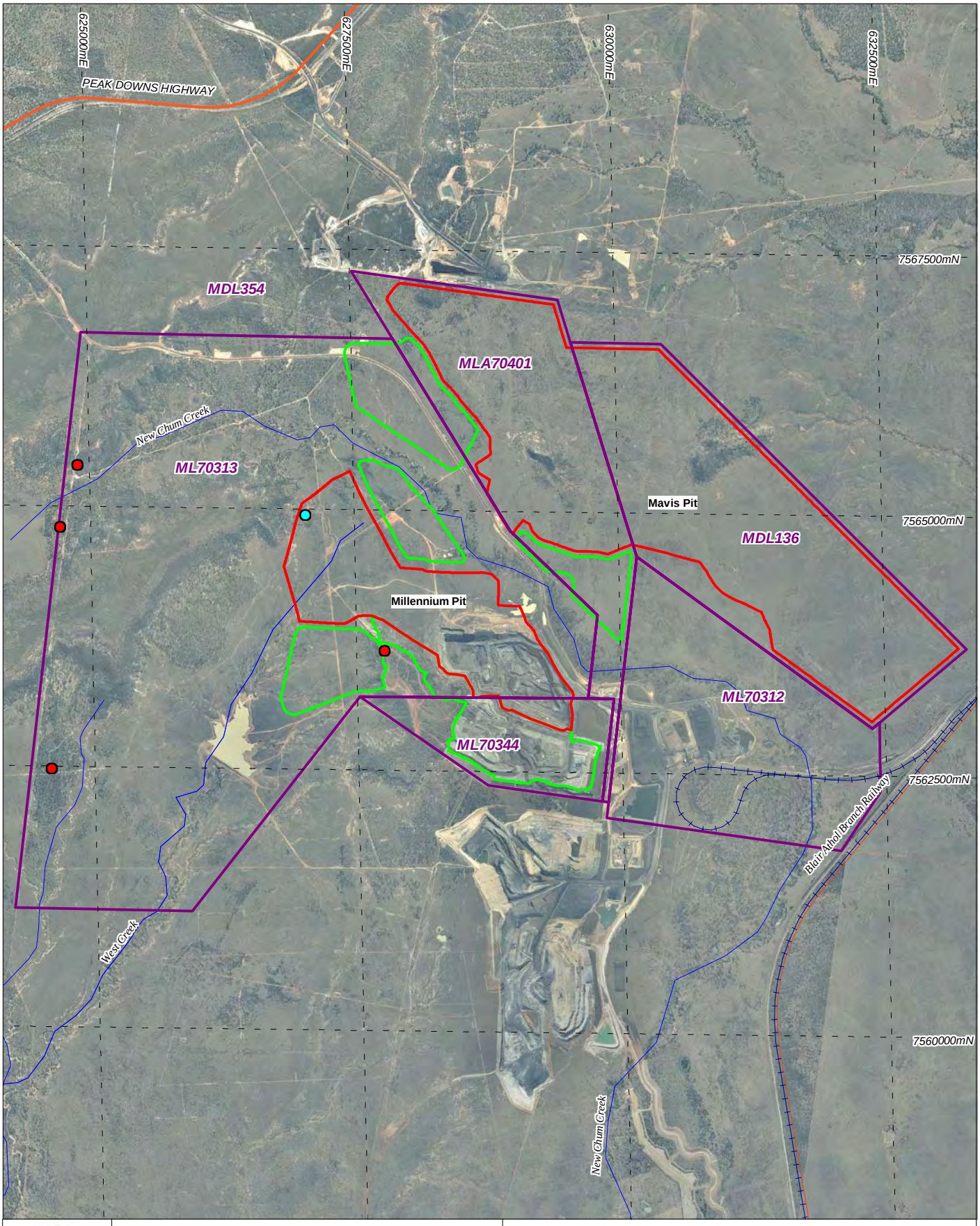
Figure 6-3 indicates where the confirmed species were detected, but their occurrence is likely to be more widely distributed than indicated by single observations.

Table 6-2 Likelihood of EVR vertebrates within the MEP area

GROUP *Scientific Name*	Common Name	NCA	EPBC	Likelihood
Legless lizards *Paradelma orientalis*	Brigalow Scaly-foot	V	V	Confirmed
Snakes *Denisonia maculata*	Ornamental Snake	V	V	Possible
Birds *Geophaps scripta scripta*	Squatter Pigeon (Southern)	V	V	Likely
Bats *Chalinolobus picatus*	Little Pied Bat	R		Confirmed

Acts: **NCA** = NC Act; **EPBC** = EPBC Act

Status: **EPBC Act**—E = Endangered; V = Vulnerable **NC Act**—E = Endangered; V = Vulnerable; R = Rare



LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

EVR Site

- Brigalow Scaly-foot
- Little Pied Bat

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.

MET SERVE

Peabody

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Records of EVR Vertebrates

0 1 2

Kilometres

Scale: 1:50,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 6-3

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6.3.2 Confirmed EVR Species

*6.3.2.1 Brigalow Scaly-foot (*Paradelma orientalis*)*

Legal status: EPBC—vulnerable; NCA—vulnerable

One Brigalow Scaly-foot was caught in a patch of Brigalow with a Buffel Grass ground cover. This patch of habitat occurred on the sand plain to the east of the mesas that dominate the western portion of the MEP area. The individual was recorded in this location despite the absence of an intact native understorey and the isolated nature of the remnant. It is unclear whether the find represents a member of declining population within this area or a population that is persisting despite habitat modification. The individual caught was not an old animal, so it is very possible that the population is persisting and reproducing.

Habitat and ecology: The Brigalow Scaly-foot is a nocturnal legless lizard found in a wide variety of forest and woodland habitat types (Tremul 2000; Wilson 2005). As its common name suggests, this is often found in Brigalow areas but can include eucalypt, cypress pine and she-oak woodlands on both cracking clay soils and sandy substrates (Schultz and Eyre 1997). As the species spends most of its time moving along the ground, surface structure is likely to be an important factor in its habitat preference. However, the species can be recorded from modified landscapes including small remnants and grasslands dominated by exotic grass species (e.g., Buffel Grass), particularly when adjacent to favourable habitats (M. Sanders, pers. obs.).

They are likely to forage on a variety of invertebrates, but have also been observed climbing small acacia bushes to lick exuding sap (Tremul 2000). In fact, some populations appear to be extremely arboreal, with more than 75% of observed animals located in shrubs to heights in excess of 2 m (Tremul 2000).

Distribution and population status: The Brigalow Scaly-foot is found mainly in the southern Brigalow Belt bioregion, from Inglewood in the south, north to Emerald and east to Gladstone (DERM 2007). While it may be common in suitable areas, habitat loss has been identified as a probable threat along with predation by feral cats.

*6.3.2.2 Little Pied Bat (*Chalinolobus picatus*)*

Legal status: EPBC—Not listed; NCA—Rare

The Little Pied Bat was recorded at several locations within the MEP area. All captures and records were associated with remnant habitat. The species is most likely to be common throughout remnant woodlands, particularly those located in the western portion of the MEP area on ML 70313. It is also possible that the species may occur within other leases, although the fragmented and isolated nature of remnant vegetation in these leases suggests that these habitats may not be regularly used. At the very least, these fragmented patches of vegetation are unlikely to be important for the local population's persistence.

Movements through the landscape are probably facilitated by vegetation along New Chum Creek. Individuals are likely to use this habitat for both foraging and sheltering as well as dispersals and local movements.

Habitat and ecology: Little Pied Bats may be found in a variety of habitats, preferring dry vegetation including open forest, woodland, acacia scrubs, cypress pine forest, mallee and even chenopod shrublands (Churchill 2008). Duncan *et al.* (1999) suggests that the species seems to be particularly prominent in vegetation near permanent or semi-permanent water.

Little data are available on the exact nature of Little Pied Bat diet. A single stomach examination revealed only moths; however, the species is likely to forage on a variety of insect types. The relatively low wing loading suggests that the species forages below the canopy but predominately follows distinct flyways rather than hovering through thick vegetation (Crome and Richards 1988). Radio tracking studies in north-western NSW recorded adults making a nightly return trip of 14–34 km between their roost sites and a creek where they remained active throughout the night (Pennay and Freeman 2005).

Little Pied Bats are known to roost in trees and caves as well as abandoned mines and houses. In most cases they are recorded in small groups (<10 individuals), but have been recorded in groups of approximately 40 individuals (Churchill 2008). Breeding appears to occur in late spring (November) and, once large enough, young are left in a maternity crèche while females forage each night (Van Dyck and Strahan 2008).

Distribution and population status: The Little Pied Bat is found the Greenvale region (north of Ingham) to the Maryborough–Childers area through south-western Queensland into western NSW and as far west as the South Australian border. While it is most commonly recorded inland, there are several records of the species from the coast (Duncan *et al.* 1999). There is no evidence that the species' range has contracted (Duncan *et al.* 1999).

Originally the species was thought to be an obligate cave-dweller and therefore rare due to the scattered occurrences of suitable roosts. However roosting colonies have been located in tree hollows and disused buildings (Duncan *et al.* 1999). It is commonly recorded within the Bowen Basin.

Known Threats: Threats to this species are likely to relate to the loss of foraging and roosting habitats due to land clearing, particularly along waterways (Duncan *et al.* 1999).

6.3.3 Potential EVR Species

*6.3.3.1 Ornamental Snake (*Denisonia maculata*)*

Legal Status: EPBC—vulnerable; NCA—vulnerable

No Ornamental Snakes have been recorded from the MEP area. However, the species is known to occur within the local area and is particularly associated with vegetation growing on black soil where surface water may collect following rainfall. This is likely to reflect their diet, which consists almost exclusively of frogs (Shine 1983). Ornamental Snakes are a cryptic, nocturnal species and detection may be difficult, even in locations where populations are known to occur. During the day they shelter down deep soil cracks and beneath logs. During times outside of peak frog activity, it is often difficult to verify their presence. Habitat similar to where the species may be located occurs along New Chum Creek. The occurrence of this suitable habitat, and occurrence of local records, suggests that the species might occur and should be considered in the impact assessment.

Habitat and ecology: A range of habitats for the Ornamental Snake have been documented including open forest, woodland, riparian habitats and brigalow scub (Shine 1983; Cogger 1993; DEWHA 2008a). While the species has been found on sandy soils (Cogger *et al.* 1993; DEWHA 2008a), it is likely to be most prevalent on deep clays, particularly gilgai areas (DEWHA 2008a; Wilson and Swan 2008).

Distribution and population status: The Ornamental Snake is known only from the drainage systems of the Dawson and Fitzroy Rivers in the Northern Brigalow Belt (McDonald *et al.* 1991; Cogger *et al.* 1993). Little data is available on its previous range or population trends, however recent evidence suggests that the species may be common in favourable habitats (Wilson and Swan 2008; DEWHA 2008a).

Known threats: The species faces a variety of threats, including grazing and associated pasture improvement as well as habitat clearance. In addition, the species feeds almost exclusively on frogs suggesting it may be particularly susceptible to poisoning from Cane Toad (*Rhinella marinus*) ingestion (Cogger *et al.* 1993).

*6.3.3.2 Squatter Pigeon (*Geophaps scripta scripta*)*

Legal Status: EPBC—vulnerable; NCA—vulnerable

No Squatter Pigeons have been recorded within the MEP area. However, the species is well known in the local area having been recorded nearby on Carborough Downs and Daunia. Habitat over the bulk of the MEP area, which is dominated by exotic grasslands, is not optimal for the species. However, they are still regularly recorded in exotic grasslands where the grass is sparse or low. Such areas within the MEP might include along roadways and around the Western Dam. Furthermore, suitable habitat is abundant on the escarpment and slopes where native grasses dominate and open ground is abundant. This allows the birds to move more freely while foraging for grass seeds. These factors

indicate that the species is very likely to occur and should be considered as part of the assessment process.

Habitat and ecology: The southern subspecies of the Squatter Pigeon occurs on the western slopes of the Great Dividing Range were it inhabits open grasslands and grassy woodlands (Higgins and Davies 1996). In most cases, it is observed in eucalypt dominated vegetation, but may also be located in disturbed areas such as along roadways, cattle yards and around settlements (Lord 1956). It may also be recorded in acacia scrubs (M. Sanders, pers. obs.).

These birds feed predominantly on the seeds of grasses and legumes as well as other herbs and forbs. While not recorded for the southern subspecies, the northern subspecies has been recorded feeding on insects (arthropods) and varies its diet seasonally according to food item availability (Crome 1976). Foraging primarily takes place on the ground where they glean items directly from the surface or from low vegetation (M. Sanders, pers. obs.). They therefore seem to be more common in grasslands with open ground allowing easy movement. This behaviour may explain the high proportion of observations from along roadsides and disturbed areas where the grass is lower and sparser than surrounding grazing land. Areas heavily infested by Buffel Grass seem to be avoided, probably due the lack of foraging resources provided by this grass (Franks *et al.* 2000; Greenfield 2007) and the high grass density that limits movement and foraging.

Nesting occurs predominately in late winter to around January (Beruldsen 2003; DEWHA 2008b), but may occur at any stage throughout the year following favourable conditions. Nests consist of a shallow scrape in the ground lined with grass and typically located beneath a grass tussock (Lord 1956; Beruldsen 2003).

The movement patterns of Squatter Pigeons are poorly known, however it is generally described as locally nomadic (Frith 1982) without undertaking long distance movements (Frith 1982; Blakers *et al.* 1984).

Distribution and population status: Historically, the southern subspecies of Squatter Pigeon inhabited inland areas west from Longreach and Charleville to the coast around Proserpine and Gladstone, and from the Burdekin-Lynd divide in central Queensland south to around West Wylong in NSW (Garnett and Crowley 2000; Higgins and Davies 1996). However, the species has undergone significant retraction in the southern portions of its range and has not been observed in NSW since the 1970s (Ayer 1996; Higgins and Davis 1996). It now can be regularly observed north from around the Gladstone and Burnett Regions with only sporadic records in southern Queensland (Higgins and Davis 1996). Current knowledge suggests that the species' population and occurrence are no longer shrinking and existing populations seem stable (Garnett and Crowley 2000).

Known threats: Significant retractions of the species in the southern portions of its range have been attributed to overgrazing during times of drought followed by habitat clearing (Garnett and Crowley 2000). Grazing in the north of the range, which was principally cattle, appears to have had a less damaging effect (Frith 1982). Within its current range, the species is still at threat from clearing and improved pasture practices. Predation from feral pests such as Cats (*Felis catus*) and Red Fox (*Vulpes vulpes*) has also been suggested as a threat (Ayres 1996).

6.3.4 Non-EVR migratory vertebrates

Surveys within the MEP area have identified only one migratory species, the Rainbow Bee-eater (*Merops ornatus*). This species has been observed extensively throughout the MEP area and inhabits a variety of habitats including artificial modified landscapes. Rainbow Bee-eaters nest at the end of long tunnels burrowed into the ground, typically on a steep surface such as a wash-away. Several (<5) nesting burrows consistent with the size and shape created by Rainbow Bee-eaters were observed in the south of the MEP area downstream of the western dam. The observed holes probably include a number of old or disused burrows.

Rainbow Bee-eaters are common within the local area and region and no habitat within the MEP is likely to constitute 'important habitat' as defined under the EPBC Act. Nesting pairs within the MEP are not likely to constitute a 'significant proportion' of the local or regional population. Impacts associated with the construction of a dam downstream of the current western dam are therefore likely to be only localised.

Under the definition provided in **Section 3.2.3.3**, the Eastern Great Egret (*Ardea modesta*) should no longer be considered migratory. Nevertheless, the species was observed foraging at the western dam. This is the only area where Eastern Great Egrets are likely to occur and the species is not expected to breed within the MEP. The western dam will be retained in future mine plans and additional foraging habitat may be created by new waterbodies downstream. Impacts are therefore expected to be negligible.

Several other migratory species identified from databases and other studies as occurring within the local area also have the potential to occur. In particular, White-throated Needletails and Fork-tailed Swifts may occur in any location over any habitat type, including urban and other modified landscapes. Activities on the land are unlikely to affect these highly mobile species.

Migratory species not expected to occur, but identified in the literature review phase, are briefly discussed in **Appendix D**.

6.4 PEST VERTEBRATES

Four exotic pest species were recorded from within the MEP area:

- Cane Toad (*Rhinella marina*);
- House Mouse (*Mus musculus*);
- European Rabbit (*Oryctolagus cuniculus*); and
- Feral Dog (*Canis lupus familiaris*).

Both the European Rabbit and Feral Dog are declared pest species (Class 2) under the LP Reg. Under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), a Class 2 pest '*is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. Management of these pests requires coordination and they are subject to programs led by local government, community or landowners. Landowners must take reasonable steps to keep land free of Class 2 pests*' (DEEDI 2009).

Feral dogs were commonly observed within the MEP area and have the potential to affect existing vertebrate populations. In particular, dispersal and recruitment of medium sized mammals such as the Unadorned Rock-wallaby and Spectacled Hare-wallaby, may be affected. This may reduce the population's ability to recover from an adverse stochastic event. Many vertebrate species would benefit from the control of feral dogs.

Under the EPBC Act, 'competition and land degradation by rabbits' is listed as a key threatening process, although it is unlikely that competition is a significant factor within the MEP due to low rabbit numbers. Nevertheless, rabbits provide a stable food source for feral dogs and their control will assist in control feral dog numbers. Rabbit control should not occur unless undertaken concurrently with feral dog control to avoid dogs prey-switching to native species.

In addition to the above key threatening process, '*The biological effects, including lethal toxic ingestion, caused by Cane Toads* (Bufo marinus)' is also listed under the EPBC Act. Any created waterbody, including ponding areas, roadside ditches, flood channels, etc, can increase breeding opportunities for Cane Toads. Cane Toads are already common throughout the MEP area, however actions should be undertaken, where possible, to avoid increasing Cane Toad breeding opportunities.

Other exotic pest species such as feral cat and European Fox are also likely to occur. Both these species are listed as a Class 2 pest under the LP Act and as a Key Threatening Process under the EPBC Act.

7 POTENTIAL ECOLOGICAL IMPACTS AND MITIGATION RECOMMENDATIONS

7.1 VEGETATION LOSS

7.1.1 Vegetation loss for pits and dumps

Analysis of the conceptual mine plan for the MEP reveals that clearing activities will mainly be restricted to the proposed open-cut pits and overburden dump areas (**Figure 7-1**). Approximately 66 ha of remnant vegetation is likely to be cleared for the pit and overburden dump areas of the MEP (**Table 7-1**). As this estimate is based on pit and dump projection areas and does not include any buffer between these and remnant vegetation, the actual area impacted due to edge effects may be slightly higher. This estimate includes the loss of 2.9 ha of Brigalow-dominated or co-dominated vegetation listed as Endangered under the VM Act and EPBC Act (REs 11.9.1 and 11.9.5). Although mining activities are generally exempt from the VM Act, endangered REs under the Act constitute category B Environmentally Sensitive Areas under the Environmental Protection Regulation 1998, and their disturbance may thus constitute an EIS trigger requiring Environmental Authority amendment.

Other areas of vegetation that lie within the proposed pit and overburden dump areas are REs 11.7.1, 11.7.2, 11.9.3, all of which are designated 'Not of Concern' under the VM Act.

Although the vegetation associated with the duricrust hills on MDL 136 (Red Hill) and on MLA 70401 (Poitrel Hill) are mapped as of "State significance", field verification reveals that these areas had relatively low floristic and faunal diversity despite minimal thinning and grazing impacts from cattle. In addition, there was evidence of a high level of grazing by rabbits, and overall structural complexity of the environment was low. Thus loss of these areas would not result in a significant loss of biodiversity on the landscape scale.

The mesa outcrop in the south of ML 70313 on its slopes extensive areas of high quality RE 11.7.1 (*Brigalow tall woodland on colluvium*—veg com 4) occurs. While this community is designated "Not of Concern", its Biodiversity Status is "Of Concern" due to threatening processes other than clearing (**Table 7-1**). Biodiversity Status is determined by DERM and incorporates an assessment of the condition of remnant vegetation—accordingly, it a more comprehensive assessment than Vegetation Management Status, which is based only on the remnant extent of an RE type in proportion to its pre-clearing extent.

Table 7-1 Areas of remnant vegetation designated for clearing for pit and spoil dumps

RE	Vegetation Type	VMA Status	Biodiversity Status	EPBC Status	Total Area in ML (ha)	Proposed Loss (ha)
11.7.1	**Brigalow tall woodland on colluvium**	Not of concern	Of concern	–	10.3	6.7
11.7.2	**Lancewood tall open forest on laterite and colluvium**	Not of concern	No concern at present	–	269.8	54.8
11.9.1	**Brigalow–Dawson Gum tall riparian open forest on sands and tall woodland on sands**	Endangered	Endangered	Endangered	78.9	2.0
11.9.3	**Mountain Coolabah tall woodland on sands**	Not of concern	No concern at present	–	2.3	1.6
11.9.5	**Brigalow tall woodland on sands**	Endangered	Endangered	Endangered	6.8	0.9
TOTAL					**368.1**	**66.0**

Biodiversity Status is used as a guide to an RE's conservation significance, but for "Of Concern" communites, does not carry any legislative implications. In association with RE 11.7.2 (*Lancewood tall open forest on laterite and colluvium*—veg com 2), this comprises the intact areas of vegetation on the southern mesa, which could be regarded as a significant landscape feature. The vegetation, and in particular the geology, of the area provide a spatially heterogeneous habitat for fauna. A high degree of habitat complexity and quality make this mesa significant within the local area, and consideration

should be given to its partial retention. The mesa also supports a suite of flora and fauna species not found in the surrounding landscape, such as figs and rock wallabies. There would be limited scope for mitigating the impacts of the mesa's removal due to the apparent absence of similar areas nearby and the inability of many fauna species to migrate though the surrounding landscape matrix. Design of overburden areas should be modified to minimise impacts where practicable.

The Brigalow communities in the proposed open-cut pit and spoil dump areas of the MEP are infested with the introduced pasture grass Buffel Grass, and some sections have been degradaed through cattle grazing and water access. In the case of RE 11.9.5 ('*Brigalow tall woodland on sands*'), the sub-canopy has been cleared for pasture improvement, with only canopy structure intact. Despite these disturbances, these remnants need to be evaluated in their regional context. Brigalow coverage has been drastically reduced throughout its range, primarily as a result of land clearing for agricultural development (DEWHA 2007). Remaining patches may act as recruitment foci for ecosystem regeneration, and even small patches have been shown to have significant value in that they provide important habitat for a variety of fauna (Collard *et al*. 2009).

The planned Millenium Pit extension will result in the clearing of 0.9 ha of a 4.6 ha patch of Brigalow located near the western edge of the pit. This patch in combination with a second 2.2 ha area to the north represents the only instances of this vegetation type within the MEP area. While only a small portion of this patch is expected to be cleared, the disturbance is likely to result in the destruction or degradation of adjacent habitat. This is also the location where a Brigalow Scaly-foot individual was observed (Section 7.4.2). As this patch contains both an EPBC Act listed endangered vegetation community and an EPBC Act listed vulnerable animal species, it is strongly recommended to avoid any clearing in the area. All instances of endangered vegetation proposed to be cleared within the MEP area occur near the edges of a pit or spoil dump projections. Relatively minor alterations of mine plans to avoid clearing these areas are recommended if practicable. This may also streamline the regulatory process, as no further endangered vegetation would be subject to clearing.

As REs 11.9.1 and 11.9.5 are included in the definition of Brigalow dominated or co-dominated EECs under the EPBC Act (Department of the Environment, Water, Heritage and the Arts [DEWHA] 2007), clearing of this vegetation has the potential to be regarded as a matter of national environmental significance.

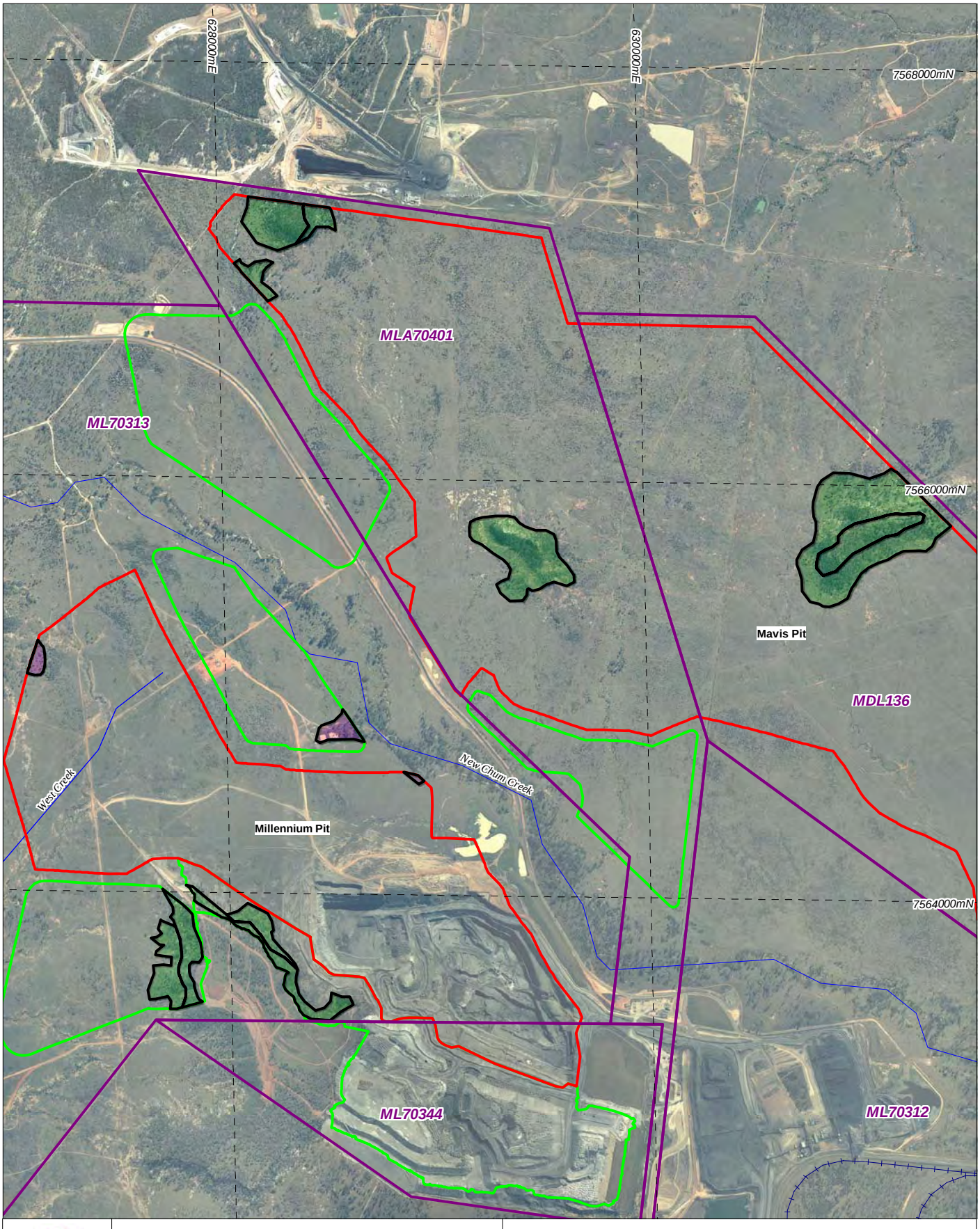
As the endangered regional ecosystems are category B environmentally sensitive areas under the *Environmental Protection Regulation 1998*, clearing of REs 11.9.1 and 11.9.5 could constitute an EIS trigger. Consequently there would be a legislative requirement for development of an offsets policy for this area as outlined in the Queensland Government Environmental Offsets Policy (EPA 2008). As part of the development process for the area, it is recommended that:

(a) a rehabilitation management plan for the endangered REs be included in the mine's EMP and actions taken to ensure the regeneration of the same community once mining activities have ceased; and

(b) offset area(s) be found and managed. The extent and nature of the vegetation to be cleared should be taken into account, and consideration may be given to factors such as:

- protection and enhancement of vegetation remaining in the surrounding area, with a view to enhancing non-remnant vegetation to remnant status;
- revegetation of excess lands on site; and/or
- off-site offsets.

Most of the area subject to proposed MEP infrastructure is Buffel Grass-infested pastures. While this habitat does support vertebrate species (e.g., Eastern Grey Kangaroo, Eastern Bearded Dragons, Australian Magpie), such species are very common within the local and wider regions. The loss of these non-remnant areas, via the MEP, is highly unlikely to have any significant impact on vertebrate communities.



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Road
- Railway
- Watercourse
- MEP Pit
- MEP Dump

VM Act Status

- Endangered
- Not of Concern

Data Source:
Topography - Geoscience Australia. Infrastructure, Imagery, Tenement - Peabody.
Revised RE Mapping - BAAM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Proposed Vegetation Loss

0 0.5 1

Kilometres

Scale: 1:25,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE 7-1

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7.1.2 Vegetation loss for associated infrastructure

The site access road may require realignment involving the construction of 2.4 km of new road, and new crossings over New Chum Creek in order to access the MEP and CHPP areas (**Figure 2-2**). The potential site access road realignment would involve disturbance through 480 m of remnant vegetation. Making a general assumption that the road would be approximately 10 m wide, 0.48 ha (0.45 ha of RE 11.5.2 and 0.02 ha of RE 11.5.3) would be disturbed. Construction of a new haul road across New Chum Creek would require the disturbance of approximately 1.3 ha of RE 11.9.1 (endangered under the EPBC Act).

Approximately 100 m of 66 kV overhead powerlines may also be relocated to traverse the same remnant vegetation as the road, before making a right-angle turn to the north. With the powerlines require a 22.5 m buffer, this will result in at least 0.1 ha of addition remnant vegetation being cleared, where the proposed road forms the other half of the buffer.

What may be more significant than the total area of vegetation to be cleared are the potentially detrimental effects of habitat fragmentation on the ecological viability of the patch though which the site access road will traverse in the northwest of the MEP area (Cunningham 2000; Hannah *et al*. 2007). Notwithstanding other impeding factors, it is recommended that the 480 m of proposed site access road and 96.6 m of 66 kV overhead powerline realignment that traverses remnant vegetation be relocated to the north-east of the remnant vegetation, though the non-remnant area west of the northern drainage channel. This may require the utilisation of a non-remnant area earmarked as a possible topsoil location.

7.1.3 Loss of vertebrate habitats and communities

In contrast to the existing cleared areas, the following areas within the impact zone contain remnant vegetation and therefore have higher habitat values than non-remnant areas:

- mesa (TA04 in **Figure 4-2**) in ML 70313;
- brigalow patch (MIL04 in **Figure 4-2**) in ML 70313;
- New Chum Creek;
- rocky outcrop (TA06 in **Figure 4-2**) in MLA 70401; and
- rocky outcrop (TA05 in **Figure 4-2**) in ML 136.

The mesa supports a high concentration of unique landforms (in the form of cliff faces, boulders, fissures, etc), plants (e.g., figs) and animals (e.g., flying foxes, rock wallabies, *Oedura monilis*) and is therefore worthy of conservation. Current mine plans have External Dump South West projected over the northwestern portion of this area. It is recommended that the waste dump be realigned so that this mesa area is avoided. In addition to preventing the clearing of the mesa itself, it is important that the mesa is not further isolated from other patches of remnant vegetation. Connectivity within the broader landscape matrix could be maintained by ensuring that at least one side (such as the western side) remains clear to allow animals to move to and from the mesa.

The patch of Brigalow tall woodland on sands (RE 11.9.5) (MIL04 in **Figure 4-2**) in ML 70313 was found to contain a threatened species (Brigalow Scaly-foot). While the Brigalow Scaly-foot was found only in this patch of vegetation, it is likely to be found in other habitats on the site. This patch of vegetation lies on the inside edge of the proposed Millennium Pit extension area. As only a small part of this patch appears to be designated for clearing, it may be possible to slightly modify the pit extension area to avoid clearing this vegetation. If the clearing of this patch is unavoidable, it is likely to result in mortality of individual Brigalow Scaly-feet, but is unlikely to have a significant impact on the wider population.

New Chum Creek is bordered by remnant vegetation along much of its length. Mine plans indicate that a 100 m buffer zone will be put in place around the creek. This buffer should ensure that the creekline is only minimally impacted. Two areas of the creekline where impacts will occur are the proposed crossings for the two new haul roads. These crossings will result in the loss of approximately 1.3 ha of habitat. Provided these crossings are constructed in a way that ensures the integrity of the remainder

of the creekline, these vegetation losses should not represent a significant impact to vertebrate communities.

The two rocky outcrops (TA05 and TA06 in **Figure 4-2**) represent highly isolated patches of vegetation. Targeted sampling of these locations during the current survey did not reveal any threatened species. While many animals (e.g., macropods, birds, lizards) use these rocky outcrops, it is unlikely that these locations provide significant habitat in the context of the broader region.

The clearing of any of these areas can be somewhat mitigated by the rehabilitation of areas of regrowth outside of future impact zones. Perhaps the greatest constraint to the regeneration of this vegetation is the threat of weed infestation and associated fire (discussed in Section 7.5). The most prevalent weed is Buffel Grass, which has formed a thick mono-specific swath.

Finally, the final land use for rehabilitation areas following mining should be clearly identified. If these areas are to be rehabilitated for biodiversity purposes, Buffel Grass should not be included in any seed mix or encouraged into rehabilitation areas. Buffel Grass is recognised as one of Australia's worst environmental weeds (Humpries *et al.* 1991). It forms thick mono-specific swards, inhibits the growth of plants through both competition and allelopathy, and provides few resources for vertebrates (Franks 2002; Greenfield 2007). Its use is contradictory to biodiversity goals.

7.2 EXOTIC PLANTS AND PEST VERTEBRATE SPECIES

7.2.1 Exotic Plants

Thirty-three exotic plant species were observed within the MEP area.

Harrisia cactus (*Harrisia martinii*) and Prickly Pear (*Opuntia stricta*) are listed as Class 2 weeds under the LP Act. Under this Act, reasonable measures are required to be taken to control them. They are scattered in low numbers throughout the MEP area and currently do not pose a threat to environmental values in most areas. The discrete occurrence of these species makes their control easy using registered herbicides. Injection of herbicide has been shown to be particularly successful by the Queensland Parks and Wildlife Service in providing control with minimal effect on adjacent native vegetation. These measures can be undertaken as part of environmental management activities within the MEP area.

Lantana (*Lantana camara*) is classified as a weed of national significance (WoN). Such weeds have been identified and listed in order to provide a framework to prioritise weed management at the federal, state, regional and local levels. As such, it is recommended that control of this species also forms part of the project's environmental management planning. However, as the State Government is responsible for legislation relating to weeds, and Lantana is a Class 3 weed under the LP Act, there is no legislative requirement for control other than within or adjacent to an environmentally significant areas (ESAs).

In the current context, such areas equate to REs 11.9.1 and 11.9.5 as these communities are included in the definition of the Brigalow EECs under the EPBC Act and are thus ESAs as defined by the LP Act. Many of the environmental weeds that are neither listed under the LP Act nor classified as a WoN nevertheless proliferate in disturbed areas and degrade the condition of native vegetation communities. To this end, regular monitoring of top soil stock piles and disturbed areas should be conducted as part of a formalised management plan to prevent the spread of both listed and unlisted weed species.

Further control of weeds may be achieved by the following general measures:

- restriction of light vehicle movement in areas outside of regular activity, particularly irregularly used tracks;
- restriction of all vehicle movement during and following rainfall; and
- strict wash-down procedures for all vehicles (including clearing and construction machinery) entering clearance zones, grazing areas or conservation areas.

7.2.2 Pest Vertebrates

Some species of vertebrate are known to increase in numbers in association with human activities and disturbances. Many of the identified pest species are known to have significant ecological impacts by:

- increasing predation (e.g., dogs/cats/foxes);
- increasing competition for resources (e.g., cats/rabbits/deer);
- habitat degradation (e.g., deer/rabbits);
- reducing vegetation recruitment following a stochastic event such as fire or mechanical disturbance (e.g., deer/rabbits); and
- increasing mortality within local populations through methods other than predation or competition (e.g., Cane Toads).

It is not anticipated that the proposed activities will significantly increase the abundance of pest species. Nor is it considered likely that any increases that do occur will significantly affect existing ecological balance. However, efforts should be made to control these pests including:

- undertaking regular pest control actions in conjunction with local authorities, landholders and neighbours, particularly for pests such as dogs, cats and foxes; and
- ensure that any waste is not allowed to accumulate outside of designated areas. These designated areas should be animal proof and waste regularly removed or buried.

7.3 IMPACTS ON EVR SPECIES

7.3.1 *Cerbera dumicola* (a shrub)

The shrub *Cerbera dumicola* is known to occur within the ML (Smith 2003), being identified at two localities.

The larger population, on the slope of the western mesa has plants aggregated over an area of at least one hectare. This population will not be impacted by the proposed infrastructure.

The smaller population consists of several individuals on the creek flat. These plants have the potential to be impacted by the proposed haul road across New Chum Creek (**Figure 2-2**). No GPS points for the population are supplied in Smith (2003) and the map showing the survey sites in which it was found is hand drawn. However, it is evident the riparian population was recorded along New Chum Creek somewhere between -22.01°S, 48.2422°E and 22.0269°S, 148.2581°E.

As this species is not listed under the EPBC Act, impacts on this species would not constitute a MNES. However, it is listed as rare under the NC Act and is therefore considered in this assessment. Limited information is available on the ecology of this species. While a minimum 100 m buffer is planned to be maintained along New Chum Creek, direct impacts on this species are possible if the proposed haul road crosses New Chum Creek where the plants occur.

Prior to construction, targeted surveys by a qualified botanist should be carried out to ensure that no individuals of this species will be disturbed and construction plans should be altered to avoid them if necessary. Alternatively, translocation of the individuals may be carried out; however, this approach is always to be considered as a last resort (Vallee *et al*. 2004).

7.3.2 Brigalow Scaly-foot (*Paradelma orientalis*)

One Brigalow Scaly-foot was recorded from a Buffel Grass-infested patch of Brigalow within the MEP area (at Site MIL04; **Figure 4-2**). While the Brigalow Scaly-foot was found only in one patch of vegetation, it is likely to be found in other habitats on the site.

As only a small part of this patch appears to be designated for clearing, it may be possible to modify slightly the pit expansion area to avoid clearing this vegetation. If the clearing of this patch is unavoidable, it is likely to result in mortality of individual Brigalow Scaly-foots, but is unlikely to have a significant impact on the wider population. Mortality of individuals may be difficult to avoid. However, contractors and operators should be made aware of the potential presence of the species and

instructed to temporarily cease clearing if an individual is observed. Clearing should occur in one direction through the vegetation, preferably from east to west to allow fleeing animals to be 'herded' into adjacent habitat. This will also benefit other vertebrate species.

7.3.3 Ornamental Snake (*Denisonia maculata*)

No ornamental snakes have been identified within the MEP area to date. However, the species is highly cryptic and may only be detected during ideal conditions. While not ideal, habitat values suggest that the species might occur and should therefore be considered.

Habitat suitable for the species may be located along New Chum Creek. The occurrence of this suitable habitat, and local records, suggest that the species might occur and should be considered in the impact assessment. Mine plans indicate that a 100 m buffer will be retained along New Chum Creek. Therefore, no disturbance of this potential Ornamental Snake habitat is anticipated, other that an 1.3 ha cleared area to bring a new haul road across the creek and the 1.0 ha under current pit projections. Clearing activities will thus result in the loss of 2.3 ha of this potential habitat.

To ensure individual mortality is limited during clearing, activities should proceed as described above for the Brigalow Scaly-foot (e.g., halted if an individual is seen, clearing to occur in one direction to allow egress of individuals). These measures should be taken avoid an action that has or will have or is likely to have a significant impact on a vulnerable species under the EPBC Act.

7.3.4 Little Pied Bat (*Chalinolobus picatus*)

The Little Pied Bat is expected to occur in most areas of remnant vegetation, but highest densities are likely in higher quality vegetation in those located in the western portion of the MEP area on ML 70313. Little Pied Bat calls were detected on the mesa in the middle of ML 70313 (TA04 in **Figure 4-2**). This area is likely to serve as both a shelter site and feeding area for Little Pied Bats. This mesa is within the proposed External Dump South West. While development of the dump in this location will remove high-quality feeding and roosting habitat for this species, it is unlikely that it will have implications for persistence of the species within the MEP area.

7.3.5 Squatter Pigeon (*Geophaps scripta scripta*)

No Squatter Pigeons have been recorded within the MEP area. Although habitat for the species is not optimal, they are still regularly recorded in exotic grasslands where the grass is sparse or low. However, the Squatter Pigeon is highly mobile and therefore able to rapidly avoid clearing activities, reducing the risk of individual mortality. Direct impacts from clearing are therefore expected to be negligible and no particular management is deemed necessary.

Few studies have been conducted on the effect of fire on Squatter Pigeons, however the ecologically similar Partridge Pigeon (*Geophaps smithii*) is threatened by altered fire regimes (Garnett and Crowley 2000). The spatial diversity of vegetation structures within optimal Squatter Pigeon habitat within the site should be maximised by introducing an appropriate fire regime. This may be achieved by burning in such a way that produces a mosaic of fire intensities, fire seasons and between-fire intervals. The effect and management of fire is detailed in Section 7.8.

7.3.6 Impacts on Migratory Species

Only one migratory species, the Rainbow Bee-eater, is known to occur within the ML. No recorded or likely migratory species will be significantly affected by the proposed activities due to:

- being extremely abundant in the local area and region (Rainbow Bee-eater and *Ardea alba s. lato*); and/or
- having considerable alternative habitat outside of proposed impact areas (Rainbow Bee-eater, *Ardea alba s. lato*, Cattle Egret, Fork-tailed Swift, White-throated Needletail); and/or
- no loss of habitat (Fork-tailed Swift, White-throated Needletail).

No special management actions for migratory species are considered necessary.

7.4 ECOLOGICAL CORRIDORS

Proposed mine activities are largely restricted to the southern and central portions of the site, where only poor corridor values are present. The loss of these areas is unlikely to significantly affect local populations or traditional movement patterns. If the mesa area in ML 70313 is retained, it is important to ensure that animals are still able to freely move to and from this area. This can be achieved by keeping the south-western side of the mesa free from disturbance. Corridor values could be enhanced in this area by revegetating areas to the west of the mesa.

Vegetation and habitat in the north-west of the ML is more likely to contribute to local movement patterns and contribute to local biodiversity values. These areas are unlikely to be directly impacted by the mining activities. Existing impacts within these areas, such as cattle grazing, should be reduced to improve local corridor values.

Dispersing or moving vertebrates may avoid areas of unsuitable habitat (e.g., cleared areas) and therefore be forced to traverse narrow stretches of vegetation. Increases in vertebrate activity may encourage predators resulting in a corresponding increase in mortality. The control of introduced predators, as described in Section 7.2.2 may assist in local movement and dispersal.

7.5 INAPPROPRIATE FIRE REGIMES

Fire regimes and ecology have a significant impact on biological systems in Australia. An inappropriate fire regime, resulting from incorrect fire frequency or fire intensity, can drastically affect vegetation structure and composition (e.g., Lunt 1997; Gill 1999; Prober *et al.* 2008) and invertebrate communities (Abensperg and Milewski 1995; York 1999; Norris and Conroy 1999). As most animals rely on these habitat characteristics, fire regime has a dramatic effect on vertebrate communities (e.g., Friend 1993; Hannah *et al.* 1998; Tasker *et al.* 1999; Woinarski 1999).

An alteration in existing fire regimes may therefore impact existing ecological values. The proposed activities are not considered likely to significantly increase the risk or occurrence of fire, provided that the following recommendations are considered:

- vehicle movement away from non-graded tracks should be prohibited to avoid fires caused by vehicle heat;
- cleared fire breaks should be established between coal dumps to avoid ignition of native vegetation from spontaneous combustion of coal; and
- dumping of rubbish (particularly glass) should not be tolerated in areas of vegetation or grass.

Appropriate fire regimes in vegetation and habitats of significance should be a priority to biodiversity conservation. Research has demonstrated that Buffel Grass increases fuel loads and encourages fire (Butler and Fairfax 2008; Greenfield 2007). Buffel Grass is also an early coloniser following fire and its incursion and abundance is facilitated by burning, producing a positive feedback between Buffel Grass and fire (Butler and Fairfax 2008). The management of areas where the aim is to return the vegetation to remnant status should include fire management strategies to ensure inappropriate fire regimes do not adversely affect regrowth. Such strategies may include pulse grazing, where cattle are allowed to graze following rainfall when Buffel Grass growth is significant, but excluded during less productive periods where grazing may damage the ecosystem.

Fire regime has also been shown to be significant in the decline of the Partridge Pigeon (*Geophaps smithii*) (Fraser *et al.* 2003), which is ecologically very similar to the threatened Squatter Pigeon. An appropriate fire regime is therefore likely to be an ecology important factor in areas of vegetation that provide suitable habitat for this species, such as those communities on red sand plains.

7.6 SUMMARY OF MITIGATION RECOMMENDATIONS

The following mitigation strategies should be implemented to reduce potential impacts arising from the proposed MEP:

- notwithstanding other impeding factors, it is recommended that the 480 m of the proposed Site Access Road that traverses remnant vegetation and the 96.6 m of 66 kV overhead powerlines that traverses remnant vegetation be re-aligned to the north-east of the remnant vegetation, through the non-remnant area west of the diversion channel adjacent to External Dump 1;
- the proposed haul road should not disturb the riparian population of the NC Act listed *Cerbera dumicola* where it crosses New Chum Creek. Prior to construction, targeted surveys should ensure that no individuals of this species will be disturbed and construction plans altered to avoid them if necessary. Alternatively, translocation of the individuals could be carried out, however this should only be considered as a last resort (Vallee *et al*. 2004);
- further survey work should be undertaken to identify potential offset areas for endangered vegetation communities that will be lost as a result of the proposed activity. The Queensland Government Environmental Offsets Policy (EPA 2008) should be used as a guide;
- remnant vegetation and offset areas should be managed for biodiversity values. This will include monitoring of biodiversity management strategies, in particular stocking rates in relation to environmental weed abundance;
- management plans should be developed for *Cerbera dumicola*, Little Pied Bat and Brigalow-scaly foot, outlining mitigation measures for potential direct and indirect impacts on these species. This should be in line with approved conservation advice (if available), and incorporate other relevant information regarding the species' ecology;
- if feasible, the western portion of the southern mesa area and areas of Brigalow-dominated or co-dominated vegetation should not be disturbed, as these areas are potentially significant habitats for threatened species, and the latter is an endangered ecological community;
- clearing contractors and operators should be made aware of the potential presence of threatened vertebrate species (including the EPBC Act listed Ornamental Snake) and instructed to temporarily cease clearing if any vertebrates are observed. Clearing should occur in one direction through the vegetation, preferably from east to west to allow fleeing animals to be 'herded' into adjacent habitat;
- regular vertebrate pest control activities should be undertaken in conjunction with local authorities and landholders, particularly for pests such as dogs, cats and foxes, in accordance with the LP Act;
- any putrescible waste should not be allowed to accumulate outside designated areas. These designated areas should be animal-proof and the wastes regularly removed or buried;
- actions should be initiated to remove the occurrence of Harrisia Cactus and Prickly Pear from the MEP area using recognised control methods, focussing particularly on areas near remnant vegetation. Reasonable measures should be taken to control other LP Act Class 1 and 2 pest species which may become established within the MEP area.
- clear consideration should be given to the final land use of rehabilitated areas. If the goal is native conservation, only native species should be used to provide soil stability and vegetation cover. Furthermore, the use of Buffel Grass in rehabilitated areas adjacent to native vegetation should be strongly discouraged as such activities may promote spread into otherwise unaffected areas and restrict the development of the native vegetation;

- cleared fire breaks should be established between coal dumps to avoid ignition of native vegetation from spontaneous combustion of coal;
- cigarette smoking and the dumping of rubbish (particularly glass) should not be tolerated in areas of vegetation or grass restriction of light vehicle movement in areas outside of regular activity, particularly infrequently used tracks;
- restriction of all vehicle movement during and following rainfall; and
- strict wash-down procedures for all vehicles (including clearing and construction machinery) entering clearance zones, grazing areas or conservation areas.

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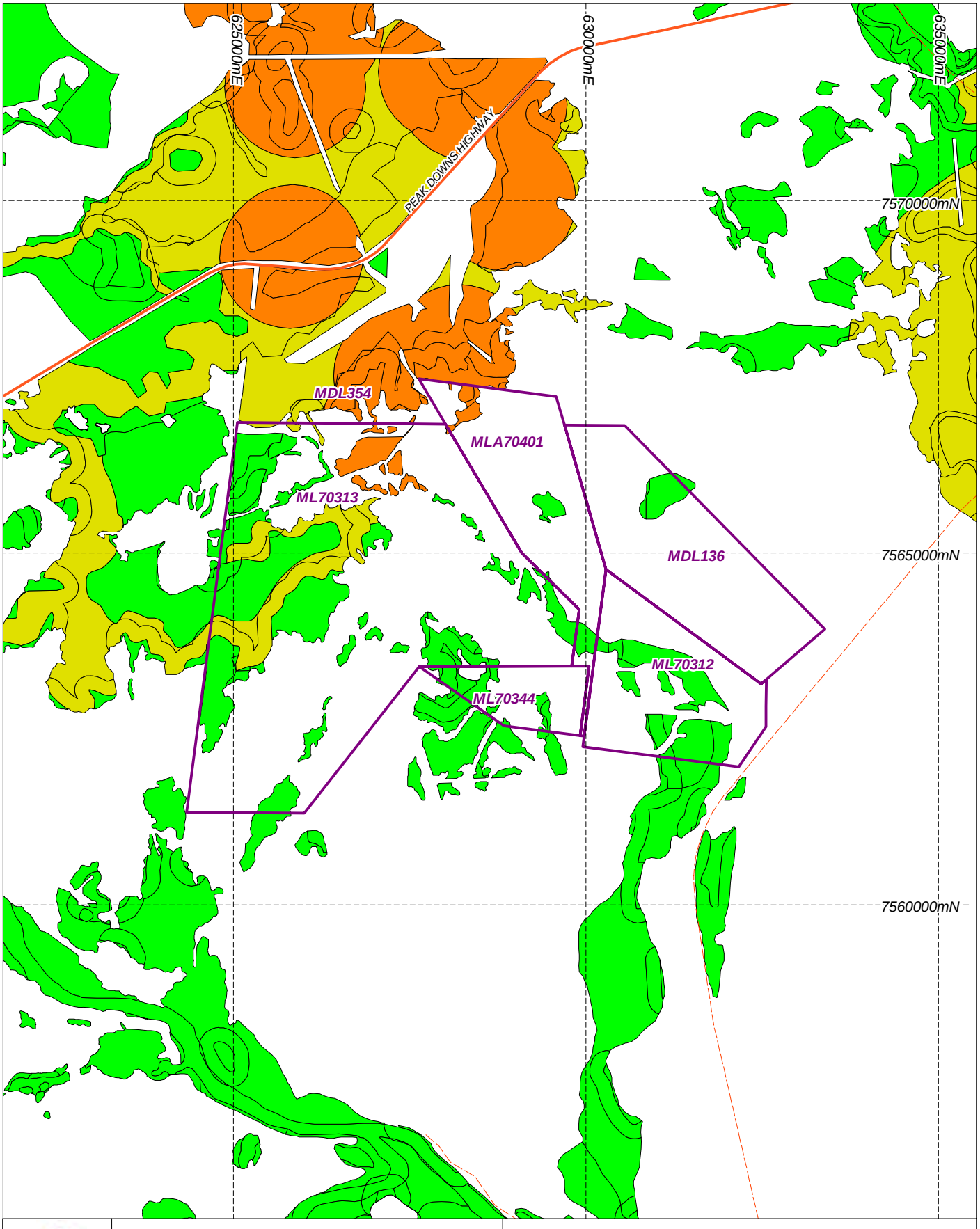
APPENDIX A

BPA MAPPING



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion A - Habitat for EVR Taxa

0 1 2

Kilometres

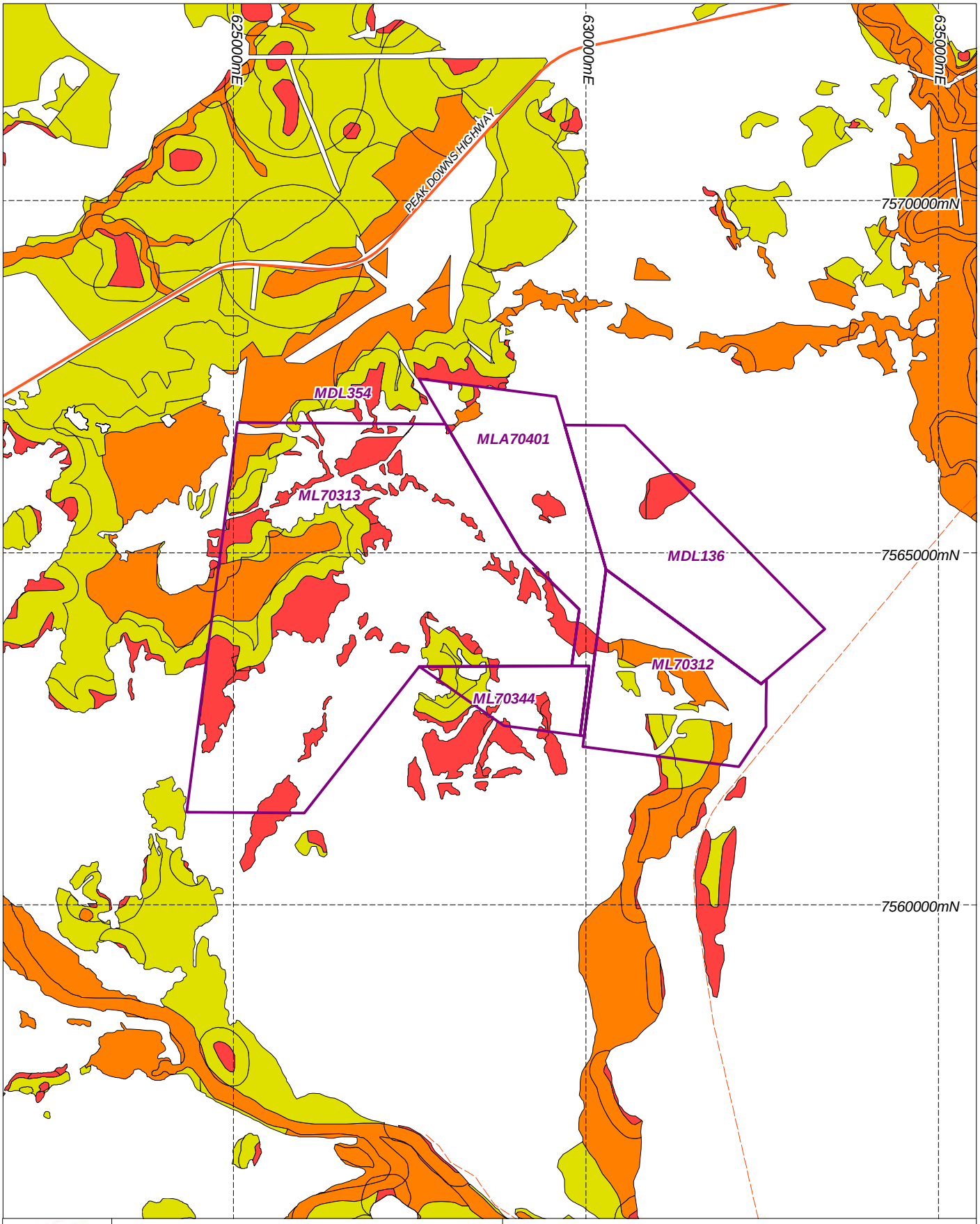
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-1

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M004D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion B - Ecosystem Value

0 1 2

Kilometres

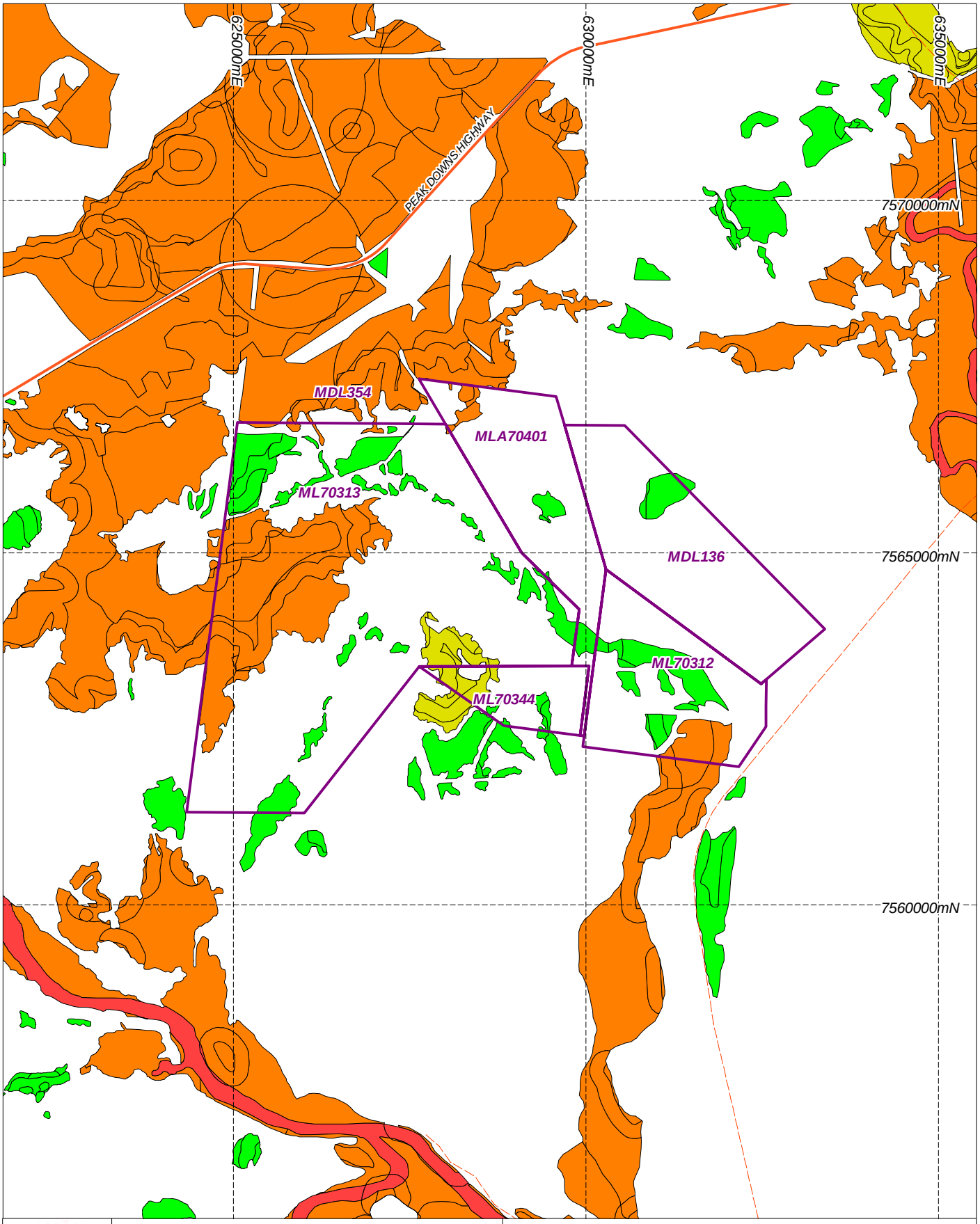
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-2

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M005D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion C - Tract Size

0 1 2

Kilometres

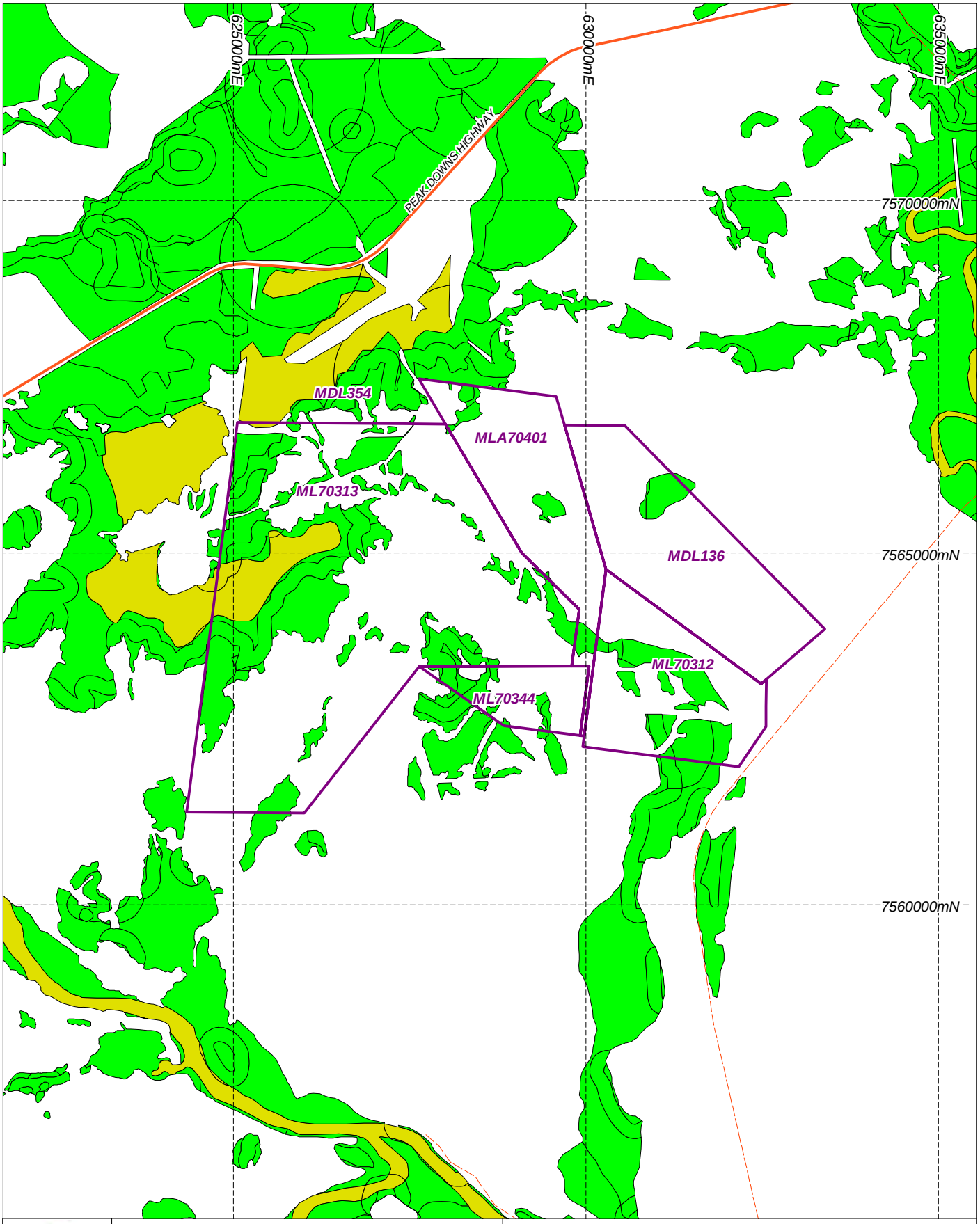
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-3

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M006D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion D - Relative Size of RE

0 1 2

Kilometres

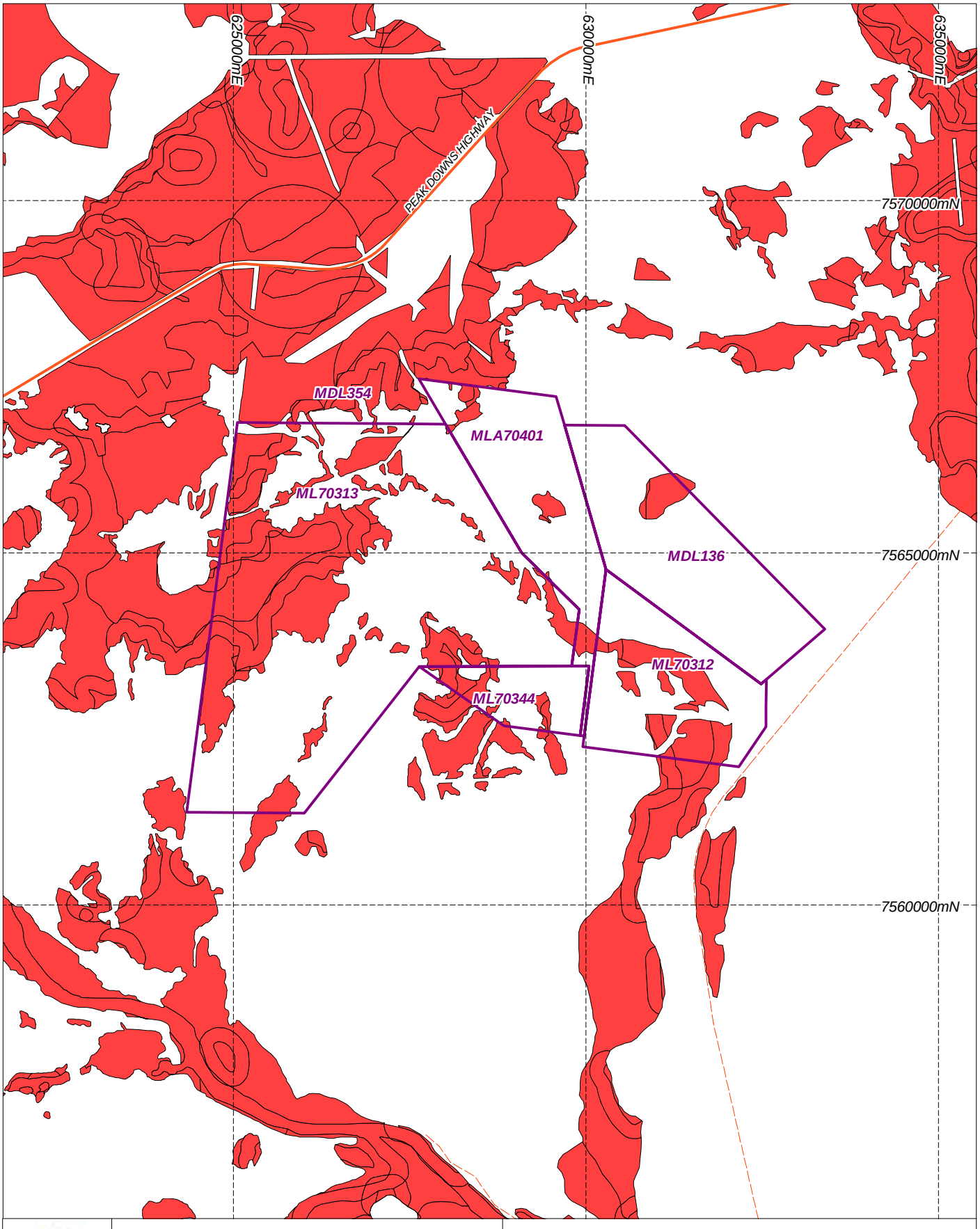
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-4

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M007D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion E - Condition

0 1 2

Kilometres

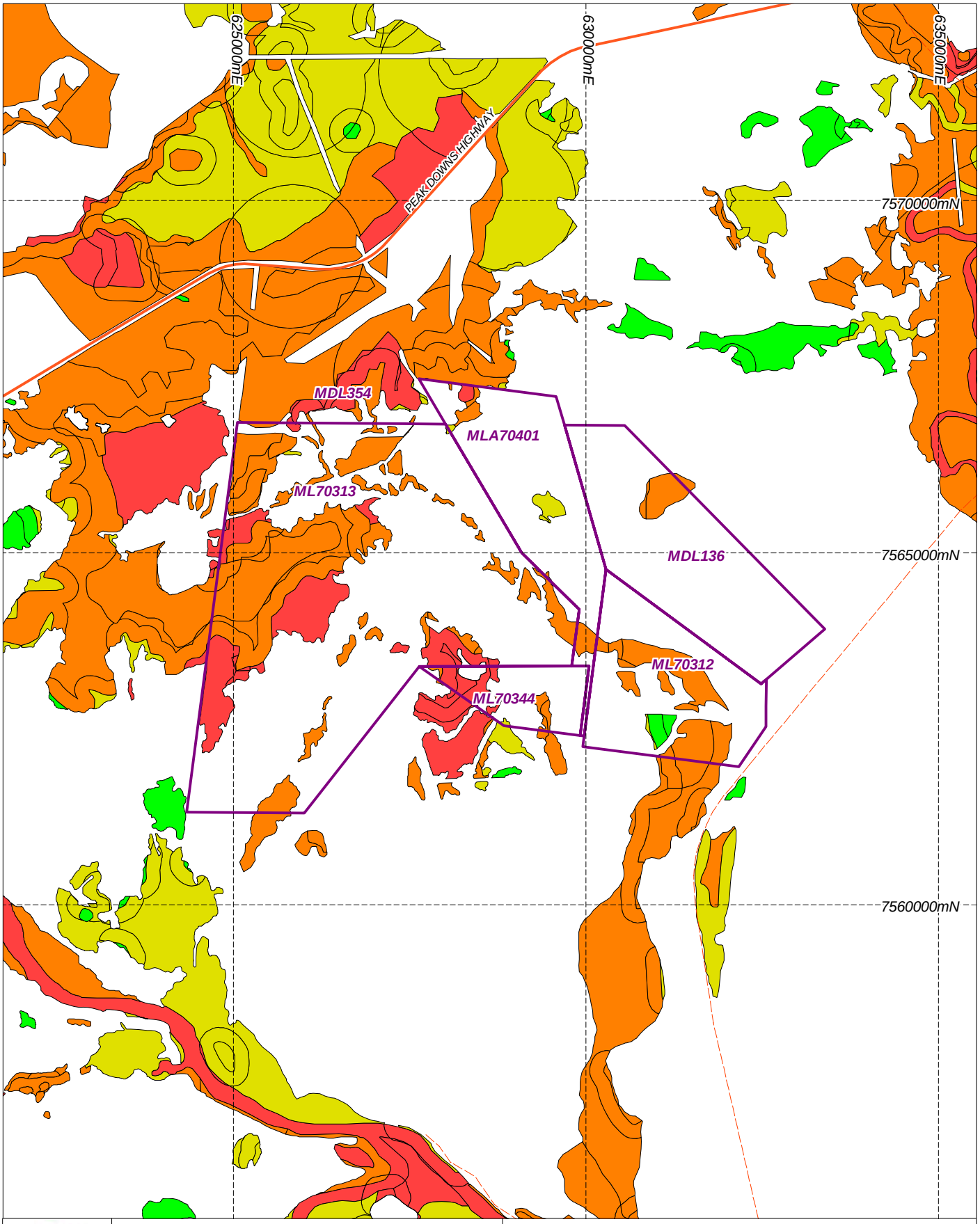
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-5

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M008D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion F - Ecosystem Diversity

0 1 2

Kilometres

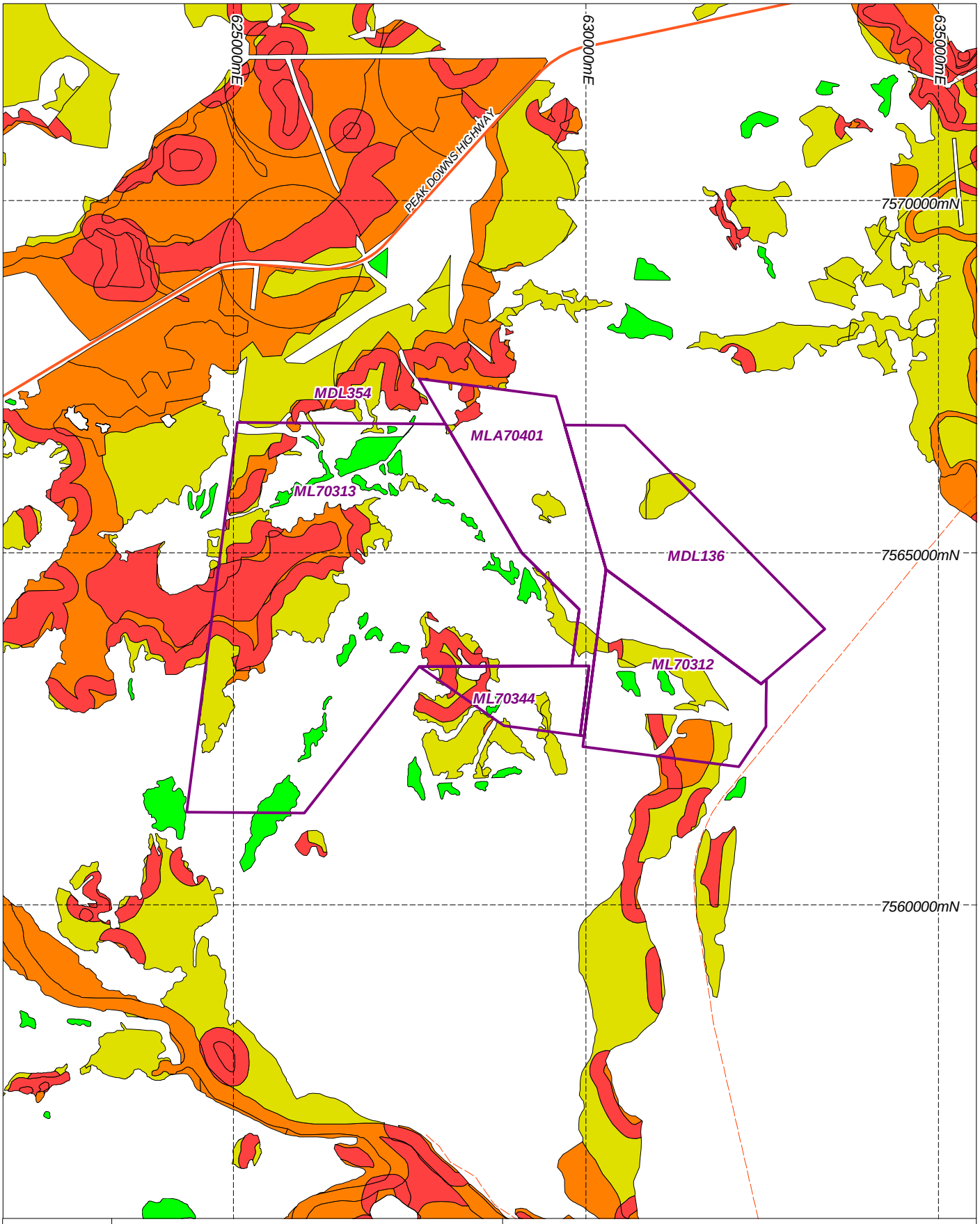
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-6

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M009D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion G - Context & Connection

0 1 2

Kilometres

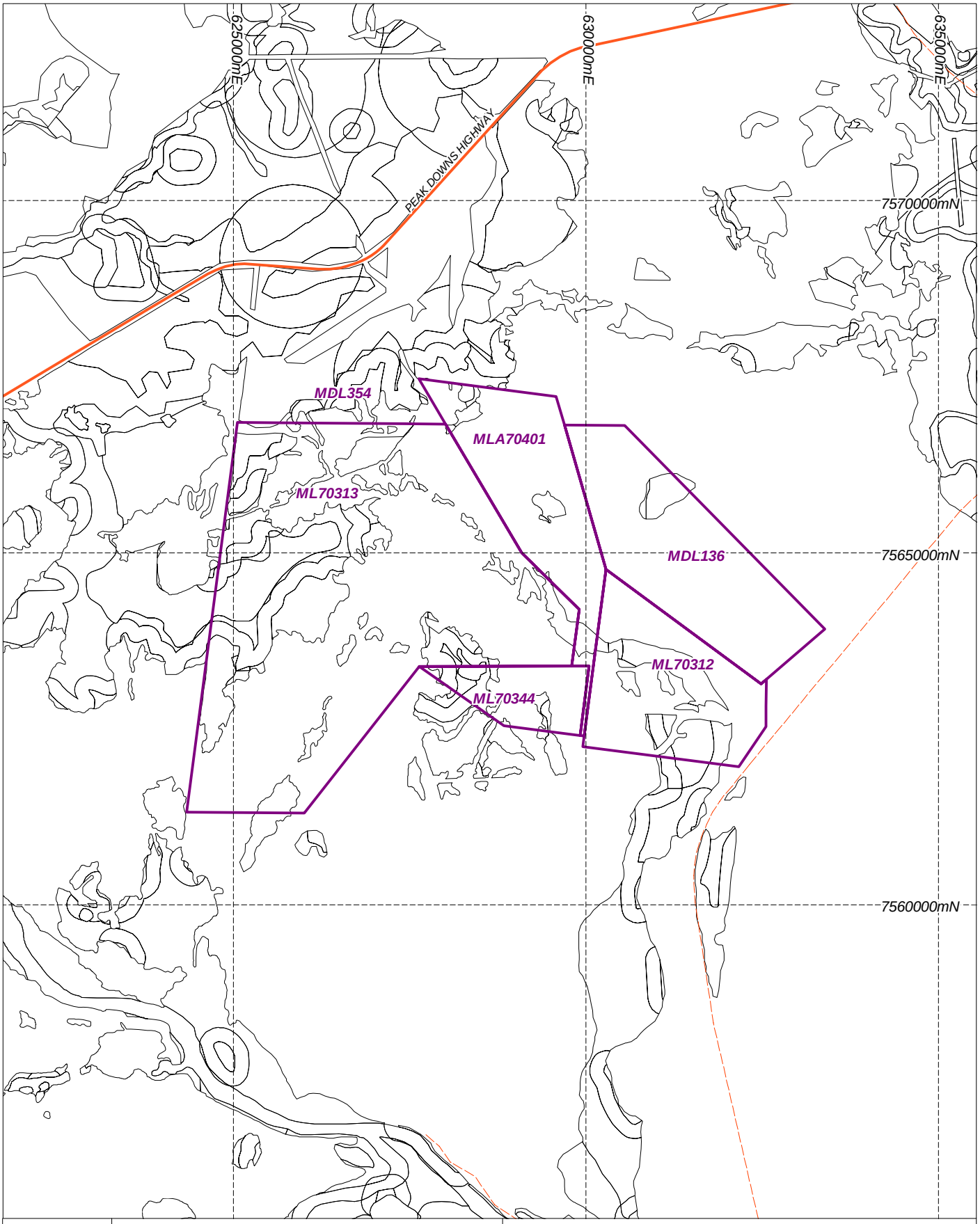
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-7

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M010D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Very High
- High
- Medium
- Low

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion H - Essential & General Habitat for Priority Taxa

0 1 2

Kilometres

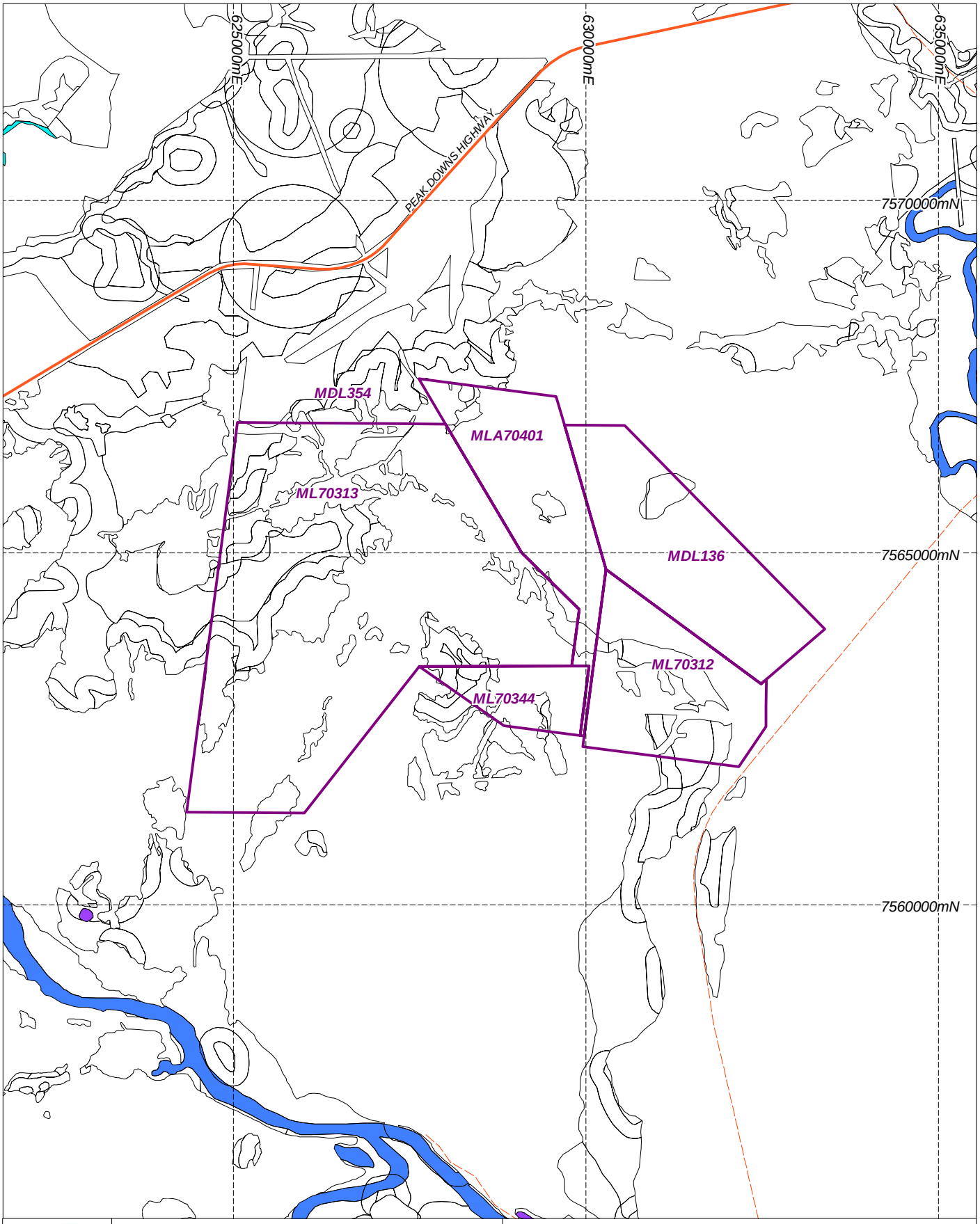
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-8

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M011D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- State
- Regional
- Local

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion I - Special Biodiversity Values

0 1 2

Kilometres

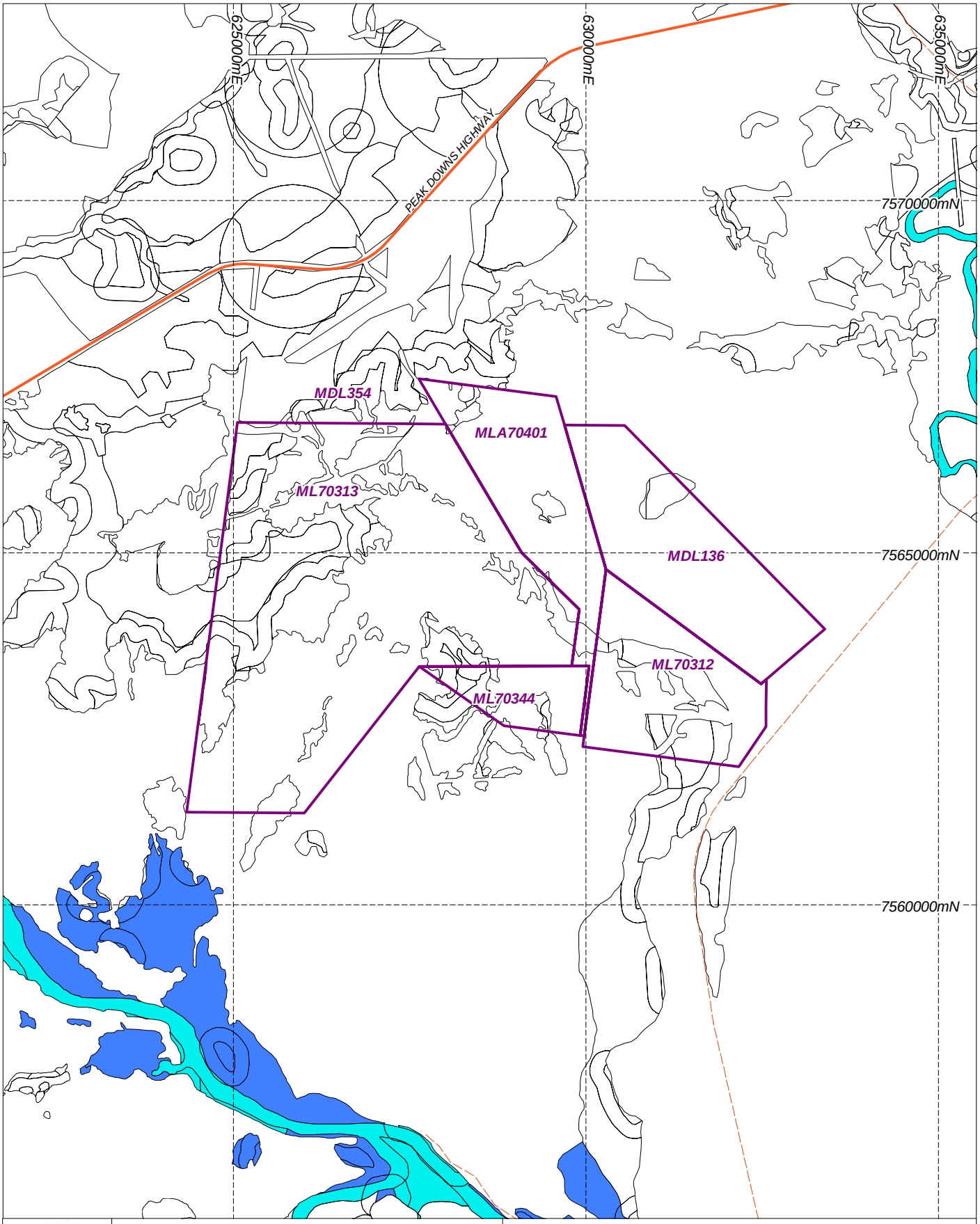
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-9

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M012D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- State
- Regional
- Local

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Criterion J - Corridors

0 1 2

Kilometres

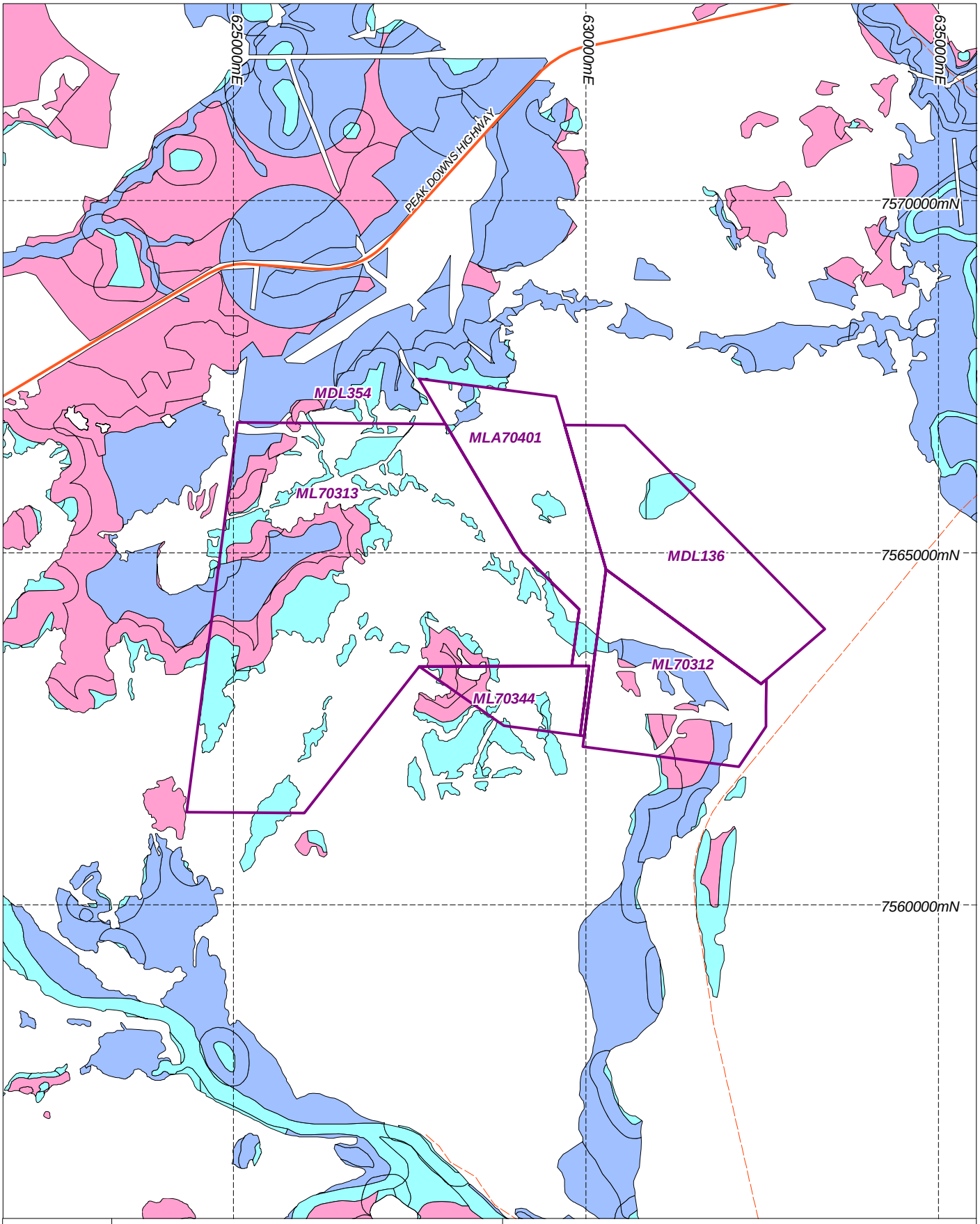
Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-10

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M013D.wor



MET SERVE

Peabody

LEGEND

- MEP Tenement
- Highway
- Track

BAMM Criteria

- Local or Other Values
- Non Bioregion Ecosystem
- Regional
- State
- State Habitat for EVR Taxa

Data Source:
Topography - Geoscience Australia. Tenement - Peabody. Biodiversity - DERM.

Millennium Coal Pty Limited

Millennium Expansion Project

Terrestrial Ecology Assessment

Summary - Biodiversity Significance

0 1 2

Kilometres

Scale: 1:75,000 (A4)

17/06/2009

Datum: GDA94
Projection: MGA55

FIGURE A-11

P:\Projects\Peabody\MapInfo\Workspaces\PEA0801_M014D.wor

APPENDIX B

LITERATURE AND DATABASE RESULTS

Amphibians

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
E = Endangered; V = Vulnerable; R = Rare; I = Introduced; M = Migratory
WildNet = Qld EPA WildNet database; QM = Queensland Museum; Birds Aus = Birds Australia; ERT = Federal Government's Environmental Reporting Tool

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
BUFONIDAE												
	Rhinella marina	Cane toad									x	x
HYLIDAE												
	Cyclorana alboguttata	Green-striped frog			x							x
	Cyclorana novaehollandiae	Eastern snapping frog			x							x
	Litoria caerulea	Green tree frog										x
	Litoria inermis	Bumpy rocketfrog			x							x
	Litoria latopalmata	Broad-palmed rocketfrog			x	x						x
	Litoria rothii	Northern laughing treefrog			x							x
	Litoria rubella	Ruddy treefrog			x							x
LIMNODYNASTIDAE												
	Limnodynastes fletcheri	Long-thumbed frog				x						
	Limnodynastes tasmaniensis	Spotted marsh frog										x
	Limnodynastes terrareginae	Pobblebonk										x
	Platyplectrum ornatum	Ornate burrowing frog			x							x
				Totals:	**7**	**2**	**0**	**0**	**0**	**0**	**1**	**11**

Reptiles

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
E = Endangered; V = Vulnerable; R = Rare; I = Introduced; M = Migratory
WildNet = Qld EPA WildNet database; QM = Queensland Museum; Birds Aus = Birds Australia; ERT = Federal Government's Environmental Reporting Tool

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
AGAMIDAE												
	Amphibolurus burnsi	Burns' dragon				x						
	Diporiphora australis				x	x						
	Pogona barbata	Eastern bearded dragon										x
GEKKONIDAE												
	Diplodactylus conspicillatus	Fat-tailed gecko			x							
	Diplodactylus vittatus	Eastern stone gecko			x	x						x
	Gehyra catenata				x							x
	Gehyra dubia				x	x						x
	Heteronotia binoei	Bynoe's gecko			x	x					x	x
	Lucasium steindachneri	Steindachner's gecko			x							x
	Nephrurus asper	Spiny knob-tailed gecko			x							x
	Oedura marmorata	Marbled velvet gecko										x
	Oedura monilis	Ocellated velvet gecko			x	x						x
	Oedura rhombifer	Zigzag velvet gecko										x
	Strophurus williamsi	Eastern spiny-tailed gecko			x	x						
PYGOPODIDAE												
	Lialis burtonis	Burton's legless lizard			x	x						x
	Paradelma orientalis	Brigalow scaly-foot	V	V				x				

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
SCINCIDAE												
	Anomalopus brevicollis	Short-necked worm-skink	R			x						
	Carlia foliorum	Burnett's skink				x						x
	Carlia munda	Shaded-litter rainbow-skink				x						x
	Carlia pectoralis				x	x						x
	Carlia schmeltzii	Robust rainbow-skink				x						
	Cryptoblepharus carnabyi	Spiny-palmed skink				x						
	Cryptoblepharus pannosus	Ragged snake-eyed skink			x							
	Cryptoblepharus plagiocephalus											x
	Cryptoblepharus virgatus sensu lato				x	x						x
	Ctenotus robustus	Robust skink			x	x			x	x	x	x
	Ctenotus strauchii	Strauch's ctenotus				x						
	Ctenotus taeniolatus	Copper-tailed skink			x	x						x
	Egernia frerei	Major skink										x
	Egernia rugosa	Yakka skink	V	V				x				
	Eulamprus brachysoma					x						
	Glaphyromorphus punctulatus	Fine-spotted mulch-skink				x						
	Lerista fragilis				x	x						x
	Lerista punctatovittata				x							x
	Menetia greyii	Common dwarf skink				x						x
	Menetia sp.											x
	Menetia timlowi				x	x						
	Morethia boulengeri				x	x						x
	Morethia taeniopleura	North-eastern firetail Skink				x						x
	Scincidae	Small skink #1							x			

Family	Scientific Name	Common Name	Status		Source							
			NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Scincidae	Small skink #2							x			
VARANIDAE												
	Varanus tristis	Black-tailed monitor			x	x						x
BOIDAE												
	Antaresia maculosa	Spotted python			x	x						
	Aspidites melanocephalus	Black-headed python				x						
COLUBRIDAE												
	Boiga irregularis	Brown tree snake			x							
	Dendrelaphis punctulatus	Common tree snake				x						x
ELAPIDAE												
	Cryptophis boschmai	Carpentaria snake				x						x
	Denisonia devisi	De Vis' banded snake										x
	Furina diadema	Red-naped snake										x
	Hoplocephalus bitorquatus	Pale-headed snake			x							
	Pseudechis colletti	Collett's black snake	R									x
	Pseudonaja textilis	Eastern brown snake			x	x						
	Suta suta	Curl snake			x							x
	Vermicella annulata	Bandy bandy				x						
TYPHLOPIDAE												
	Ramphotyphlops affinis				x							
	Ramphotyphlops polygrammicus	North-eastern blind snake				x						
	Ramphotyphlops unguirostris				x							
CHELUIDAE												
	Rheodytes leukops	Fitzroy river turtle	V	V				x				
Totals:					**28**	**33**	**0**	**3**	**3**	**1**	**2**	**32**

Birds

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
E = Endangered; V = Vulnerable; R = Rare; I = Introduced; M = Migratory
WildNet = Qld EPA WildNet database; QM = Queensland Museum; Birds Aus = Birds Australia; ERT = Federal Government's Environmental Reporting Tool

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
ACANTHIZIDAE												
	Acanthiza apicalis	Inland thornbill			x							
	Acanthiza chrysorrhoa	Yellow-rumped thornbill			x							
	Acanthiza nana	Yellow thornbill										x
	Acanthiza pusilla	Brown thornbill										x
	Acanthiza reguloides	Buff-rumped thornbill			x							
	Chthonicola sagittata	Speckled warbler			x							x
	Gerygone albogularis	White-throated gerygone			x		x					x
	Smicrornis brevirostris	Weebill			x		x					x
	Accipiter cirrocephalus	Collared sparrowhawk			x							
ACCIPITRIDAE												
	Accipiter fasciatus	Brown goshawk			x							x
	Aquila audax	Wedge-tailed eagle			x		x			x	x	x
	Aviceda subcristata	Pacific baza					x					
	Elanus axillaris	Black-shouldered kite			x		x					x
	Erythrotriorchis radiatus	Red goshawk		V				x				
	Haliaeetus leucogaster	White-bellied sea-eagle		M			x	x				

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Haliastur sphenurus	Whistling kite			x		x					x
	Hieraaetus morphnoides	Little eagle			x							x
	Milvus migrans	Black kite			x		x					x
ACROCEPHALIDAE												
	Acrocephalus australis	Australian reed-warbler			x							
	Acrocephalus stentoreus	Clamorous reed-warbler					x					
AEGOTHELIDAE												
	Aegotheles cristatus	Australian owlet-nightjar			x							x
ALAUDIDAE												
	Mirafra javanica	Horsfield's bushlark			x		x				x	x
ANATIDAE												
	Anas gracilis	Grey teal			x		x		x			x
	Anas superciliosa	Pacific black duck			x		x				x	x
	Aythya australis	Hardhead			x		x					
	Chenonetta jubata	Australian wood duck			x		x				x	x
	Cygnus atratus	Black swan			x		x					
	Dendrocygna arcuata	Wandering whistling-duck					x					x
	Dendrocygna eytoni	Plumed whistling-duck			x		x					x
	Nettapus coromandelianus	Cotton pygmy-goose		M			x	x				
ANHINGIDAE												
	Anhinga novaehollandiae	Australasian darter			x		x					x
ANSERANATIDAE												
	Anseranas semipalmata	Magpie goose		M				x				

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
APODIDAE												
	Apus pacificus	Fork-tailed swift		M				x				
	Hirundapus caudacutus	White-throated needletail		M				x				
ARDEIDAE												
	Ardea ibis	Cattle egret		M				x				x
	Ardea modesta	Eastern great egret*		M	x		x	x				x
	Ardea pacifica	White-necked heron			x		x					x
	Egretta garzetta	Little egret					x					
	Egretta novaehollandiae	White-faced heron			x		x		x			x
	Nycticorax caledonicus	Nankeen night heron					x					
ARTAMIDAE												
	Artamus cinereus	Black-faced woodswallow			x		x				x	x
	Artamus leucorynchus	White-breasted woodswallow			x		x		x	x		x
	Cracticus nigrogularis	Pied butcherbird			x		x		x	x	x	x
	Cracticus tibicen	Australian magpie			x				x		x	x
	Cracticus torquatus	Grey butcherbird			x		x		x		x	x
	Strepera graculina	Pied currawong			x		x		x			x
BURHINIDAE												
	Burhinus grallarius	Bush stone-curlew			x		x					
CACATUIDAE												
	Calyptorhynchus funereus	Yellow-tailed black-cockatoo									x	
	Cacatua galerita	Sulphur-crested cockatoo			x		x		x		x	x
	Cacatua guimea	Little corella										x
	Eolophus roseicapillus	Galah			x		x		x		x	x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Nymphicus hollandicus	Cockatiel			x				x		x	x
CAMPEPHAGIDAE												
	Coracina maxima	Ground cuckoo-shrike			x		x					x
	Coracina novaehollandiae	Black-faced cuckoo-shrike			x		x		x			x
	Coracina papuensis	White-bellied cuckoo-shrike										x
	Coracina tenuirostris	Cicadabird			x		x					x
	Lalage sueurii	White-winged triller			x		x					x
CASUARIIDAE												
	Dromaius novaehollandiae	Emu			x		x					x
CHARADRIIDAE												
	Elseyornis melanops	Black-fronted dotterel			x		x				x	x
	Vanellus miles	Masked lapwing			x		x				x	x
	Vanellus miles miles	Masked lapwing (northern subspecies)			x							
CICONIIDAE												
	Ephippiorhynchus asiaticus	Black-necked stork	R		x		x					
CISTICOLIDAE												
	Cisticola exilis	Golden-headed cisticola			x		x					
CLIMACTERIDAE												
	Climacteris picumnus	Brown treecreeper										x
COLUMBIDAE												
	Geopelia cuneata	Diamond dove					x					
	Geopelia humeralis	Bar-shouldered dove			x		x					x
	Geopelia striata	Peaceful dove			x		x					x
	Geophaps scripta scripta	Squatter pigeon (southern subspecies)	V	V	x		x	x				x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Ocyphaps lophotes	Crested pigeon			x		x		x			x
	Phaps chalcoptera	Common bronzewing			x		x					x
CORACIIDAE												
	Eurystomus orientalis	Dollarbird			x		x				x	x
CORCORACIDAE												
	Corcorax melanorhamphos	White-winged chough			x		x					x
	Struthidea cinerea	Apostlebird			x		x		x	x	x	x
CORVIDAE												
	Corvus bennetti	Little crow			x		x					x
	Corvus coronoides	Australian raven										x
	Corvus orru	Torresian crow			x		x		x	x	x	x
CUCULIDAE												
	Cacomantis flabelliformis	Fan-tailed cuckoo										x
	Cacomantis pallidus	Pallid cuckoo			x		x					
	Centropus phasianinus	Pheasant coucal			x		x					x
	Chalcites basalis	Horsfield's bronze-cuckoo			x							x
	Chalcites lucidus	Shining bronze-cuckoo			x							
	Chalcites minutillus minutillus	Little bronze-cuckoo			x							
	Chalcites osculans	Black-eared cuckoo										x
	Eudynamys orientalis	Eastern koel			x		x			x		x
	Scythrops novaehollandiae	Channel-billed cuckoo			x		x					x
DICRURIDAE												
	Dicrurus hottentottus	Spangled drongo										x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
ESTRILDIDAE												
	Lonchura castaneothorax	Chestnut-breasted mannikin			x		x					
	Neochmia modesta	Plum-headed finch									x	
	Neochmia ruficauda ruficauda	Star finch		E				x				
	Taeniopygia bichenovii	Double-barred finch			x		x		x		x	x
	Taeniopygia guttata	Zebra finch			x						x	x
EUROSTOPODIDAE												
	Eurostopodus mystacalis	White-throated nightjar			x							x
FALCONIDAE												
	Falco berigora	Brown falcon			x		x		x	x	x	x
	Falco cenchroides	Nankeen kestrel			x		x		x		x	x
	Falco longipennis	Australian hobby			x		x					x
	Falco peregrinus	Peregrine falcon										x
GRUIDAE												
	Grus rubicunda	Brolga			x		x				x	x
HALCYONIDAE												
	Dacelo leachii	Blue-winged kookaburra			x		x					x
	Dacelo novaeguineae	Laughing kookaburra			x				x	x	x	x
	Todiramphus macleayii	Forest kingfisher			x		x					x
	Todiramphus pyrrhopygius	Red-backed kingfisher			x		x		x			
	Todiramphus sanctus	Sacred kingfisher			x		x					x
HIRUNDINIDAE												
	Hirundo neoxena	Welcome swallow			x		x					x
	Petrochelidon ariel	Fairy martin			x		x					x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Petrochelidon nigricans	Tree martin			x		x					x
LARIDAE												
	Chlidonias hybridus	Whiskered tern					x					
	Larus novaehollandiae	Silver gull					x					
MALURIDAE												
	Malurus cyaneus	Superb fairy-wren			x							
	Malurus lamberti	Variegated fairy-wren			x		x					x
	Malurus melanocephalus	Red-backed fairy-wren			x		x		x		x	x
MEGALURIDAE												
	Cincloramphus mathewsi	Rufous songlark			x							x
	Megalurus gramineus	Little grassbird										x
	Megalurus timoriensis	Tawny grassbird										x
MELIPHAGIDAE												
	Acanthagenys rufogularis	Spiny-cheeked honeyeater			x		x					x
	Entomyzon cyanotis	Blue-faced honeyeater			x		x					x
	Lichenostomus chrysops	Yellow-faced honeyeater			x						x	x
	Lichenostomus flavicollis	Yellow-throated honeyeater										x
	Lichenostomus virescens	Singing honeyeater			x		x					x
	Lichmera indistincta	Brown honeyeater			x		x					x
	Manorina flavigula	Yellow-throated miner			x		x		x		x	x
	Manorina melanocephala	Noisy miner			x		x		x		x	x
	Meliphaga lewinii	Lewin's honeyeater			x							
	Melithreptus albogularis	White-throated honeyeater			x		x		x			x
	Melithreptus gularis	Black-chinned honeyeater	R		x		x					x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Myzomela obscura	Dusky honeyeater					x					
	Philemon citreogularis	Little friarbird			x		x			x		x
	Philemon corniculatus	Noisy friarbird			x		x		x	x		x
	Plectorhyncha lanceolata	Striped honeyeater			x		x					x
MEROPIDAE												
	Merops ornatus	Rainbow bee-eater		M	x		x	x			x	x
MONARCHIDAE												
	Grallina cyanoleuca	Magpie-lark			x		x		x		x	x
	Monarcha melanopsis	Black-faced monarch		M			x	x				x
	Myiagra cyanoleuca	Satin flycatcher		M				x				x
	Myiagra inquieta	Restless flycatcher					x					
	Myiagra rubecula	Leaden flycatcher			x							x
MOTACILLIDAE												
	Anthus novaeseelandiae	Australasian pipit			x		x		x		x	x
NECTARINIIDAE												
	Dicaeum hirundinaceum	Mistletoebird			x		x					x
NEOSITTIDAE												
	Daphoenositta chrysoptera	Varied sittella			x							x
ORIOLIDAE												
	Oriolus sagittatus	Olive-backed oriole			x		x					x
	Sphecotheres vieilloti	Australasian figbird			x		x					x
OTIDIDAE												
	Ardeotis australis	Australian bustard			x		x					x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
PACHYCEPHALIDAE												
	Colluricincla harmonica	Grey shrike-thrush			x		x					x
	Pachycephala pectoralis	Golden whistler										x
	Pachycephala rufiventris	Rufous whistler			x		x		x			x
PARDALOTIDAE												
	Pardalotus rubricatus	Red-browed pardalote										x
	Pardalotus striatus	Striated pardalote			x		x		x		x	x
PASSERIDAE												
	Passer domesticus	House sparrow	I		x		x					
PELECANIDAE												
	Pelecanus conspicillatus	Australian pelican			x		x			x		x
PETROICIDAE												
	Microeca fascinans	Jacky winter			x		x					x
PHALACROCORACIDAE												
	Microcarbo melanoleucos	Little pied cormorant			x						x	
	Phalacrocorax melanoleucos	Little pied cormorant					x					
	Phalacrocorax sulcirostris	Little black cormorant			x	x	x					
	Phalacrocorax varius	Pied cormorant					x					
PHASIANIDAE												
	Coturnix chinensis	King quail										x
	Coturnix pectoralis	Stubble quail			x							
	Coturnix ypsilophora	Brown quail			x		x					x
PODARGIDAE												
	Podargus strigoides	Tawny frogmouth			x				x		x	x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
PODICIPEDIDAE												
	Podiceps cristatus	Great crested grebe					x					
	Tachybaptus novaehollandiae	Australasian grebe			x		x					x
POMATOSTOMIDAE												
	Pomatostomus temporalis	Grey-crowned babbler			x		x		x	x	x	x
PSITTACIDAE												
	Aprosmictus erythropterus	Red-winged parrot			x		x		x		x	x
	Melopsittacus undulatus	Budgerigar							x			x
	Platycercus adscitus	Pale-headed rosella			x	x	x		x	x	x	x
	Platycercus adscitus palliceps	Pale-headed rosella (southern form)			x							
	Trichoglossus chlorolepidotus	Scaly-breasted lorikeet										x
	Trichoglossus haematodus moluccanus	Rainbow lorikeet			x		x				x	x
PTILONORHYNCHIDAE												
	Ptilonorhynchus maculatus	Spotted bowerbird			x		x					x
	Ptilonorhynchus nuchalis	Great bowerbird			x		x					x
RALLIDAE												
	Fulica atra	Eurasian coot					x					x
	Gallinula tenebrosa	Dusky moorhen			x		x					
	Porphyrio porphyrio	Purple swamphen			x		x					
RECURVIROSTRIDAE												
	Himantopus himantopus	Black-winged stilt					x					x
RHIPIDURIDAE												
	Rhipidura albiscapa	Grey fantail			x		x		x			x
	Rhipidura leucophrys	Willie wagtail			x		x		x	x	x	x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Rhipidura rufifrons	Rufous fantail		M								x
ROSTRATULIDAE												
	Rostratula australis	Australian painted snipe		V				x				
	Rostratula benghalensis s. lato	Painted snipe		M				x				
SCOLOPACIDAE												
	Calidris acuminata	Sharp-tailed sandpiper					x					
	Gallinago hardwickii	Latham's snipe		M				x				
	Numenius minutus	Little whimbrel		M				x				
	Tringa nebularia	Common greenshank					x					
	Tringa stagnatilis	Marsh sandpiper					x					
STRIGIDAE												
	Ninox connivens	Barking owl			x		x					
	Ninox novaeseelandiae	Southern boobook			x		x			x		x
THRESKIORNITHIDAE												
	Platalea flavipes	Yellow-billed spoonbill			x		x					x
	Platalea regia	Royal spoonbill			x		x					
	Threskiornis molucca	Australian white ibis			x		x					x
	Threskiornis spinicollis	Straw-necked ibis			x		x					x
TIMALIIDAE												
	Zosterops lateralis	Silvereye			x					x		
TURNICIDAE												
	Turnix varius	Painted button-quail			x							
TYTONIDAE												
	Tyto javanica	Eastern barn owl										x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Tyto novaehollandiae	Masked owl										x
Totals:					**136**	**2**	**127**	**17**	**35**	**16**	**39**	**134**

Mammals

Legend
EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
E = Endangered; V = Vulnerable; R = Rare; I = Introduced; M = Migratory
WildNet = Qld EPA WildNet database; QM = Queensland Museum; Birds Aus = Birds Australia; ERT = Federal Government's Environmental Reporting Tool

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
DASYURIDAE												
	Dasyurus hallucatus	Northern quoll		E				x				
	Sminthopsis macroura	Stripe-faced dunnart			x							x
	Planigale maculata	Common planigale										x
MACROPODIDAE												
	Lagorchestes conspicillatus	Spectacled hare-wallaby			x							
	Macropus dorsalis	Black-striped wallaby			x				x			
	Macropus giganteus	Eastern grey kangaroo			x				x	x	x	x
	Macropus robustus	Common wallaroo			x				x			x
	Petrogale inornata	Unadorned rock-wallaby							x			
	Petrogale herberti	Herbert's rock-wallaby										x
	Wallabia bicolor	Swamp wallaby			x				x			x
POTOROIDAE												
	Aepyprymnus rufescens	Rufous bettong			x	x			x			x
PEREMELIDAE												
	Peremeles sp.	Bandicoot										x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
PETAURIDAE												
	Petaurus breviceps	Sugar glider							x			
	Petaurus australis	Yellow-bellied glider										x
PSEUDOCHEIRIDAE												
	Petauroides volans	Greater glider			x							x
PHALANGERIDAE												
	Trichosurus vulpecula	Common brushtail possum			x	x			x			x
PHASCOLARCTIDAE												
	Phascolarctos cinereus	Koala			x							
TACHYGLOSSIDAE												
	Tachyglossus aculeatus	Short-beaked echidna			x				x		x	x
EMBALLONURIDAE												
	Saccolaimus flaviventris	Yellow-bellied sheathtail bat			x				x	x		x
	Taphozous troughtoni	Troughton's sheathtail bat	E		x				x	x	x	
MOLOSSIDAE												
	Austronomus australis	White-striped freetail bat										x
	Chaerephon jobensis	Northern freetail bat			x				x	x		x
	Mormopterus beccarii	Beccari's freetail bat			x				x	x	x	
	Mormopterus sp.				x				x		x	
	Mormopterus sp. 2											x
	Mormopterus sp. 6											x
VESPERTILIONIDAE												
	Chalinolobus gouldii	Gould's wattled bat			x				x	x	x	x
	Chalinolobus morio	Chocolate wattled bat			x				x			

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
	Chalinolobus nigrogriseus	Hoary wattled bat			x				x	x		x
	Chalinolobus picatus	Little pied bat	R		x				x	x	x	x
	Miniopterus australis	Little bent-wing bat			x				x			x
	Nyctophilus gouldi	Gould's long-eared bat			x				x			
	Nyctophilus sp.				x				x			
	Nyctophilus timoriensis (sp. 2)	Eastern Long-eared bat (SE form)	V	V				x				
	Scotorepens balstoni	Inland broad-nosed bat			x				x			x
	Scotorepens greyii	Little broad-nosed bat			x				x	x	x	x
	Vespadelus baverstocki	Inland forest bat			x							x
	Vespadelus troughtoni	Eastern cave bat			x				x	x		x
	Microbat spp. calling at 39-42 kHz								x	x		
PTEROPODIDAE												
	Pteropus scapulatus	Little red flying-fox			x							x
LEPORIDAE												
	Oryctolagus cuniculus	Rabbit	I					x	x	x	x	
MURIDAE												
	Mus musculus	House mouse	I		x							x
	Pseudomys delicatulus	Delicate mouse			x							x
	Pseudomys gracilicaudatus	Eastern chestnut mouse										x
	Rattus tunneyi	Pale field rat										x
	Rattus sp.	Rat				x						
CANIDAE												
	Canis familiaris	Dingo/dog	I									x
	Vulpes vulpes	Fox	I					x				x

Family			Status		Source							
	Scientific Name	Common Name	NCA	EPBC	WildNet	QM	Birds Aus	ERT	Smith (2003)	Smith (2004)	Smith (2006)	Daunia
FELIDAE												
	Felis catus	Cat	I					x				x
BOVIDAE												
	Bos taurus	Cattle	I								x	x
SUIDAE												
	Sus scrofa	Pig	I									x
Totals:					**30**	**3**	**0**	**5**	**26**	**12**	**10**	**35**

APPENDIX C

UNLIKLEY EVR SPECIES

Legend

EPBC = Environment Protection and Biodiversity Conservation Act 1999
NCA = Queensland Nature Conservation Act 1992
E = Endangered; V = Vulnerable; R = Rare; M = Migratory

Name	NCA status	EPBC status	Comments
REPTILES			
Egernia rugosa Yakka skink	V	V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Yakka Skinks inhabit a variety of dry forest types and may be found in highly modified habitats. While it is often associated with fallen debris or soil dumps (in which the species shelters) in habitats with relatively open ground covers, its occurrence is notoriously difficult to predict. Nevertheless, habitat within the MEP area is not consistent with ideal habitat and hence the species is not expected to occur.
Rheodytes leukops Fitzroy River turtle	V	V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. The species inhabits permanent watercourses with riffle zones and large lentic pools. No suitable habitat is present.
Anomalopus brevicollis Short-necked worm-skink	R		Little is known about the habits of this cryptic species. Most records occur on black cracking clays or rocky vine thicket gullies. Habitats within the MEP are marginal for this species.
Pseudechis colletti Collett's snake	R		The known range of this species is over 300km to the west of the project area in different habitat to any found around the MEP area. The one record of this species from the Moranbah region is presumably erroneous. It is highly unlikely that this species occurs in the region.
BIRDS			
Erythrotriorchis radiatus Red goshawk	E	V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Red Goshawks are a highly mobile species, able to cover a variety of habitat types. However, most remaining pairs are associated with large areas of contiguous woodland habitat. The highly fragmented nature of the surrounding region suggests the species is unlikely to occur.
Ephippiorhynchus asiaticus Black-necked Stork	R		This species has been recorded from specimen- or observation-based databases and is therefore present within the local area. Black-necked storks inhabit a variety of wetland associated habitats including rivers, lakes, dams, estuaries and can be found in flooded paddocks. While they may occasionally be located around extremely small ephemeral waterbodies, observations of this nature are uncommon. Little habitat for this species occurs on the Project site, restricted to the western dam. This dam is affected by mine water and is not considered to hold good values for the species.
Neochmia ruficauda ruficauda Star Finch	E	E	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. An inhabitant of open native grasslands and woodlands, particularly those associated with watercourses, the species is extremely uncommon in the local area and rarely detected. Heavy infestations of Buffel Grass inhibit native grass growth and diversity (Fairfax and Fensham 2000, Frank 2002, Greenfield 2007) and outcompete native species. Most granivorous birds do not eat Buffel Grass seeds (Low 1997) and thick Buffel Grass infestations render the habitat unsuitable. These groups of birds are often considerably less common in Buffel Grass dominated landscapes (Franks *et al*. 2000). Hence, habitats within the Project site are unlikely to be suitable or at best marginal for this species.

Name	NCA status	EPBC status	Comments
Melithreptus gularis Black-chinned Honeyeater	R		This species has been recorded from specimen- or observation-based databases and is therefore present within the local area. Black-chinned Honeyeaters inhabit a variety of open woodland and dry eucalypt forest communities. They are most often associated with local flowering events and may therefore be locally nomadic. They are very uncommon within the region and records probably represent transient individuals.
Haliaeetus leucogaster White-bellied Sea-Eagle		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. Inhabits coastlines, lakes, large dams, inland rivers and waterways. No suitable habitat present.
Nettapus coromandelianus Cotton Pygmy-goose		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. Cotton Pygmy-geese inhabit permanent wetlands, particularly those with open water and extensive floating vegetative growth. No suitable habitat occurs within the Project site.
Ardea ibis Cattle Egret		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area and not expected to occur.
Anseranas semipalmata Magpie Goose		M	This species has been recorded from the local region, but not on the project site itself. An uncommon species in the local area and not expected to occur. No suitable habitat occurs in the MEP area.
Monarcha melanopsis Black-faced Monarch		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which typically inhabits wet forests and rainforests. Not expected to occur.
Myiagra cyanoleuca Satin Flycatcher		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which is not expected to occur.
Rhipidura rufifrons Rufous Fantail		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which typically inhabits wet forests and rainforests. Not expected to occur.
Rostratula australis Australian Painted Snipe		V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen or observation based databases were present and hence the species may not occur within the local area. Australian Painted Snipes preferentially inhabit ephemeral and semi-ephemeral wetlands with emergent aquatic and semi-aquatic vegetation. No suitable habitat for this species occurs within the Project site.
Rostratula benghalensis s. lato Painted Snipe	V	M	As for *Rostratula australis*
Gallinago hardwickii Latham's Snipe		M	As for *Rostratula australis*
Numenius minutus Little Whimbrel		M	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen or observation based databases were present and hence the species may not occur within the local area. A coastal species which inhabits mudflats, saline creeklines and saltflats. No suitable habitat present.

Name	NCA status	EPBC status	Comments
MAMMALS			
Dasyurus hallucatus Northern quoll		E	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Northern Quolls historically inhabited a variety of habitat types ranging from open woodlands to more closed mesic forests. However they have significantly declined due to land clearing, feral predation and poisoning from Cane Toad ingestion (Maxwell *et al*. 1996). Fire ecology may also impact some populations by affecting community structure and prey items (A. Dinwoodie pers. comm.). Most records now occur in areas of large continuous vegetation or where there are abundant rock outcrops, overhangs and fissures. Some suitable, but highly fragmented, habitat occurs on Red Hill.
Taphozous troughtoni Troughton's sheathtail bat	E		This species has been recorded in observation- or specimen-based databases. The taxon was listed as Endangered under Queensland legislation when it was thought to be entirely restricted to the Mt Isa region. Work by Reardon *et al* (2001) has shown this species to be much more widespread than previously thought.
Nyctophilus timoriensis (sp. 2) Eastern long-eared bat (SE form)	V	V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Eastern Long-eared Bats are not common within the region. Most records seem to be associated with large contiguous stands of vegetation containing Brigalow, Casuarina and/or Callitris. Field assessment suggests that habitats present are marginal and highly fragmented. It is therefore unlikely that this species will occur.

Appendix C References:

Maxwell, S., Burbidge, A. A. and Morris, K., (1996). The Action Plan for Australian Marsupials and
Monotremes. IUCN Species Survival Commission and Environment Australia: Canberra.

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Thomson, B., C. Pavey, and T. Reardon (2001). Recovery plan for cave-dwelling bats, Rhinolophus philippinensis, Hipposideros semoni and Taphozous troughtoni 2001-2005. [Online]. Queensland Parks and Wildlife Service.

Available from:
http://www.epa.qld.gov.au/publications/p00170aa.pdf/Recovery_plan_for_cavedwelling_bats_emRhinolophus_philippinensis/em_emHipposideros_semoni/em_and_emTaphozous_troughtoni/em_20012005.pdf

APPENDIX D

MET SERVE TERRESTRIAL ECOLOGY SURVEY SPECIES LISTS

1 AMPHIBIANS

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
End = Endangered; Vul = Vulnerable; Rar = Rare; I = Introduced; Mig = Migratory
MILXX = trapping site; TAXX = Targeted site; HpXXXX = Harp trap site; Opp = Opportunistic sighting

FAMILY		Common name	Status		Sites											
	Scientific name		EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
BUFONIDAE																
	Rhinella marina	Cane toad		I	x	x	x	x	x							x
HYLIDAE																
	Cyclorana brevipes	Spade-footed frog			x		x		x							
	Litoria caerulea	Green tree frog			x	x	x	x	x				x			
	Litoria rubella	Desert tree frog							x							
MYOBATRACHIDAE																
	Platyplectrum ornatum	Ornate burrowing frog			x		x	x	x			x				
Totals (species = 5):					**4**	**2**	**4**	**3**	**5**	**0**	**0**	**1**	**1**	**0**	**0**	**1**

2 REPTILES

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
End = Endangered; Vul = Vulnerable; Rar = Rare; I = Introduced; Mig = Migratory
MILXX = trapping site; TAXX = Targeted site; HpXXXX = Harp trap site; Opp = Opportunistic sighting

FAMILY		Common name	Status		Sites											
	Scientific name		EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
AGAMIDAE																
	Diporiphora australis	Tommy roundhead									x					
	Pogona barbata	Eastern bearded dragon														x
BOIDAE																
	Antaresia maculosa	Spotted python														x
ELAPIDAE																
	Cryptophis boschmai	Carpentaria snake							x							
GEKKONIDAE																
	Diplodactylus conspicillatus	Fat-tailed gecko				x										
	Heteronotia binoei	Bynoe's gecko						x								
	Nephrurus asper	Prickly knob-tailed gecko											x			x
	Oedura monilis	Ocellated velvet gecko											x			
PYGOPODIDAE																
	Paradelma orientalis	Brigalow scaly-foot	Vul	Vul				x								
SCINCIDAE																
	Carlia pectoralis	Open-litter rainbow-skink			x	x		x								
	Ctenotus robustus	Eastern striped skink				x		x	x			x	x			
	Ctenotus strauchii	Eastern barred wedgesnout ctenotus							x							

FAMILY		Status		Sites											
Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
Ctenotus taeniolatus	Copper-tailed skink				x			x		x					
Lerista fragilis	Eastern mulch-slider			x											
Menetia greyii	Common dwarf skink			x				x							
Tiliqua scincoides	Common blue-tongued skink						x								
Totals (species = 16):				**3**	**4**	**0**	**5**	**5**	**0**	**2**	**1**	**3**	**0**	**0**	**3**

3 BIRDS

Legend

EPBC = Environment Protection and Biodiversity Conservation Act
NCA = Nature Conservation Act
End = Endangered; Vul = Vulnerable; Rar = Rare; I = Introduced; Mig = Migratory
MILXX = trapping site; TAXX = Targeted site; HpXXXX = Harp trap site; Opp = Opportunistic sighting

FAMILY		Common name	Status		Sites											
	Scientific name		EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
ACANTHIZIDAE																
	Acanthiza apicalis	Inland thornbill				x										
	Acanthiza reguloides	Buff-rumped thornbill				x			x							
	Gerygone albogularis	White-throated gerygone					x									
	Smicrornis brevirostris	Weebill				x	x					x				x
ACCIPITRIDAE																
	Accipiter fasciatus	Brown goshawk			x								x			x
	Aquila audax	Wedge-tailed eagle												x		
	Milvus migrans	Black kite														x
AEGOTHELIDAE																
	Aegotheles cristatus	Australian owlet-nightjar				x			x							
ALAUDIDAE																
	Mirafra javanica	Horsfield's bushlark								x						x
ANATIDAE																
	Anas gracilis	Grey teal								x						x
	Anas superciliosa	Pacific Black duck								x						
ANHINGIDAE																
	Anhinga novaehollandiae	Australasian darter								x						

FAMILY			Status		Sites											
	Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
ARDEIDAE																
	Ardea intermedia	Intermediate egret								x						
	Ardea modesta	Eastern Great egret*								x						
	Ardea pacifica	White-necked heron								x						x
	Egretta novaehollandiae	White-faced heron								x						
ARTAMIDAE																
	Artamus cinereus	Black-faced woodswallow								x						
	Cracticus nigrogularis	Pied butcherbird			x	x		x	x					x		x
	Cracticus tibicen	Australian magpie				x		x	x							x
	Cracticus torquatus	Grey butcherbird				x	x		x				x			x
	Strepera graculina	Pied currawong				x							x			
CACATUIDAE																
	Eolophus roseicapillus	Galah			x											x
CAMPEPHAGIDAE																
	Coracina novaehollandiae	Black-faced cuckoo-shrike						x	x							x
CASUARIIDAE																
	Dromaius novaehollandiae	Emu														x
CHARADRIIDAE																
	Elseyornis melanops	Black-fronted dotterel								x						
CISTICOLIDAE																
	Cisticola exilis	Golden-headed cisticola														x
COLUMBIDAE																
	Geopelia humeralis	Bar-shouldered dove				x			x					x		x
	Geopelia striata	Peaceful dove			x	x										x
	Ocyphaps lophotes	Crested pigeon						x								x
	Phaps chalcoptera	Common bronzewing				x										

FAMILY		Status		Sites											
Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
CORCORACIDAE															
Corcorax melanorhamphos	White-winged chough				x			x							
Struthidea cinerea	Apostlebird							x							
CORVIDAE															
Corvus orru	Torresian crow			x		x									x
CUCULIDAE															
Centropus phasianinus	Pheasant coucal							x							x
DICRURIDAE															
Dicrurus bracteatus	Spangled drongo				x			x							
ESTRILDIDAE															
Taeniopygia bichenovii	Double-barred finch				x			x		x					x
Taeniopygia guttata	Zebra finch								x						x
EUROSTOPODUS															
Eurostopodus argus	Spotted nightjar														x
FALCONIDAE															
Falco berigora	Brown falcon														x
Falco cenchroides	Nankeen kestrel												x		x
Falco longipennis	Australian hobby								x						
GRUIDAE															
Grus rubicunda	Brolga										x				x
HALCYONIDAE															
Dacelo leachii	Blue-winged kookaburra							x							
Dacelo novaeguineae	Laughing kookaburra			x	x			x							x
Todiramphus sanctus	Sacred kingfisher					x									
HIRUNDINIDAE															
Petrochelidon ariel	Fairy martin														x

FAMILY			Status		Sites											
	Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
	Petrochelidon nigricans	Tree martin														x
MALURIDAE																
	Malurus lamberti	Variegated fairy-wren							x							
	Malurus melanocephalus	Red-backed fairy-wren				x		x			x				x	x
MEGALURIDAE																
	Cincloramphus mathewsi	Rufous songlark								x						
MELIPHAGIDAE																
	Entomyzon cyanotis	Blue-faced honeyeater			x			x	x							x
	Lichenostomus virescens	Singing honeyeater			x					x		x		x	x	x
	Lichmera indistincta	Brown honeyeater							x							
	Manorina flavigula	Yellow-throated miner					x	x								x
	Melithreptus albogularis	White-throated honeyeater														x
	Philemon corniculatus	Noisy friarbird					x		x				x			x
	Plectorhyncha lanceolata	Striped honeyeater				x	x		x							
MEROPIDAE																
	Merops ornatus	Rainbow bee-eater	Mig			x			x							
MOTACILLIDAE																
	Anthus novaeseelandiae	Australasian pipit								x						x
NECTARINIIDAE																
	Dicaeum hirundinaceum	Mistletoebird				x							x			
NEOSITTIDAE																
	Daphoenositta chrysoptera	Varied sittella							x							
ODONTOPHORIDAE																
	Oriolus sagittatus	Olive-backed oriole							x							
OTIDIDAE																
	Colluricincla harmonica	Grey Shrike-thrush					x									x

FAMILY			Status		Sites											
	Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
	Pachycephala rufiventris	Rufous whistler				x	x	x				x				x
PARDALOTIDAE																
	Pardalotus striatus	Striated pardalote			x	x	x		x			x	x			x
PELECANIDAE																
	Pelecanus conspicillatus	Australian pelican								x						
PHASIANIDAE																
	Coturnix pectoralis	Stubble quail					x		x							
	Coturnix ypsilophora	Brown quail				x				x						
PODARGIDAE																
	Podargus strigoides	Tawny frogmouth											x			x
POMATOSTOMIDAE																
	Pomatostomus temporalis	Grey-crowned babbler				x	x		x							x
PSITTACIDAE																
	Aprosmictus erythropterus	Red-winged parrot			x	x	x									x
	Platycercus adscitus	Pale-headed rosella				x			x							x
	Trichoglossus haematodus	Rainbow lorikeet			x		x		x				x			x
PTILONORHYNCHIDAE																
	Ptilonorhynchus maculatus	Spotted bowerbird										x				
RECURVIROSTRIDAE																
	Rhipidura albiscapa	Grey fantail				x										
	Rhipidura leucophrys	Willie wagtail								x						x
STRIGIDAE																
	Ninox novaeseelandiae	Southern boobook							x		x					x
THRESKIORNITHIDAE																
	Platalea flavipes	Yellow-billed spoonbill								x						

FAMILY			Status		Sites											
	Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
	Platalea regia	Royal spoonbill								x						
	Threskiornis molucca	Australian white ibis								x						
TYTONIDAE																
	Tyto javanica	Eastern barn owl											x			x
Totals (species = 81):					**11**	**26**	**15**	**8**	**28**	**21**	**3**	**6**	**9**	**5**	**2**	**45**

4 MAMMALS

Legend

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FAMILY		Common name	Status		Sites											
	Scientific name		EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
CANIDAE																
	Canis lupus	Dingo/dog		I		x	x		x	x						x
DASYURIDAE																
	Planigale maculata	Common planigale			x											
LEPORIDAE																
	Oryctolagus cuniculus	European rabbit		I												x
MACROPODIDAE																
	Lagorchestes conspicillatus	Spectacled hare-wallaby														x
	Macropus giganteus	Eastern grey kangaroo				x										x
	Petrogale inornata	Unadorned rock-wallaby											x			
MURIDAE																
	Mus musculus	House mouse		I			x		x							
PHALANGERIDAE																
	Trichosurus vulpecula	Common brushtail possum				x										
EMBALLONURIDAE																
	Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat				x	x		x				x			
MINIOPTERIDAE																
	Miniopterus australis	Little bent-winged bat					x									

FAMILY		Status		Sites											
Scientific name	Common name	EPBC	NCA	MIL01	MIL02	MIL03	MIL04	MIL05	TA01	TA02	TA03	TA04	TA05	TA06	Opp
MOLLOSIDAE															
Chaerophon jobensis	Northern free-tailed bat				x	x		x				x			
Mormopterus beccarii	Beccari's free-tailed bat				x	x						x			
Mormopterus ridei	Eastern free-tailed bat					x		x				x			
VESPERTILIONIDAE															
Chalinolobus gouldii	Gould's wattled bat				x	x		x				x			
Chalinolobus morio	Chocolate wattled bat				x	x									
Chalinolobus nigrogriseus	Hoary wattled bat					x		x				x			
Chalinolobus picatus	Little pied bat		Rar		x	x		x				x			
Nyctophilus gouldi	Gould's long-eared bat					x									
Nyctophilus sp.						x		x							
Scotorepens balstoni	Inland broad-nosed bat					x		x				x			
Scotorepens greyii/sanborni	Broad-nosed bat				x	x		x				x			
Vespedalus baverstocki	Inland forest bat				x	x		x				x			
Vespadelus troughtoni	Eastern cave bat				x	x		x				x			
Totals (species = 14):				**1**	**12**	**17**	**0**	**13**	**1**	**0**	**0**	**12**	**0**	**0**	**4**

5 PLANTS

Legend

* = Exotic species

Family	*Scientific name*	*Common name*
Amaranthaceae	*Alternanthera nodiflora**	Joyweed
Amaranthaceae	*Gomphrena celesoides**	Gomphrena Weed
Amaranthaceae	*Maireana villosa*	Silky Bluebush
Amarnthaceae	*Achyranthes aspera*	Chaff Flower
Amranthaceae	*Alternanthera denticulata*	Joyweed
Anthericaceae	*Laxmania gracilis*	Slender Wire Lily
Apiaceae	*Trachymene procumbens*	Native Parsnip
Apocynaceae	*Alstonia constricta*	Bitter Bark
Apocynaceae	*Carissa lanceolata*	Conkerberry
Apocynaceae	*Carissa ovata*	Currant Bush
Asclepidaceae	*Sarcostemma viminale*	Pencil Caustic
Asteraceae	*Tridax procumbens**	Tridax Daisy
Asteraceae	*Xanthium pungens**	Noogoora Burr
Asteraceae	*Chrysocephalum apiculatum*	Yellow Buttons
Boraginaceae	*Ehretia membranifolia*	Peach Bush
Boranginaceae	*Trichodesma zeylanicum*	Camel Bush
Brassicaceae	*Capsella bursa-pastoris **	Shepards Purse
Cactaceae	*Eriocereus martinii**	Harissa Cactus
Cactaceae	*Opuntia stricta**	Prickly Pear
Caesalpinaceae	*Chamaecrista concina**	
Caesalpiniaceae	*Lysiphyllum carronii*	Queensland Ebony
Caesalpiniaceae	*Senna coronilloides*	Brigalow Senna
Capparaceae	*Capparis lasinatha*	Split Jack
Capparaceae	*Capparis loranthifolia*	Narrow-Leafed Bumble
Capparaceae	*Capparis mitchellii*	Wild Orange
Capparaceae	*Cleome viscosa*	Tick Weed
Casealpinaceae	*Lysiphyllum cunninghamii*	Bauhinia
Casuarinaceae	*Allocasuarina leuhmanii*	Bulloak
Casuarinaceae	*Casuarina cristata*	Belah
Casuarinaceae	*Casuarina cunninghamiana*	River She-Oak
Celastraceae	*Denhamia oleaster*	
Celastraceae	*Maytenus cunninghamii*	Yellowberry Bush
Chenopodiaceae	*Atriplex muelleri*	Mueller's Saltbush
Chenopodiaceae	*Chenopodium carinatum*	Green Crumbweed
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush
Chenopodiaceae	*Salsola kali*	Soft Roly Poly
Chenopodiaceae	*Sclerolaena bicornis*	Goathead Burr
Combretaceae	*Terminalia oblongata*	Yellow Wood
commelinaceae	*Commelina cynaea*	Scurvy Weed
Convolvulaceae	*Evolvulus alsinoides**	Tropical Speedwell
Convolvulaceae	*Ipomea plebia*	Bell Vine
Cucurbitaceae	*Cucumis melo*	Native Cucumber

Family	Scientific name	Common name
Cyperaceae	*Cyperus exaltatus*	Giant Sedge
Cyperaceae	*Cyperus gilesii*	Giles' Sedge
Cyperaceae	*Cyperus gracilis*	Slender Sedge
Cyperaceae	*Fimbristylis dichotoma*	Common Finger Rush
Cyperaceae	*Fimbristylus aestivalis*	Summer Fingerush
Ebanaceae	*Diospyros humilis*	Ebony
Erythroxylaceae	*Erythroxylum australe*	Cocaine Tree
Euphorbiaceae	*Acalypha eremorum*	Soft Acalypha
Euphorbiaceae	*Alchornia ulicifolia*	Native Holly
Euphorbiaceae	*Bertya oleifolia*	
Euphorbiaceae	*Bertya opponens*	
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Euphorbiaceae	*Chamaesyce sp.**	
Euphorbiaceae	*Euphorbia sp.**	
Euphorbiaceae	*Petalostigma pubescens*	Quinine Bush
Euphorbiaceae	*Phyllanthus sp.**	
Fabaceae	*Aeschynomene indica*	Buddha Pea
Fabaceae	*Cassia brewsteri*	Leichhardt Bean.
Fabaceae	*Crotolaria dissitiflora*	Grey Rattlepod
Fabaceae	*Crotolaria novae-hollandiae*	New-Holland Rattlepod
Fabaceae	*Crotolaria pallida*	Streaked Rattlepod
Fabaceae	*Hovea longipes*	Brush Hovea
Fabaceae	*Rynchosia minima*	Runchosia
Fabaceae	*Senna obtusifolia**	Sicklepod
Fabaceae	*Senna occidentalis**	Coffee Senna
Fabaceae	*Sesbania cannabina**	Sesbania Pea
Fabaceae	*Stylosanthes scabra**	Stylo
Family	*Indigofera linifolia*	Austral Indigo
Lamiaceae	*Gmelina elliptica*	Badhara Bush
Lamiacee	*Clerodendrum floribundum*	Lolly Bush
Lauraceae	*Cassytha pubescens*	Dodder
Loranthaceae	*Amyema quandang*	Grey Mistletoe
Loranthaceae	*Amyema sanguineum*	Red Mistletoe
Loranthaceae	*Dendrophthoe galbrescens*	Yellow-Red Mistletoe
Malvaceae	*Abutilon indicum*	Country Mallow
Malvaceae	*Abutilon oxycarpum*	Straggly Lantern-Bush
Malvaceae	*Hibiscus leptocladus*	White Hibiscus
Malvaceae	*Hibiscus sturtii*	Desert Rose
Malvaceae	*Malvastrum americanum**	Spiked Malvastrum
Malvaceae	*Sida acuta**	Spinyhead Sida
Malvaceae	*Sida cordifolia*	Flannel Weed
Malvaceae	*Sida rohlenae*	Shrub Sida
Malvaceae	*Sida subsicata*	Spiked Sida
Meliaceae	*Owenia acidula*	Emu Apple
Mimosaceae	*Acacia decora*	Pretty Wattle
Mimosaceae	*Acacia disparrima*	Hickory Wattle
Mimosaceae	*Acacia flavescens*	Red Wattle
Mimosaceae	*Acacia harpophylla*	Birgalow

Family	Scientific name	Common name
Mimosaceae	*Acacia leiocalyx*	Black Wattle
Mimosaceae	*Acacia shirylei*	Lancewood
Mimosceae	*Acacia julifera*	Catkin Wattle
Mimosceae	*Acacia salicina*	Sally Wattle
Moraceae	*Ficus opposita*	Sandpaper Fig
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn
Myoporaceae	*Eremophila bignoniiflora*	Creek Wilga
Myoporaceae	*Eremophila sp.*	
Myoporaceae	*Myoporum acuminatum*	Boobialla
Myrtaceae	*Corymbia aspera (check)*	Rough-Leaved Ghost Gum
Myrtaceae	*Corymbia cambageana*	Dawson Gum
Myrtaceae	*Corymbia clarksoniana*	Clarkson's Bloodwood
Myrtaceae	*Corymbia dallachiana*	Dallachy's Gum
Myrtaceae	*Corymbia tessellaris*	Moreton Bay Ash
Myrtaceae	*Eculayptus brownii*	Reid River Box
Myrtaceae	*Eucalyptus crebra*	Narrow-Leaved Ironbark
Myrtaceae	*Eucalyptus moluccana*	Gum-Topped Box
Myrtaceae	*Eucalyptus orgadophila*	Mountain Coolibah
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Euclayptus camaldulensis*	River Red Gum
Myrtaceae	*Euclayptus coolabah*	Coolabah
Myrtaceae	*Euclayptus populnea*	Poplar Box
Myrtaceae	*Euclyaptus platyphylla*	Poplar Gum
Myrtaceae	*Melaleuca viridiflora*	Broad-Leafed Paperbark
Myrtaceae	*Micromyrtus capricornia*	A Micromyrtus
Oleaceae	*Jasmimum didymum*	Jasmine
Oleaceae	*Notelaea microcarpa*	Native Olive
Onagraceae	*Ludwidgia octavalvis*	Willow Primrose
Orchidaceae	*Cymbidium canaliculatum*	Black Orchid
Oxalidaceae	*Oxalis corniculata*	Wood Sorrell
Passifloraceae	*Passiflora aurantia*	Blunt-Leaved Passionfruit
Passifloraceae	*Passiflora foetida**	Stinking Passionfruit
Pittosporaceae	*Pittosporum spinescens*	Orange Thorn
Poaceae	*Alloteropsis semilata*	Cockatoo Grass
Poaceae	*Aristida calycina*	Dark Wiregrass
Poaceae	*Aristida caput-medusae*	Many Headed Wiregrass
Poaceae	*Aristida jerichoensis*	Jericho Wiregrass
Poaceae	*Aristida latifolia*	Feathertop
Poaceae	*Aristida personata*	Purple Wiregrass
Poaceae	*Arundinella nepalensis**	Reed Grass
Poaceae	*Bothriochloa bladhii*	Forest Blue-Grass
Poaceae	*Bothriochloa ewartiana*	Desert Blue-Grass
Poaceae	*Calyptochloa gracillima*	Tableland Couch
Poaceae	*Chloris divaricata*	Slender Chloris
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Chloris inflata**	Purpletop Chloris
Poaceae	*Chloris virgata**	Feathertop Chloris
Poaceae	*Chrysopogon fallax*	Golden Beard Grass

Family	Scientific name	Common name
Poaceae	*Cynodon dactylon**	Blue Couch
Poaceae	*Dactyloctenium radulans**	Button Grass
Poaceae	*Dicanthium sericeum*	Blue Grass
Poaceae	*Echinochloa colona*	Awnless Barnyard Grass
Poaceae	*Eleusine indica**	Crowsfoot Grass
Poaceae	*Enneapogon gracilis*	Slender Nineawn
Poaceae	*Enteropogon acicularis*	Curly Windmill Grass
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Eragrostis leptocarpa*	Drooping Lovegrass
Poaceae	*Eragrostis sororia*	Woodland Lovegrass
Poaceae	*Eragrostis speciosa*	Handsome Lovegrass
Poaceae	*Heteropogon contortus*	Black Spear Grass
Poaceae	*Imperata cylindrica**	Blady Grass
Poaceae	*Iseilema vaginiflorum*	Red Flinders Grass
Poaceae	*Megathyrsus maximus**	Guinea Grass
Poaceae	*Melinis repens**	Red Natal Grass
Poaceae	*Panicum decompositum*	Native Millet
Poaceae	*Panicum effusum*	Hairy Panic
Poaceae	*Panicum queenslandicum*	Yabila Grass
Poaceae	*Paspalidium caespitosum*	Brigalow Grass
Poaceae	*Paspalidium distans*	Shotgrass
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Pennisetium alupecuoriodes**	Swamp Foxtail
Poaceae	*Sporobolus australasicus*	Australian Dropseed
Poaceae	*Sporobolus caroli*	Fairy Grass
Poaceae	*Themeda triandra*	Kangaroo Grass
Poaceae	*Tragus australianus*	Tick Grass
Pontederiaceae	*Eichhornia crassipes**	Water Hyacinth
Portulacaceae	*Portulaca oleracea*	Pig Weed
Proteaceae	*Hakea chordophylla*	Bootlace Oak
Proteaceae	*Persoonia falcata*	Milky Plum
Restionaceae	*Gahnia aspera*	Rough Saw-Sedge
Rhamnaceae	*Alphitonia excelsa*	Soap Tree
Rubiaceae	*Cyclophyllum coprosmoides*	Brigalow Canthium
Rubiaceae	*Psydrax johnsonii*	
Rubiaceae	*Psydrax longipes*	
Rutaceae	*Eremocitrus glauca*	Wild Lime
Rutaceae	*Flindersia australis*	Crows Ash
Rutaceae	*Geijera salicifolia*	Scrub Wilga
Rutaceae	*Phebalium glandulosum*	Desert Phebalium
Sapindaceae	*Alectryon connatus*	Grey Birdseye
Sapindaceae	*Alectryon diversifolius*	Scrub Bonaree
Sapindaceae	*Atalaya hemiglauca*	Whitewood
Sapindaceae	*Dodonaea viscosa*	Sticky Hop Bush
Sapotaceae	*Planchonella pubescens*	
Solanaceae	*Solanum ellipticum**	Potato Bush
Sterculiaceae	*Brachychiton australis*	Broad-Leafed Bottle Tree
Sterculiaceae	*Brachychiton ruprestris*	Bottle Tree

Family	*Scientific name*	*Common name*
Sterculiaceae	*Keraudrenia hookeriana*	
Tiliaceae	*Grewia latifolia*	Dog's Balls
Tiliaceae	*Grewia retusifolia (check)*	Emu Berry
Typhaceae	*Typha orientalis*	Typha
Ulmaceae	*Trema tomentosa*	Poison Peach
Verbenaceae	*Lantana camara**	Lantana
Verbenaceae	*Stachytarpheta jamaicensis**	Jamaica Snakeweed
Zygophyllaceae	*Tribulus terrestris**	Goat's Head Burr

Name	NCA status	EPBC status	Comments
Melithreptus gularis Black-chinned Honeyeater	R		This species has been recorded from specimen- or observation-based databases and is therefore present within the local area. Black-chinned Honeyeaters inhabit a variety of open woodland and dry eucalypt forest communities. They are most often associated with local flowering events and may therefore be locally nomadic. They are very uncommon within the region and records probably represent transient individuals.
Haliaeetus leucogaster White-bellied Sea-Eagle		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. Inhabits coastlines, lakes, large dams, inland rivers and waterways. No suitable habitat present.
Nettapus coromandelianus Cotton Pygmy-goose		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. Cotton Pygmy-geese inhabit permanent wetlands, particularly those with open water and extensive floating vegetative growth. No suitable habitat occurs within the Project site.
Ardea ibis Cattle Egret		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area and not expected to occur.
Anseranas semipalmata Magpie Goose		M	This species has been recorded from the local region, but not on the project site itself. An uncommon species in the local area and not expected to occur. No suitable habitat occurs in the MEP area.
Monarcha melanopsis Black-faced Monarch		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which typically inhabits wet forests and rainforests. Not expected to occur.
Myiagra cyanoleuca Satin Flycatcher		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which is not expected to occur.
Rhipidura rufifrons Rufous Fantail		M	This species has been recorded from specimen- or observation-based databases and is therefore present within the local region, but not necessarily on the project site itself. An uncommon species in the local area which typically inhabits wet forests and rainforests. Not expected to occur.
Rostratula australis Australian Painted Snipe		V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen or observation based databases were present and hence the species may not occur within the local area. Australian Painted Snipes preferentially inhabit ephemeral and semi-ephemeral wetlands with emergent aquatic and semi-aquatic vegetation. No suitable habitat for this species occurs within the Project site.
Rostratula benghalensis s. lato Painted Snipe	V	M	As for *Rostratula australis*
Gallinago hardwickii Latham's Snipe		M	As for *Rostratula australis*
Numenius minutus Little Whimbrel		M	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen or observation based databases were present and hence the species may not occur within the local area. A coastal species which inhabits mudflats, saline creeklines and saltflats. No suitable habitat present.

Name	NCA status	EPBC status	Comments
MAMMALS			
Dasyurus hallucatus Northern quoll		E	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Northern Quolls historically inhabited a variety of habitat types ranging from open woodlands to more closed mesic forests. However they have significantly declined due to land clearing, feral predation and poisoning from Cane Toad ingestion (Maxwell *et al*. 1996). Fire ecology may also impact some populations by affecting community structure and prey items (A. Dinwoodie pers. comm.). Most records now occur in areas of large continuous vegetation or where there are abundant rock outcrops, overhangs and fissures. Some suitable, but highly fragmented, habitat occurs on Red Hill.
Taphozous troughtoni Troughton's sheathtail bat	E		This species has been recorded in observation- or specimen-based databases. The taxon was listed as Endangered under Queensland legislation when it was thought to be entirely restricted to the Mt Isa region. Work by Reardon *et al* (2001) has shown this species to be much more widespread than previously thought.
Nyctophilus timoriensis (sp. 2) Eastern long-eared bat (SE form)	V	V	Records of this species were present only within the EPBC Online search which includes predictive results. No local records from specimen- or observation-based databases were present and hence the species may not occur within the local area. Eastern Long-eared Bats are not common within the region. Most records seem to be associated with large contiguous stands of vegetation containing Brigalow, Casuarina and/or Callitris. Field assessment suggests that habitats present are marginal and highly fragmented. It is therefore unlikely that this species will occur.

Appendix C References:

Maxwell, S., Burbidge, A. A. and Morris, K., (1996). The Action Plan for Australian Marsupials and
Monotremes. IUCN Species Survival Commission and Environment Australia: Canberra.

Available from:
http://www.environment.gov.au/biodiversity/threatened/publications/action/marsupials/index.html

Thomson, B., C. Pavey, and T. Reardon (2001). Recovery plan for cave-dwelling bats, Rhinolophus philippinensis, Hipposideros semoni and Taphozous troughtoni 2001-2005. [Online]. Queensland Parks and Wildlife Service.

Available from:
http://www.epa.qld.gov.au/publications/p00170aa.pdf/Recovery_plan_for_cavedwelling_bats_emRhinolophus_philippinensis/em_emHipposideros_semoni/em_and_emTaphozous_troughtoni/em_20012005.pdf

APPENDIX E

SYSTEMATIC VERTEBRATE SAMPLING SITE PHOTOS

Appendix E: Systematic Vertebrate Site Photos

MIL 01

MIL 02

MIL 03

MIL 04

MIL 05

Exotic Species Management

Peabody

EXOTIC SPECIES MANAGEMENT
ENV STD (DRAFT)

1.0 Purpose

The purpose of this Standard is to:

1. Provide information regarding the identification and appropriate control mechanisms for potential weed populations on site.
2. Provide information regarding the identification and appropriate control mechanisms for feral animals on site.

2.0 Scope

This Standard forms part of the Peabody Environmental Management System (EMS).

This procedure is to be complied with by all persons undertaking exotic species management on the mine site.

The main objective is to minimise the spread of weeds and feral animals on Peabody mine sites.

3.0 Definitions

Environment	• All living things, their physical, biological and social surrounding, and the resultant interactions between these components.
Weed	• A species of plant considered harmful to the environment or regarded as a nuisance.
Weed Infestation	• Total area containing the weed species.
Feral Animal	• Any non-native animal that causes serious damage to human interests and to native flora and fauna through competition, predation, disease resistance etc.
Rehabilitation	• Processes involved in returning a disturbed area to a stable and sustainable condition that conforms to a predetermined land use and abides by relevant legislative requirements.
Shall and Should	• The word “shall” is to be understood as mandatory and the word “should”, as non-mandatory, advisory or recommended.

4.0 Standard – Weed Management

4.1 Identification of Weed Species

- The on site Environment Department shall provide a set of documents describing and displaying pictures of all species to be defined as weeds applicable to site for the purpose of this Standard.
- The documents are to be in a form that can be readily distributed by hard copy and electronic means.

- The intent is to be able to give copies of these documents to on site personnel and contractors, and to display the documents on mine notice boards.
- A weed distribution map and/or inventory of species present should be developed for the mine site area. This map/inventory can form part of the site rehabilitation management plan/monitoring programme.

4.2 Notification Process

1. Any person sighting a weed infestation shall notify the Environment Department immediately, either directly or through their Supervisor.
2. The Environment Department will verify the plant species and determine the controls to be applied. If necessary, the area will be marked with survey pegs (and taped off as appropriate) to show the boundary of the infestation. Refer to Section 4.2.1.
3. The Environment Department will update the weed distribution map/weed species inventory with any new information. Where possible, record the location, plant species, and approximate size/spread of the infestation.
4. The Environment Department will coordinate weed eradication works and record the details on the Weed Eradication Work Sheet (Appendix A).
5. Driving though a declared weed infestation is to be avoided. If it is not possible to avoid driving machinery through a stand of declared weeds, the vehicle should be washed down thoroughly at the site vehicle wash down facility prior to driving off-site.

4.2.1 Pest Fact Sheets

- The Queensland Department of Employment, Economic Development and Innovation (DEEDI, 2010) Pest Fact Sheets provide information regarding the identification and recommended control strategies for weed species. Go to: http://www.dpi.qld.gov.au . Copies of the Pest Fact sheets shall be made available to mine site personnel upon request.
- Alternatively, the Environment Department can create pest fact sheets once a species has been identified.
- The Pest Fact sheet shall be checked to verify the identification of the weed infestation and to learn about the appropriate methods to reduce the population (may include biological, mechanical and chemical controls).

4.3 Reporting and Monitoring

Weed monitoring will be undertaken using the following methods:

1. After the treatment of weed species' the Environment Department shall continue to monitor the area as part of routine inspections.
2. If weeds remain in the treated area or a new outbreak of a different species are observed, supplementary treatment shall be implemented using methods prescribed by relevant approved authorities.
3. Regular routine inspections shall occur following the completion of any supplementary treatment.

4. Following treatment of a weed infestation, the treated area shall be monitored on a quarterly basis to ensure the eradication of the seed bank.
5. Following the successful management of weed species within the identified area, the weed distribution map for the Project site shall be updated.
6. The distribution of weed affected areas and the treatments applied will be recorded on the Weed Eradication Work Sheet (Appendix A) and reported in the mine site rehabilitation management plan/monitoring programme or relevant environmental management plans/reports.

4.4 Safety and Health Considerations

- All personnel involved in the chemical control of weeds will be appropriately licensed and trained.
- Any chemicals used for weed control are to be authorised for use on site prior to their use (ENV STD – Hazardous Materials Management).
- All persons using and handling herbicides shall be familiar with the current material safety data sheet (MSDS) information.
- All persons using herbicides must wear appropriate personal protective equipment (PPE), as detailed in the current MSDS.
- Chemical control equipment and chemicals are to be stored in accordance with MSDS and site requirements.
- Equipment used to control weed infested areas is to be cleaned following clearing and prior to use at subsequent sites.

5.0 Standard – Feral Animal Control

5.1 Identification of Feral Animal Species

- The Environment Department shall provide a set of documents describing and displaying pictures of all feral animal species that may exist in the area.
- The documents are to be in a form that can be readily distributed by hard copy and electronic means.
- The intent is to be able to give copies of these documents to on site personnel and contractors, and to display the documents on mine notice boards.
- Commonly, feral animal control will target feral cats, foxes, pigs, goats, rats, cane toads and dogs.

5.2 Notification Process

1. Any person sighting a feral animal shall notify the Environment Department immediately, either directly or through their Supervisor.

2. The Environment Department will attempt to confirm the possible feral animal species and determine the controls to be applied.
3. The Environment Department shall update the feral animal map and record the location, species, and approximate numbers.
4. The Environment Department will coordinate feral animal control works and record the details on the Feral Animal Control Work Sheet (Appendix B).

5.3 Feral Animal Management

If the site Environment Department is undertaking feral animal control then the following guidelines shall be followed. In addition, any State or Local Government guidelines on feral animal management shall be strictly adhered to.

5.3.1 Setting & Checking Traps

- To prevent damage, the traps are to be located away from traffic.
- Traps are set using a meat bait. Sausage meat is successful for trapping both cats and foxes.
- To prevent animals from perishing from heat exposure, the traps shall be checked twice daily. Suitable gloves (e.g. riggers gloves) should be worn when checking the traps.

5.3.2 Collection

- Wear gloves when moving the trapped animal to the vehicle.
- Use the handles provided on the traps/cages. In a situation where the animal is aggressive a survey peg can be used to carry the cage by pushing it through the cage, avoiding contact with the animal. Be especially careful not to put fingers through the cage.
- Take photographic records where necessary.

5.4 Recording and Reporting

- Record the weight, sex and colouring of any feral animal collected.
- If the animal is female, check if it is pregnant or lactating.
- Check the animal's teeth, claws and coat to determine its health.
- Record these along with the location where it was trapped in the Feral Animal Species Work Sheet (Appendix B).
- Following trapping programme, the identified area shall be monitored on a monthly basis to ensure the eradication of the feral animal species.
- Following the successful management of feral animals within the identified area, the Exotic Species distribution map for the Project site shall be updated.
- The distribution of feral animal species and the treatments applied will be reported in the mine site rehabilitation/environmental management plans/programme.

5.5 Safety and Health

- All personnel involved in the control of feral animals shall be appropriately licensed and trained.
- Any chemicals used for feral animal management are to be authorised for use on site (ENV STD - Hazardous Materials Management).
- All persons using and handling chemicals shall be familiar with the current material safety data sheet (MSDS) information.
- All persons using chemicals must wear appropriate personal protective equipment (PPE), as detailed in the current MSDS.
- Chemical control equipment and chemicals are to be stored in accordance with MSDS and site requirements.

6.0 Records Management

Records to be managed in relation to this Standard are:

- Weed Distribution Map/Exotic Species Distribution Map, as per plan expectations (i.e. title, date, legend, appropriate scale etc).
- Species Inventory
- ENV STD – Hazardous Materials Management.

7.0 Responsibilities

Role	Accountability
General Manager **Senior Site Executive**	• Ensure adequate resources are available for the successful development and implementation of the Exotic Species Management Standard. • This Standard will be reviewed on an event basis with the following triggers being applicable: ▪ A non-compliance to this Standard. ▪ An incident directly related to the procedures contained herein. ▪ On direction of the Site Senior Executive (SSE).
Managers and Supervisors	• Ensure periodic reviews and audits of the compliance with and effectiveness of the standard are carried out, and steps taken to modify the standard if necessary. • Ensure weed control and feral animal control are completed in accordance with this Standard.
Environment Department/Site Engineer(s)	• Communicate requirements regarding exotic species management. • Environment Department to ensure relevant employees undertake training in this Standard.
All persons	• Comply with this Standard. • Report any issues/concerns observed associated with final landforms.

8.0 References

Specific to site:

- Environmental Management Plan (Qld)
- Plan of Operations (Qld)
- Mine Operations Plan (NSW)
- Annual Environmental Management Report (NSW)
- Environmental Authority (QLD)
- Development Consent (NSW)
- Rehabilitation Plan / Programme

- *Environmental Protection Act (1994) (Qld)*
- *Environmental Protection Regulation (2008) (Qld)*
- *Environmental Planning and Assessment Act (1979) (NSW)*
- *State Environmental Planning Policy (Major Projects) 2005 (NSW)*
- *Protection of the Environment Operations Act (1997)*
- *Mining Act (1992) (NSW)*

And amendments.

- DEEDI (2010) http://www.dpi.qld.gov.au

9.0 Revision Date

All corporate standards shall be reviewed every three (3) years or as needed.

Rev	Date	Revision Description	By	Approved	Next Review

10.0 Appendices

Appendix A: Weed Eradication Work Sheet

Appendix B: Feral Animal Species Work Sheet

Appendix A

Weed Eradication Work Sheet

Date:					
Name:					
Weed Type:	**Prickly Pear**	**Harrisia Cactus**	**Parthenium**	**Fireweed**	**Other?**
Area (ha):					
Location:					
Action Taken:					
Comments:					

Appendix B

Feral Animal Species Work Sheet

Date:					
Name:					
Feral Animal Species:	**Cat**	**Dog**	**Fox**	**Pig**	**Goat**
Other:	**Rat**	**Mice**	**Cane Toad**		
Location:					
Action Taken:					
Comments:					

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F8:

AQUATIC ECOLOGY

Millennium Mine
Aquatic Assessment

May 2009

Prepared for:

Peabody Energy

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Executive Summary

Millennium Coal Pty Ltd (MCPL), proposes to extend current operations into two new lease areas; Mineral Development Licence (MDL) 136 “Mavis Downs” and Mining Lease Application (MLA) 70401 “North Poitrel”. The proposed expansion areas are collectively referred to as the “Millennium Expansion Project” (MEP).

In accordance with Section 240(b) of the *EP Act*, this report describes the ecological values of aquatic habitat and communities within the Project Site, potential environmental impacts and required mitigation and management strategies as part of the environmental impact assessments to be performed during the EIS process for EMP approval.

Field surveys undertaken during this assessment included aquatic macroinvertebrates, fish, aquatic macrophytes, physico-chemical water quality, aquatic habitat and aquatic macro-fauna. In addition to field surveys, State and Commonwealth environmental database searches were performed in order to identify listed species and communities, critical habitat or other environmental values potentially present at the site.

Waterways at the Millennium site were found to be typical examples of ephemeral streams in the Moranbah region and were unremarkable in terms of biological assemblages, habitat value, water quality or fluvial geomorphology. No listed species, communities or critical habitat values would be impacted by the project.

Whilst the MEP will result in some loss or disturbance of aquatic ecosystems at the site, the impacts on local and regional ecosystems outside of the mine boundaries are expected to be negligible. The implementation of leading practice for the management of stormwater, chemicals and waste can be expected to negate or minimise impacts from these sources. Mitigation strategies for altered hydrology and strategies for minimising physical disturbance of waterways have also been described.

Contents

1 Introduction 1

1.1 Background 1

1.2 Scope of Works 1

1.3 Project Site 2

1.4 Locality Description 2

1.5 Climate 3

2 Assessment Methods 4

2.1 Overview 4

2.2 Sampling Site Selection 6

2.3 Water Quality 6

2.4 Aquatic Macroinvertebrates 6

2.5 Fish 8

3 Description of Aquatic Ecosystem 11

3.1 Description of Sites 11

3.2 Database searches 13

3.3 Water Quality 15

3.4 Aquatic Flora 17

3.5 Aquatic Fauna 18

4 Potential MEP Impacts on Aquatic Ecosystems 36

4.1 Impacts on Riparian Vegetation 37

4.2 Impacts on Aquatic Macrophytes 38

4.3 Impacts on Aquatic Fauna 38

4.4 Mitigation of Impacts to Aquatic Ecosystems 41

5 References 43

6 Appendix A Photographs of Sampling Sites 44

List of Tables

Table 2-1	Potential fish assemblages within the Isaac-Connors Rivers System, based on DPIF surveys	10
Table 3-1	Site descriptions	12
Table 3-2	Summary of EPBC protected matters report for the site	14
Table 3-3	In situ physico-chemical water quality, Millennium Coal Mine, March 2009	15
Table 3-4	Statistical summary of physico-chemical water quality across all Millennium sites, during the March 2009 surveys	15
Table 3-5	Comparison between in situ physico-chemical water quality data at the New Chum Creek (NCC) downstream site with data collected at the site between 5 December 2007 and 1 May 2008	16
Table 3-6	Macrophyte species recorded at the Daunia Site during recent aquatic ecology surveys	18
Table 3-7	Abundance of Macroinvertebrate taxa recorded at the Millennium site	24
Table 3-8	Predictor variables used in the AusRivAs modelling	29
Table 3-9	Predictor values used in AusRivAS modelling of invertebrate data	29
Table 3-10	Species richness thresholds for AusRivAS assigned OE scores	31
Table 3-11	OE50 scores, OE50Signal scores and AusRivAs risk bands	32

List of Figures

Figure 3.1	Aquatic Ecology Sampling Sites, March 2009	13
Figure 3.2	Number of fish caught and species richness	19
Figure 3.3	Relative proportion of fish species recorded across the Millennium Site	19
Figure 3.4	Number of macroinvertebrate organisms recorded at each site within both bed and edge habitat	26
Figure 3.5	Number of macroinvertebrate families recorded at each site within both bed and edge habitat	26
Figure 3.6	PET richness across all Millennium sites	27
Figure 3.7	OE50 vs OE50Signal scores for the Millennium sites	33
Figure 3.8	Dendogram of macroinvertebrate taxa at the Millennium sites based on Bray-Curtis similarity matrix	34
Figure 6.1	New Chum Creek Downstream	44
Figure 6.2	New Chum Creek Upstream	44
Figure 6.3	West Creek Downstream	44
Figure 6.4	West Creek Upstream	45
Figure 6.5	NP1	45
Figure 6.6	NP2	45

1 Introduction

1.1 Background

The Millennium Coal Mine is an existing open-cut coal mine, operated by Millennium Coal Pty Limited (MCPL), a wholly owned subsidiary of Peabody Pacific Pty Limited (Peabody Pacific). The Proponent, MCPL, proposes to extend the current operation into two new lease areas namely, Mineral Development Licence (MDL) 136 “Mavis Downs” and Mining Lease Application (MLA) 70401 “North Poitrel”. The proposed expansion areas are collectively referred to as the “Millennium Expansion Project” (MEP).

1.2 Scope of Works

In accordance with Part 2 of the *Environmental Protection Act 1994* (EP Act), MCPL voluntarily applied to the Queensland Environmental Protection Agency (EPA) to prepare an Environmental Impact Statement (EIS) for the proposed MEP. The EIS will ensure that all potential positive and negative environmental and social impacts of the MEP are identified, assessed and appropriately mitigated. On 19 September 2008, MCPL received approval from the EPA to commence the Voluntary EIS process for the proposed project.

In accordance with Section 240(b) of the *EP Act*, this report describes the ecological values of aquatic habitat and communities within the Project Site, potential environmental impacts and required mitigation and management strategies as part of the environmental impact assessments to be performed during the EIS process for EMP approval.

The potential impact of the Project on the local and regional aquatic environment is presented using a range of standard indices to assess the condition of aquatic environments. The results presented in this report are based on a desktop analysis of background information and field surveys completed from 24 to 26 March 2009.

The tasks and objectives of the assessment were to:

- Review relevant background information and data related to aquatic ecology in a local context.
- Complete a field survey program to census aquatic macroinvertebrates and fish within the Project Site and neighbouring environs.
- Compile a description and confirm the extent of the aquatic habitats of the Project Site.
- Assess the values of each aquatic habitat within the Project Site.

- Assess the potential impact of the Project on aquatic flora and fauna in the context of relevant legislation, in particular the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act*) and the *Nature Conservation Act 1992* (Qld).
- Provide recommendations for measures to avoid or mitigate adverse impacts on significant aquatic flora and fauna at the construction and operational phases.

1.3 Project Site

The Millennium Coal Mine is situated within the Isaac Regional Council area and is located adjacent to the Poitrel Coal Mine and Carborough Downs Coal Mine.

The site is accessed from the Peak Downs Highway, approximately 22 km east of the Moranbah township turnoff. The site access road traverses pastoral holdings prior to entering ML 70313 in the northwest corner of the Millennium Coal Mine. The mine access road traverses a number of New Chum Creek tributaries and eventually New Chum Creek itself, prior to reaching the main industrial area. The access road then continues on to the CHPP on ML 70312. The access road is shared by the Poitrel Mine which lies to the south of the Millennium Mine and will also be utilised by the proposed Daunia Project.

1.4 Locality Description

The entire Project Site has been altered by mining and agricultural practices (low density cattle grazing). Coal mining operations represent the greatest alteration to the landscape, with open pits and associated infrastructure, including temporary road drainage construction, water storage dam construction and construction and inundation of tailings dams. The impacts of these activities, including land clearing, pasture improvement, weed invasion, and exacerbated erosion processes were observed throughout the Project Site.

The Project Site experiences a high level of temporal variability in rainfall and all of the systems that were sampled during this study were highly ephemeral. The highly seasonal rainfall patterns have a profound influence on aquatic ecological processes at the Millennium site and have been carefully considered in this report, particularly given that the two most significant issues affecting macroinvertebrate communities in particular, are flow velocity and water quality. Highly variable velocities and water quality associated with ephemeral systems almost universally result in depauperate macroinvertebrate and fish assemblages, with species sampled generally the most capable of adapting to significant temporal variability.

1.5 Climate

The most reliable source of meteorological data for the site is the Bureau of Meteorology weather station at the Moranbah Water Treatment Plant, (Station 034038) which has climatic records from 1972 to 2009

Moranbah has a warm climate with mean maximum temperatures ranging from 34.2°C in January to 23.6°C in July. Mean minimum temperatures range from 22°C in January to 9.8°C in July. Heat wave conditions can be expected between October and March and frosts between May and August. The average annual rainfall at Moranbah is 592.4 mm, of which the majority falls in the warmer months of the year (November to February). It is noted that variability occurs throughout the region. Historically, the highest monthly rainfalls occur in December, and 70% of the annual rainfall occurs between October and March.

2 Assessment Methods

2.1 Overview

The assessment and management of highly ephemeral aquatic ecosystems such as those at the Millennium site is fraught with numerous challenges stemming from the high variability and transient nature of key water quality parameters over relatively short temporal scales. These include:

- The influence of storm events on water quality during the wetter months, which typically results in elevated turbidity, nutrients and other parameters, which may be linked to catchment process and anthrogenic influences such as mining operations.
- Desiccation over the drier months, with progressively higher salinity as evaporative losses reduce pools to dryness.

This variability makes the task of collecting representative water quality samples logistically challenging, since sampling would ideally occur more frequently during storm events. “Snapshot” water quality monitoring is therefore of limited value, although such data can be useful when collected in conjunction with ecological data, as they can assist in interpretation of the latter. The use of auto-sampling devices is generally impractical due to cost and the remote location of the sites.

It should be noted that the ANZECC (2000) guidelines for water quality and their derivative, the Queensland Water Quality Guidelines (2004) specifically state that trigger values are intended for waterways experiencing ambient flow conditions and are unsuited to the extremes of either flood or drought. In the context of ephemeral systems these guidelines are therefore inappropriate, since the term ‘ambient conditions’ does not apply, the systems typically are either in flood or in the process of drying up.

Whilst aquatic macroinvertebrates are widely accepted as excellent indicators of the health of more hydrologically stable lotic systems, particular caution must be exercised when using them to assess ephemeral systems because:

- The families represented in ephemeral systems tend to be those that are able to colonise rapidly, are highly motile (able to move from one water body to another), or are very tolerant of a wide range of environmental conditions. All of these characteristics breach fundamental principles on which ecological indicators are normally selected.
- Macroinvertebrates tend to be particularly sensitive to hydrological fluctuations and salinity, both of which are highly variable even in pristine ephemeral systems.

- These systems tend to have limited available habitat, substrates often being predominantly sand/silt, and whilst hydrology tends to be temporally variable it often shows limited spatial variability.
- The annual wetting/drying cycles tend to preclude colonisation by many of the longer lived aquatic taxa that are commonly accepted as indicators of ecological health in more permanent water bodies.

When applied to Queensland rivers and streams, the widely accepted AusRivAS system for using macroinvertebrates to assess or monitor aquatic ecosystems utilises data collected during both October to December and May to July, representing 'early wet' and 'late wet' seasons respectively (DNRM 2001). It is generally accepted that macroinvertebrate assemblages during the 'early wet' tend to reflect point source influences on water quality under stable hydrological conditions, whilst 'late wet' macroinvertebrate assemblages tend to reflect more variable hydrology and the impact of catchment processes and diffuse loads, both of which are likely to be high at the Millennium site.

In the case of ephemeral systems, macroinvertebrate sampling must be opportunistic whilst there is water in the system and sufficient time following rainfall is required to ensure that macroinvertebrate assemblages have the opportunity to colonise and stabilise. However, the window of opportunity is short, as the systems rarely contain water for extended periods and the remote location of the sites creates a logistical challenge.

In common with macroinvertebrate assemblages, fish communities in ephemeral systems tend to exhibit relatively low taxonomic diversity and overall abundance, being dominated by species that move opportunistically from more permanent water bodies to spawn or forage.

Other ecological indicators such as microcrustaceans (zooplankton), algae (e.g. diatoms) or hyporheic fauna are probably more appropriate as ecological indicators in ephemeral systems, although their use requires more specialist expertise and has not been widely adopted in Australia at the present time (Smith et. al. 2004).

Notwithstanding the above limitations and the need for careful interpretation, water quality, macroinvertebrates and fish have been used in similar assessments of mine sites in the Moranbah area (BMA 2008). Their use in the current assessment therefore enables direct comparison with other sites and provides a reasonable, if imperfect, approach.

2.2 Sampling Site Selection

Six sites were assessed during the aquatic ecology survey through consultation with Millennium Environmental Manager and onsite reconnaissance. Factors influencing site selection included:

- The need to sample both upstream and downstream of the current mining operation and of the proposed mine expansion area.
- Sampling site access.
- The availability of wetted aquatic habitat - many of the creeks on the site flow only during and immediately after a rainfall event. Most sampling sites during March consisted of remnant pools, whilst many proposed sampling sites did not contain water.
- The location at which water quality samples are currently collected, which provides some historical context for the water quality data and the observed macroinvertebrate assemblages.

2.3 Water Quality

Physico-chemical water quality parameters were assessed in situ using a TPS 90FL series multiprobe water quality instrument following the Queensland Water Quality Sampling Manual (1999). The measured parameters included pH, electrical conductivity, turbidity, water temperature and dissolved oxygen.

2.4 Aquatic Macroinvertebrates

Macroinvertebrate samples were using standard field protocols outlined in the Australian Rivers Assessment System Queensland field manual (DNRM 2001), the commonly accepted Australian methodology for assessments of this nature. AusRivAS utilises regional models to statistically compare observed invertebrate assemblages at test sites with those expected at comparable but pristine (reference) sites.

Field sampling conventions under this AusRivAS field sampling conventions were followed:

- A 250μM mesh triangular net (250mm x 250mm x 250mm) was used to collect kick samples along a 10 m transect at each site, starting from “downstream” and working “upstream”.

- Where possible, two habitat types were sampled at each site. Edge and pool bed habitat were sampled at all sites, riffle, run and macrophyte habitat being absent throughout. 'Gleaning' of rocks was performed where appropriate.
- At site NP2 only 1 habitat type (pool) was available, whilst at NP1 the deep, unconsolidated sediment precluded safe sampling of macroinvertebrates.
- Samples were "live picked" in the field following AusRivAS protocols:
  - Samples were initially picked for 10 minutes to collect the most abundant and/or visible animals with a maximum of 10 examples of each taxon being collected.
  - Samples were picked for a further 20 minutes, concentrating on less common or more cryptic taxa. Again, collection of a particular taxon ceased once 10 animals were collected.
  - A further 10 minutes picking was performed on each sample and picking ceased if no new taxa were found, otherwise the process continued in10 minute blocks until either no new taxa were found, or the total time elapsed was 60 minutes.
- Macroinvertebrate assemblages in the preserved samples were identified and counted at the family level.

Macroinvertebrate assemblage data were entered into the AusRivAS models (Queensland regional streams west of the Great Dividing Range, autumn season, pool/edge habitat) or along with predictor variables specifically appropriate to that particular model. The model mathematically predicts the aquatic macroinvertebrate families expected to occur in comparable but unimpacted systems (reference condition) and compares these results with the fauna actually collected, providing a measure of biological impairment.

The AusRivAS model software outputs specify the ratio of Observed to Expected taxa and abundances (O/E score). The 'Observed' macroinvertebrates are calculated for all families which were observed and which had a predicted probability of occurrence greater than 50%. The 'Expected' variable is calculated as the sum of all probabilities greater than 50%. An O/E value close to 1 indicates that the observed macroinvertebrate assemblages are similar to those of the reference streams, and a value close to zero indicates severe impairment compared to reference condition. Based upon these ratios, band ranking indicating the ecological health of the river is assigned:

- Band X (OE50>1.21): Macroinvertebrate assemblage is more biologically diverse than reference sites.
- Band A (OE50= 0.78 to 1.21): Site is in reference condition with most/all of the expected families found.

- Band B (OE50= 0.36 to 0.78): Site is significantly impaired, indicating a potential impact either on water quality and/or habitat quality which has resulted in a loss of taxa.
- Band C (OE50= 0 to 0.36): Site is severely impaired; indicating a loss of taxa due to substantial impacts on water and/or habitat quality.
- Band D (OE50 = 0): Site is extremely impaired; few expected taxa remain, indicating extremely poor water and/or habitat quality resulting in a highly degraded waterway.

In addition to O/E scores the AusRivAS models calculate a "Stream Invertebrate Grade Number – Average Level (SIGNAL) score. SIGNAL is a biotic index system that allocates a value to each macroinvertebrate family based largely upon their sensitivity to pollution (a value of 10 indicates high sensitivity, 1 represents high tolerance) (Chessman 2003). Weighted SIGNAL2 is a revised index which weights the SIGNAL scores of taxa by their abundance, relative to the overall abundance of all taxa at the site. Based on the presence or absence of macroinvertebrate families the environmental quality of the site can be assessed and provide an indication of long term water quality (Chessman 2003a).

PET richness refers to the number of observed families within the families Plecoptera, Ephemeroptera and Tricoptera. These families are considered sensitive to pollution, hence a high PET richness indicates a waterway that typically enjoys good water quality.

Due to the limitations of using a single season AusRivAS model on an ephemeral system with low overall diversity, a multivariate statistical approach was also utilized to determine whether the sites upstream of the current and proposed mining areas differed in terms of macroinvertebrate assemblages. The statistical package Primer-E v6 was used to perform Bray Curtis similarity analysis on log transformed macroinvertebrate data. The log transformation of the dataset is a commonly used approach for ecological data where assemblages are strongly dominated by a small number of taxa (Clark & Warwick 2001) and reduces the influence dominant taxa to reveal the influence of less common taxa. As the common taxa tend to be highly tolerant of a range of water quality, habitat and hydrological regimes, it is the less common taxa that are of greatest interest in distinguishing impacted from unimpacted sites.

2.5 Fish

Based on a desktop review of potential fish assemblage within the Isaac-Connors River and Fitzroy River catchments (Table 2-1) and an assessment of the aquatic habitats at the project site, the use of seine nets and baited traps were the most appropriate approach to

assessing fish assemblages. Electrofishing surveys were not performed due to high turbidity at the sites and elevated electrical conductivity at some sites.

A 2 mm mesh seine net was used to “sweep” each site, with one operator on each bank enabling the entire pool to be netted.

Depending on water depth and pool size, four to five baited traps (45 × 25 × 25 cm) were deployed overnight at each site for a minimum of 14 hours. Traps were positioned near available in-stream habitat (e.g. woody debris; draping aquatic vegetation; or in-stream aquatic macrophytes) where available.

All fish were identified to species level and total count recorded prior to being released unharmed at the site of capture.

Table 2-1 Potential fish assemblages within the Isaac-Connors Rivers System, based on DPIF surveys

Common Name (Freshwater Species)	**Scientific Name (Freshwater Species)**
Firetail Gudgeon	*Hypseleotris galii*
Hyrtl's tandan	*Neosilurus hyrtlii*
Agassiz's glassfish	*Ambassis agassizii*
Bony bream	*Nematalosa erebi*
Banded Grunter	*Amniataba percoides*
Fly-speckled Hardyhead	*Craterocephalus stercusmuscarum*
Mouth Almighty	*Glossamia aprion*
Empire Gudgeon	*Hypseleotris compressa*
Western Carp Gudgeon	*Hypseleotris klunzingeri*
Spangled Perch	*Leiopotherapon unicolor*
Eastern Rainbowfish	*Melanotaenia splendida splendida*
Sleepy Cod	*Oxyeleotris lineolatus*
Mosquito Fish	*Gambusia holbrooki*
Common Name (Estuarine-dependent Species)	**Scientific Name (Estuarine-dependent Species)**
Sea mullet	*Mugil cephalus*
Ox-eye herring	*Megalops cyprinoides*
Bullrout	*Notesthes robusta*
Swamp eel	*Ophisternon gutturale*
Long tom	*Tylosurus gavialoides*
Barramundi	*Lates Calcarifer*
Long-finned eel	*Agilla reinhardtii*
Fork-tailed catfish	*Arius graeffei*

3 Description of Aquatic Ecosystem

3.1 Description of Sites

At the time of sampling, many of the creeks and drainage lines at the site were dry, with the more significant streams, New Chum Creek and West Creek, having been reduced to a series of remnant pools. Six sites were chosen for the aquatic ecology field assessment (Table 3-1 and Figure 3.1):

- New Chum Creek downstream. This site is essentially below the operational area of the coal mine and is utilised by MCPL as an end of system water quality monitoring site.
- New Chum creek upstream. This site was intended to provide an assessment of water quality and ecology in New Chum Creek upstream of the influences of the Millennium operation. It was originally intended that sampling would occur further upstream where MCPL have a water quality monitoring station, but the upstream site was dry at the time of sampling. The site ultimately selected for the aquatic ecology assessment is closer to the mine site and to the influences of a dam that discharges into New Chum Creek, but remains above both of these influences.
- West Creek downstream. This site is below a major dam and is used by MCPL as an end of system water quality monitoring site.
- West Creek upstream. The West Creek upstream site was intended to provide an assessment of water quality and aquatic ecology upstream of the influences of the current mining operations. As the area is relatively low lying, care was taken to ensure the selected site was above the area into which the dam would back up during periods of high water levels, ensuring comparability between upstream and downstream macroinvertebrate and fish populations.
- NP1 and NP2. These sites are within the North Poitrel lease and are currently outside of the active mining area. However, the MEP may result in this area being utilised for coal extraction, hence there is potential for future impacts. NP1 and NP2 are very small first order drainage lines emanating within close proximity to the sampling site. Access was difficult, hence only a single site was sampled on each creek, which will effectively become downstream sites when the MEP commences.

Table 3-1 Site descriptions.

Site Name	Position	Comments
New Chum Creek Downstream	22°02'06"S 148°16'44"E	Some cobble at the site, gently sloping banks in places, in contrast to other sites.
New Chum creek Upstream	22°01'09"S 148°15'11"E	Creek steeply channelized with numerous tree roots and snags stabilising banks and providing aquatic habitat, particularly at edges.
West Creek downstream	22°02'29" 148°13'18"	Site contained some tree roots, logs and cobble, providing greater diversity of habitat than many of the sites.
West Creek upstream	22°01'24" 148°13'49"	Site was characterised by incised channel with grassy riparian zones.
NP1	21°01'04" 148°15'14"	Stock access was obvious, although damage to substrate and banks appeared to be minimal. Some woody habitat, but site had all but dried out at the time of sampling.
NP2	22°01'19" 148°15'28"	Water depth estimated at 20cm, but unable to sample macroinvertebrates due to deep unconsolidated silt/mud substrate. Stock access was obvious, although damage to substrate and banks appeared to be minimal.

A number of habitat attributes were common to all sites:

- Streams tended to be strongly channelized, with steeply incised banks. Vegetative stabilisation of banks was generally by grasses, although low trees and shrubs were present at some site.
- All sites were characterised by limited overhanging (shading) and/or trailing vegetation and by a riparian zone that was predominantly grasses.
- There was no flow at any of the sites at the time of sampling.
- Aquatic habitat was generally minimal and of relatively low quality. Woody debris, rock, boulder, cobble etc were generally sparse and the substrate was predominantly silt/clay.

- Anoxia within the sediments was not noted at any site and algal growth (attached/planktonic) was notably absent, suggesting relatively low nutrient and organic levels.

Photographs of the sampling sites are provided in Appendix A.

Figure 3.1 Aquatic Ecology Sampling Sites, March 2009

3.2 Database searches

EPBC (Commonwealth) Protected Matters Report

A protected matters report was generated from the EPBC database using a 5km buffer from the centre of the Millennium Mine site (22°02'18"S, 148°15'30"E). This search highlighted the following protected matters within a 5km radius of the site (Table 3-2).

Table 3-2 Summary of EPBC protected matters report for the site.

Protected Matter	Number
World Heritage Properties	0
National Heritage Places	0
Wetlands of International Significance (Ramsar Sites)	1
Commonwealth Marine Areas	0
Threatened Ecological Communities	2
Threatened Species	9
Migratory Species	14

The Ramsar wetland identified by the database search refers to the Shoalwater and Corio Bays area, some 160km to the east of the Millennium Site and reflects that changes in the catchment at Millennium and other sites have a cumulative impact on these coastal systems.

The threatened ecological communities and threatened species identified by the search are largely terrestrial and hence are not considered further in the context of this report. An exception is *Rheodytes leukops* (Fitzroy River turtle), which is identified as potentially present at the site and is listed under the *EPBC Act* as vulnerable. However, the preferred habitat for this species (deeper, well oxygenated pools with sandy, gravelly or rocky substrates, clear water and macrophytes) was not found at the Millennium site.

The migratory species identified by this database search were birds and have not been considered further in the context of this assessment.

Department of Environment and Resource Management (DERM) (Qld)

A regional Ecosystem map was generated from the DERM website using the coordinates of the Millennium Mine as the central point (22°02'18"S, 148°15'30"E). No moratorium watercourses[1] were identified at the site and no other ecosystem values were flagged by the mapping.

[1] Waterways for which all regrowth vegetation (vegetation that is not remnant vegetation on a regional ecosystem map) located within 50 metres on either side is protected under the *Vegetation Management (Regrowth Clearing Moratorium) Act 2009.*

A search of the DERM Wildlife Online database using the same search criteria returned a list of 46 species recorded within a 5km radius of the Millennium site. However, no aquatic fauna or flora species were listed.

3.3 Water Quality

Water quality at the time of the sampling program was spatially variable, as would be expected from ephemeral systems during a well advanced stage of desiccation. **Table 3-3** shows the results of field physico-chemical water quality assessments at each site, whilst **Table 3-4** provides a statistical summary of water quality across all sites.

Table 3-3 In situ physico-chemical water quality, Millennium Coal Mine, March 2009.

Parameter	Unit	Value						ANZECC
		New Chum D/S	New Chum U/S	West Ck D/S	West Ck U/S	NP1	NP2	
Dissolved Oxygen	mg/L	5.92	7.18	7.82	6.88	5.85	7.26	
pH		7.86	7.34	7.99	7.39	6.88	7.22	7.50-8.50
Temperature	C	27.6	27.1	24.9	27.6	29.6	24.3	-
Electrical conductivity	µS/cm	705	224	1990	293	191	201	-
Turbidity	mg/L	64	71	132	398	329	300	0.750

Table 3-4 Statistical summary of physico-chemical water quality across all Millennium sites, during the March 2009 surveys.

Parameter	Unit	Value				ANZECC
		Mean	Max.	Min.	Std. Dev.	
Dissolved Oxygen	mg/L	6.82	7.82	5.85	0.84	
pH		7.45	7.99	6.88	0.44	7.50 – 8.50
Temperature	C	26.85	29.5	24.9	1.68	-
Electrical Conductivity	µS/cm	601	1990	191	761	-
Turbidity	mg/L	215	398	64	155	0.750

Physico-chemical water quality was relatively good across all of the sampling sites, for an ephemeral system.

Electrical conductivity was highly variable, with most sites considered relatively fresh, but with the New Chum downstream site exhibiting slightly elevated salinity and the West Creek downstream site being classed as moderately saline. Whilst the West Creek downstream site exhibited significantly higher conductivity than other sites at the time of sampling, it remained lower than the average electrical conductivity recorded historically at the Millenium mine. Some variability in salinity is to be expected, since the system had been reduced to a series of pools at the time of sampling, hence evaporative losses would be expected to concentrate salts to varying degrees depending on sun and wind exposure and other variables.

Table 3-5 Comparison between in situ physico-chemical water quality data at the New Chum Creek (NCC) downstream site with data collected at the site between 5 December 2007 and 1 May 2008

		NCC Mar 09	Historical				
			Sampling events	Mean	Max	Min	Standard Deviation
Temp	(C)	27.6	57	23.9	32.57	19.38	2.55
Elec Cond	μS/cm	705	63	2110	2794	77	742
pH		7.86	63	8.05	8.68	7	0.31
Turbidity	(NTU)	64	59	322	918	56.4	184

Whilst long term water quality datasets for the site do not exist, MCPL have undertaken water quality monitoring over the period 5 December 2007 to 1 May 2008 at the New Chum downstream site when the creek contained water. All physico-chemical water quality parameters measured during the March 2009 surveys were within 2 standard deviations of the mean for that parameter (Table 3-5), indicating that they were within the 95 percent confidence intervals for the limited water quality data set available and hence do not represent unusual water quality for the site.

3.4 Aquatic Flora

Riparian Vegetation

Riparian vegetation was not specifically assessed in the course of aquatic ecology surveys, other than in terms of its contribution to aquatic habitat values (overhanging/trailing vegetation, canopy cover/shading, streambank stabilisation etc).

Two botanical surveys of the site have been performed independent of aquatic surveys (Spain, pers. Com.), with one identifying *Cerbera dumicola* (a small evergreen shrub listed as rare under the *Nature Conservation Act* (1992)) in the riparian zone of New Chum Creek, although the exact location of these plants is unclear. A more recent survey did not find this species at the Millennium site.

Macrophytes

At the time of sampling no aquatic macrophytes, emergent or submerged, were recorded at any of the sites. The lack of aquatic vegetation was most likely due to:

- Scouring and removal of vegetation during recent high flow events.
- The very steep sided, channelized nature of the watercourses on the Millennium site, which tend to deter colonisation by emergent species.
- Reduced light penetration due to high turbidity, reducing opportunity for colonisation by submerged species.
- The unconsolidated and highly mobile sand/silt substrate present at many of the sites.

Surveys of macrophytes at the neighbouring Daunia Coal Mine (BMA 2008) identified the species indicated in Table 3-6:

Table 3-6 Macrophyte species recorded at the Daunia Site during recent aquatic ecology surveys.

Scientific Name	Common Name
Cyperus digitatus	Finger Flat Sedge
Persicaria attenuata	N/A
Cyperus polystachyos	Bunchy Sedge
Cyperus difformis	Rice Sedge
Monochoria cyanea	N/A
Ammannia multiflora	Jerry-Jerry
Juncus planifolius	Broad-leaf Rush
Cyperus unioloides	Uniola Flatsedge
Cyperus esculentus	Yellow Nutgrass
Marsilea drummondii	Common Nardoo
Marsilea hirsuta	Hairy Nardoo
Nitella spp	Stonewarts

It is possible that some of these species may colonise the Millennium sampling sites when hydrological conditions are favourable.

3.5 Aquatic Fauna

Fish

As is typical of ephemeral systems, the abundance and diversity of fish at the Millennium site was relatively low, with field surveys recording a total of 121 individual fish from 5 species across all 6 of the sampling sites (Figure 3.2). *Melanotaenia splendida* (Eastern rainbowfish) was the most prolific species, with *Leiopotheropon unicolor* (spangled perch) also relatively common. *Nematolosa erebi* (bony bream) were locally abundant at the West Creek downstream site, but were not recorded at any other site. A single *Hypseleostris galii* (firetail gudgeon) and a single *Mogurnda adspersa* (purple spotted gudgeon) were recorded from the West Creek downstream and upstream sites respectively. Figure 3.3 shows the number of fish and proportion of species recorded during the March 2009 surveys across all sites.

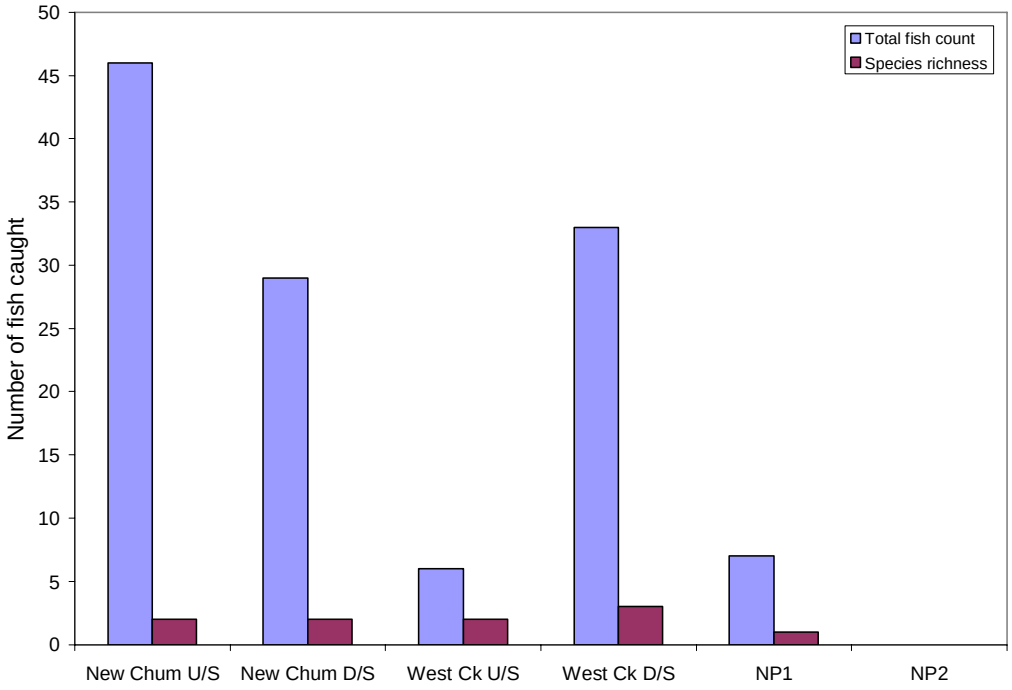

Figure 3.2 Number of fish caught and species richness by site during the March 2009 surveys.

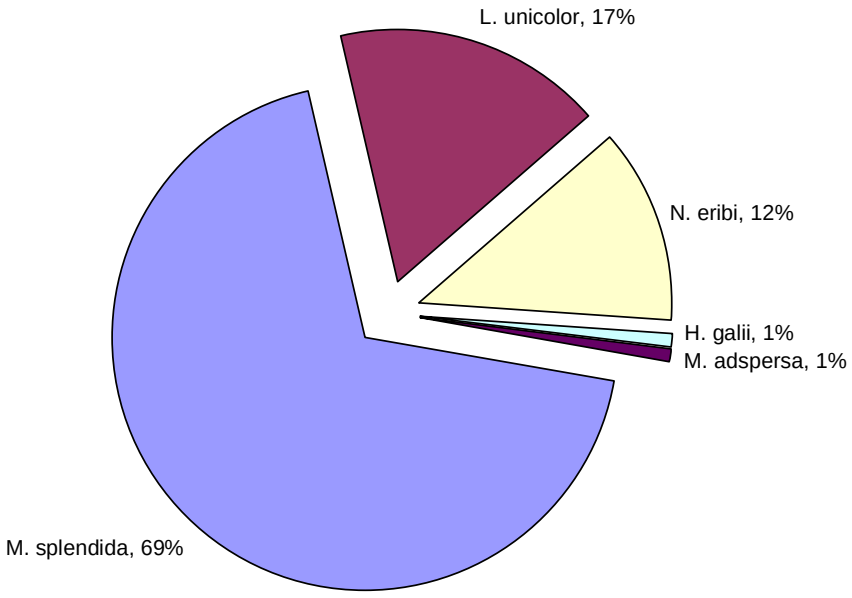

Figure 3.3 Relative proportion of fish species recorded across the Millennium Site, March 2009.

M. splendida (Eastern Rainbowfish)

A significant number of larval fish were recorded during the surveys, notably at the New Chum Creek downstream site. Larger examples of these larvae had begun to exhibit characteristics of *M. splendida*, particularly body and fin morphology. As no other species of rainbowfish were represented in the mature fish catch, the larvae are considered highly likely to be juvenile *M. splendida* and hence have been included in the overall count for that species.

M.splendida is a species that is commonly found in the highly intermittent streams of the Isaac River catchment, hence it's presence at the Millennium site was not unexpected. It is a very widely distributed species along the east coast of Queensland and is usually highly abundant where it occurs (Pusey 2004). The wide distribution and high abundance are largely due to the fact the *M. splendida* is not dependent on any particular substrate or habitat type, although it does show a preference for slower moving streams and those that are relatively free of aquatic vegetation (Pusey 2004). An omnivorous and opportunistic diet that includes a high proportion of terrestrial insects also aids in sustaining populations in ephemeral systems.

M. splendida is believed to be reproductively active throughout the year, although peak periods of reproduction tend to occur when flows are moderate to slow and relatively stable, which may explain the abundance of larval fish in the remnant pools of New Chum Creek. There is some evidence that this species undergoes upstream migration in intermittent streams, although mass migration seems to be uncommon.

M. splendida is not considered a threatened species and does not seem to have any specific migratory requirements. The sites sampled during this survey tend to desiccate during the dry season, hence it is likely that populations in the remnant pools represent fish that have moved upstream during periods of flow or have been translocated downstream from dams on the site, rather than permanent communities.

Leiopotheropon unicolor (Spangled Perch)

L. unicolor is the second most widespread of Australia's freshwater fish species and is often very abundant when present. It is frequently the most dominant fish species in the isolated pools of intermittent streams (Pusey 2004). *L. unicolor* has been shown to exhibit tolerance to a wide range of salinities within inland systems, with the upper tolerance approaching that of seawater (35‰), which is beneficial in enabling the species to survive in pools that evaporate to near dryness. Although experimental data are not available,

tolerances for low dissolved oxygen and high turbidity are inferred from distributional studies.

L. unicolor is a relatively fast swimming species and is capable of swimming through quite shallow water in order to colonise expanding habitat such as floodplains and ephemeral streams during storm events. It appears to undergo spawning migrations, although various studies have suggested that adult fish may move upstream at the start of the wet season in some systems but downstream in others, usually with a return migration following spawning. Fishway studies have tended to be uninformative regarding these movements.

L. unicolor is not a threatened species and is highly adaptable and tolerant of a very wide range of environmental conditions. As with other fish species recorded in these studies, populations of *L. unicolor* recorded in remnant pools probably reflect fish that have moved upstream or downstream and have become trapped as flows ceased.

Nematolosa erebi (Bony Bream)

Nematalosa erebi is the most widespread fish species in Australian freshwater systems and is often the most abundant. Despite this, there is surprisingly little information available regarding its microhabitat usage.

N. erebi is omnivorous, occasionally feeding on molluscs and terrestrial or aquatic invertebrates, however the species largely feeds on detritus and algae, both of which would have been in short supply in the West Creek downstream site where these fish were observed.

Whilst it is known the *N. erebi* undertakes significant movement within river systems, it is unclear whether mass migration for the purposes of spawning are part of the life history of the species.

N erebi is not a threatened species and is able to tolerate widely variable water quality and habitat conditions. Given that *N erebi* was recorded only at the site downstream of the Western Dam, it seems likely that its presence in the samples may be due to stocking within the dam. Although no anecdotal or other data were available to confirm this hypothesis, the stocking of bony bream as a food source for recreational species such as barramundi is known to have occurred in other waterways in central and northern Queensland.

Hypseleostris galii (Firetailed Gudgeon)

Hypseleostris galii is a relatively small gudgeon that is particularly common in floodplain and swamp habitat with significant detritus and vegetation. In contrast to the hydrologically dynamic, mud substrate site at which it was recorded in these surveys, *H. galii* prefers slow flowing waters with relatively coarse sand or fine gravel substrates.

H. galii is a benthic species, most often associated with the bottom third of the water column, and is considered to be a particularly hardy fish with a tolerance for very poor water quality. Diet reflects the association of this fish with the substrate, aquatic macroinvertebrates and microcrustaceans being the strongly favoured food sources.

Males are territorial, aggressively defending their territory from other males, particularly during spawning, the timing of which is believed to vary between river systems. Mass migration of *H. galii* has occasionally been recorded, on each occasion these have coincided with elevated water flows and fish have been observed aggregating below minor obstructions to passage.

H. galii was neither widespread nor abundant in the Millennium surveys, a single individual having been recorded at the West Creek downstream site. Given the species affinity for aquatic vegetation and its dependence on this habitat for spawning, it seems unlikely that *H. galii* is a regular inhabitant of this environment, but rather was displaced from the West Creek Environmental Control Dam during a high flow event and became trapped downstream as the creek dried into a series of pools.

H. galii is relatively common and is not considered to be of conservation significance.

Mogurnda adspersa (Purple-Spotted Gudgeon)

Mogurnda adspersa is a relatively common species of coastal drainages of Eastern Australia north of the Clarence River, NSW. It is found in a range of lentic and lotic habitats, most commonly in slow flowing and weedy areas of rivers, creeks and billabongs. However, it has also been recorded from shallows with moderately high flow velocities. It is a species that is found over a range of substrates from mud and sand to gravel, boulder and bedrock. *M. adspersa* is rarely found distant from cover, being highly dependent on root masses and submerged, emergent or trailing vegetation. This habitat preference is reflected in the diet of the species, which is comprised largely of aquatic invertebrates, mollusc, micro- and macro-crustaceans. Terrestrial insects also make a contribution to the diet of *M. adspersa.*

M. adspersa is able to tolerate low dissolved oxygen concentrations, but appears unable to endure either elevated salinity or turbidity. The latter observation is significant given that the single individual that was recorded during the Millennium surveys (a mature fish of 87mm) was caught at the West Creek upstream site, where turbidity was significantly elevated at the time of the March surveys.

Little is known about the movement of *M. adspersa* within lotic systems, although very low representation in fishway surveys suggests it does undertake significant mass migration.

M. adspersa is not considered to be of conservation significance in Queensland, although it has undergone substantial decline in distribution and abundance in some areas. It is more common in coastal drainages and its presence in inland systems such as West Creek is considered unusual.

Macroinvertebrates

Macroinvertebrate Abundance, Richness and PET Score

Table 3-7 shows macroinvertebrate families recorded across all of the Millennium sites, whilst Figure 3.4 and Figure 3.5 show the total abundance and the number of families of macroinvertebrates recorded at each site, respectively.

Whilst overall macroinvertebrate numbers were relatively high, it should be noted that microcrustaceans contributed significantly to these figures. For the three sites at which the highest overall abundances were recorded, West Creek Upstream, NP2 and New Chum Downstream, microcrustaceans accounted for 82, 79 and 45% of the invertebrates recorded. This is not unusual for intermittent systems, as microcrustaceans are quick to colonise and have relatively short life histories, hence “blooms” of these organisms tend to occur once the system ceases flowing and the habitat becomes more typical of a lentic system.

Microcrustaceans are a very important food organism for fish and for larger invertebrate species, graze on algae and play a key role in the recycling of nutrients and organic material.

Table 3-7 Abundance of Macroinvertebrate taxa recorded at the Millennium site, March 2009

Common name	Order	Family	New Chum - U/S2		New Chum – D/S		West Crk – U/S		West Ck – D/S		NP 2
			Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed
Segmented worms	Annelida	Oligochaeta		3	1						1
Water mites	Aracihnida	Acarina	6	1	18	1	4	11	2	3	
Copepods	Calanoida	Centropagidae		1	1	1	6	1			
	Cyclopoida		3	5	48	29	18	8	3		102
Water fleas	Cladocera	Chydoridae		1	16	1					6
		Dapniidae			1		149				31
		Macrothricidae	1		3	2					
		Moinidae					12				
		Sididae		4	6		81	6			17
Hydra	Cnidaria	Hydridae			1						
Beetles	Coleoptera	Dyticidae		2			4	4			
		Hydrophilidae							1		
Freshwater crab	Decapoda	Atyidae			2		7	2			
True flies	Diptera	Ceratopoginae			3	1			2	3	
		Chironomidae									
		(Chironominae)	6	7	25	13	2	6	10	13	20
		Chrironomidae		4	1	8	6	5	1	1	1

Common name	Order	Family	New Chum - U/S2		New Chum – D/S		West Crk – U/S		West Ck – D/S		NP 2
			Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed
		(Tanypodinae)									
		Culicidae				1					2
Mayflies	Ephemoroptera	Baetidae	4	3	14	9	39	21	5	1	3
		Caenidae	3		4	4			1		
Dragonflies	Epiproctophora	Gomphidae			1						
		Hemicordulidae	1	2		1			1		
Bugs	Hemiptera	Corixidae	6	1	7	6	6	3	6	5	2
		Veliidae		1							
Moths	Lepidoptera	Pyralidae					1				
Seed shrimp	Ostracoda	Cyprididae	1		3	1				1	
		Juvenile sp.			3				1		5

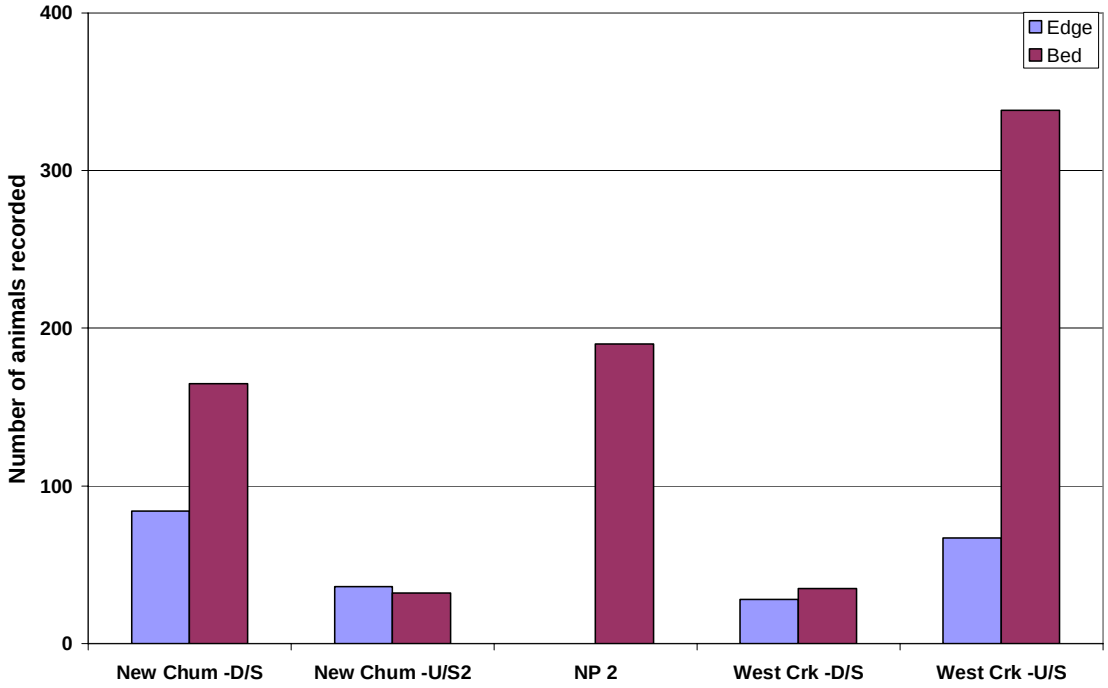

Figure 3.4 Number of macroinvertebrate organisms recorded at each site within both bed and edge habitat.

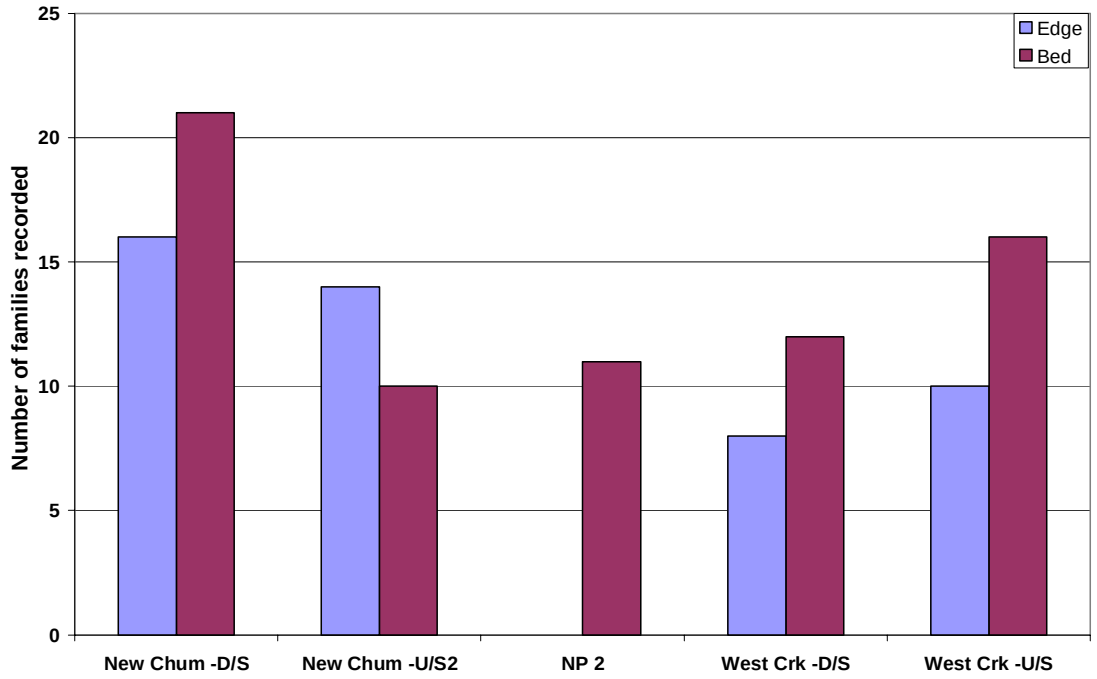

Figure 3.5 Number of macroinvertebrate families recorded at each site within both bed and edge habitat.

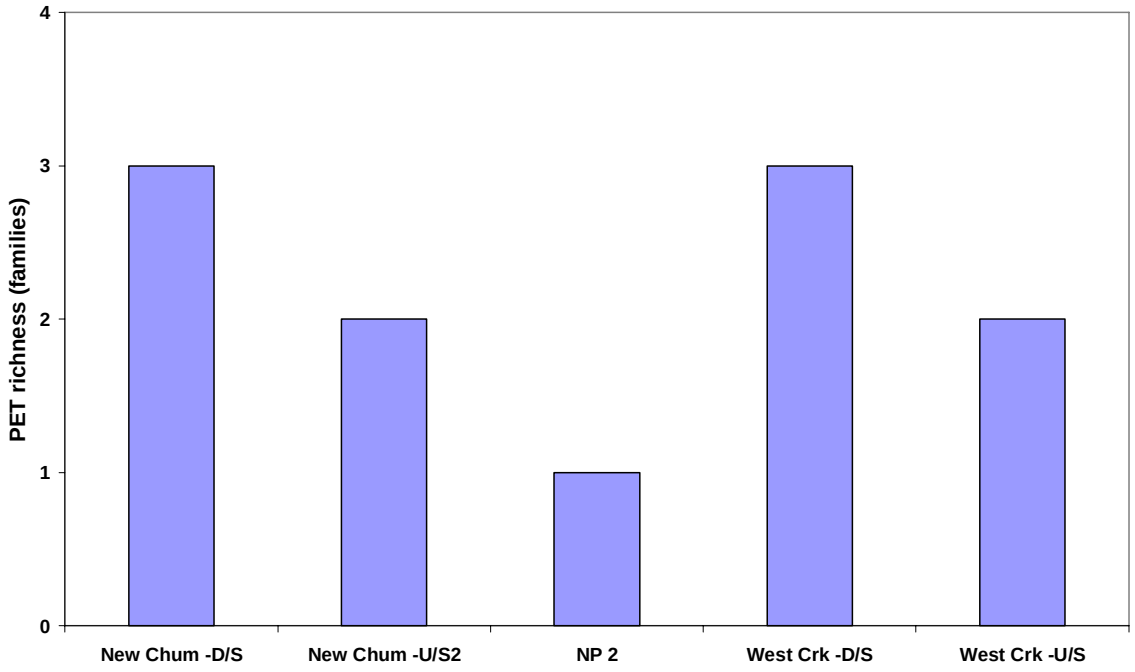

Figure 3.6 PET richness across all Millennium sites during the March 2009 surveys.

The diversity of macroinvertebrates was relatively high for an intermittent system, and at most sites more invertebrate families were recorded from the stream bed habitat than from edge samples. As the banks at most sites were steeply incised, this observation cannot be attributed to the impacts of cattle on the streambanks, and is more likely a reflection of variable water levels and better quality habitat on the stream beds. The upstream site in New Chum Creek was an exception, the greater diversity being found in the edge samples, possibly due to more stable banks with a greater proportion of woody debris than most of the other sites.

PET richness (the number of Plecoptera, Ephemeroptera and Tricoptera families represented) was low, ranging from 1-3 families (Figure 3.6). These families are particularly sensitive to anthropogenic influences, hence a low PET score is generally considered an indication of a heavily impacted aquatic ecosystem. Whilst PET richness is widely used in this type of assessment, it should be noted that Plecopterans (stone flies) are generally not well represented in Queensland, hence rarely contribute significantly to the analysis – none were recorded at the Millennium site. Characteristic of Ephemeropterans (mayflies) and Tricopterans (caddis flies) is a very short lifespan of the adult (winged) insect, but relatively long aquatic larval stages ranging from several months to a year. These organisms are therefore not common in ephemeral systems, where annual desiccation prevents development of the larvae. PET scores are therefore more

suited for assessing more permanent water bodies, and the low scores recorded at Millennium probably reflect natural environmental constraints.

AusRivAs Modelling and Risk Bands

The Australian River Assessment System (AusRivAS) includes methods and manuals for using macroinvertebrates as indicators of freshwater ecosystem health. A series of models are available for regional Queensland and typically require the collection of macroinvertebrate samples, physico-chemical data and site descriptors during both Spring and Autumn. In the case of waterways at the Millennium site, it is not possible to collect spring samples, since the creeks are typically dry during the prescribed sampling months. The single season (Autumn) models for bed and edge habitat at sites west of the Great Dividing Range are therefore the most appropriate for this assessment. The predictor variables required for input are described below, whilst Table 3-8 shows the predictor values used in the modelling.

Table 3-8 Predictor variables used in the AusRivAs modelling.

Predictor	Model	Description
Dryrange	Edge	Range in mean dry season monthly rainfall (mm)
Latitude	Edge	Latitude in decimal degrees to 4 places
Mintemp	Edge	Mean daily minimum temperature (C)
MWMR	Edge	Mean wet season monthly rainfall (mm)
Storder	Edge / Bed	Stream order based on the degree of branching
Wetpercent	Edge	Percentage of annual rainfall occurring during the wet season
Processzone	Bed	Erosional=2, Transport=1, Depositional=2
Wetr	Bed	Range in wet season monthly rainfall (mm)

Average monthly rainfall data and annual minimum daily temperature data from the Australian Bureau of Meteorology Moranbah station (# 34038 – 1973 until current time) have been used for the modelling.

Table 3-9 Predictor values used in AusRivAS modelling of invertebrate data, March 2009.

Predictor	Value
Dryrange	29.3mm
Latitude	-22.0550
Mintemp	16.7 C
MWMR	75.1mm
Storder	1
Wetpercent	76%
Processzone	1
Wetr	65mm

The AusRivAS models utilise only those taxa calculated to have a 50% or greater probability of occurring at a test site, based on reference site data. This level of resolution represents a compromise that reduces the occurrence of low probability taxa whilst maintaining sufficient analytical resolution to detect significant shifts in species assemblages. The ratio of observed over expected taxa with an occurrence probability of ≥0.5 (50%) is referred to as the OE50 score for a site.

The OE50 score assigned to a site is normally within the range within 0 – 1, with lower scores indicating impacted sites at which the observed macroinvertebrate fauna are depleted in comparison to reference sites. Conversely, sites for which the OE50 score nears a value of 1 have observed macroinvertebrate assemblages similar to those expected from comparable unimpacted sites. On some occasions the species richness may exceed that expected based on the reference sites, resulting in an OE50 score of greater than 1.

To simplify interpretation of modelled outputs, the AusRivAS models divide sites into bands based on the OE50 scores obtained. The thresholds for each of these bands are provided in Table 3-10, along with interpretive information.

Table 3-10 Species richness thresholds for AusRivAS assigned OE scores.

Band	Description	O/E Taxa	O/E Taxa Interpretations
X	Greater biological diversity than reference sites	O/E greater than 90th percentile of reference sites used to create the model.	More families found than expected. Potential biodiversity "hot-spot" or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream.
A	Biodiversity similar to reference	O/E within range of central 80% of reference sites used to create the model.	Expected number of families within the range found at 80% of the reference sites.
B	Biodiversity significantly reduced	O/E below 10th percentile of reference sites used to create the model. Same width as band A.	Fewer families than expected. Potential impact either on water and/or habitat quality resulting in a loss of families.
C	Biodiversity severely impaired	O/E below band B. Same width as band A.	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	Biodiversity extremely impaired	O/E below band C down to zero.	Few of the expected families and only the hardy, pollution tolerant families remain. Severe impairment.

In addition to OE50 scores, AusRivAS assigns a signal score to each of the test sites based on the sensitivity of macroinvertebrate families to pollution. High signal scores indicate the presence of taxa that are sensitive to pollution. Again, a threshold of a 50% probability of a taxon occurring is considered appropriate for this assessment (the OE50 Signal score).

Table 3-11 OE50 scores, OE50Signal scores and AusRivAs risk bands for Millennium sites, March 2009.

Site	Habitat	OE50	OE50Signal	Band
New Chum U/S	Edge	0.45	0.89	B
	Pool	0.60	0.98	B
New Chum D/S	Edge	0.39	1.08	C
	Pool	0.90	0.96	A
West Ck U/S	Edge	0.32	1.09	C
	Pool	0.60	0.98	B
West Ck D/S	Edge	0.32	1.09	C
	Pool	0.90	0.96	A
NP2	Pool	0.45	0.84	B

OE50 scores for samples collected from the pool beds were relatively high (Table 3-11), 0.45 to 0.90 scores indicating that 45 to 90% of the expected macroinvertebrate taxa were present in the samples respectively. For New Chum and West Creeks, the downstream pool sites tended to exhibit higher scores than the upstream sites. NP2 returned the lowest OE50 for pool habitat. This observation probably reflects more stable hydrology in the downstream sites, as both receive discharge from dams, which would be expected to reduce the severity of flood flows and extend the period over which the sites contain water. Macroinvertebrate assemblages within all of the pools places the sites in risks bands A or B, indicating that the sites are close to pristine or have a undergone significant, though not severe, impacts through anthropogenic processes.

By contrast, samples collected from the edges of the pools tended to exhibit lower OE50 scores (0.32 to 0.45), indicating that the edge habitat was relatively poor at all sites. This is not surprising given the natural channelization that has occurred due to highly variable hydrological regimes. Assemblages on the edges of pools are also more susceptible to water level fluctuations than those in deeper water. Based on the edge habitat assemblages, all sites fell within risk band C (severely impaired), with the exception of the New Chum Creek upstream site, which feel into risk band B, possibly due to a greater abundance and diversity of edge habitat at this site.

OE50 Signal scores were high across all of the monitoring sites and all habitat types, indicating that a high proportion of the pollution sensitive taxa expected from comparable reference sites were observed at the Millennium sites. Combined, the OE50 and OE50

Signal scores indicate that the Millennium sampling sites have experienced slight to moderate impacts associated with habitat degradation, rather than poor water quality (Figure 3.7).

Figure 3.8 shows a dendogram of all sites (Bray-Curtis similarity on log-transformed data). This analysis shows that macroinvertebrate assemblages were similar at all upstream sites (including NP2), with the exception of the New Chum Creek upstream pool assemblages, which grouped with downstream sites. This tends to suggest that downstream sites are impacted by the grazing and mining activities at Millennium, either through water quality or altered hydrological regimes (eg influences of dams and altered catchment drainage lines).

Secondary clusters indicate differences between pool and edge habitat assemblages at the upstream sites, although this was not reflected in the downstream sites, where the factors influencing clustering are not obvious.

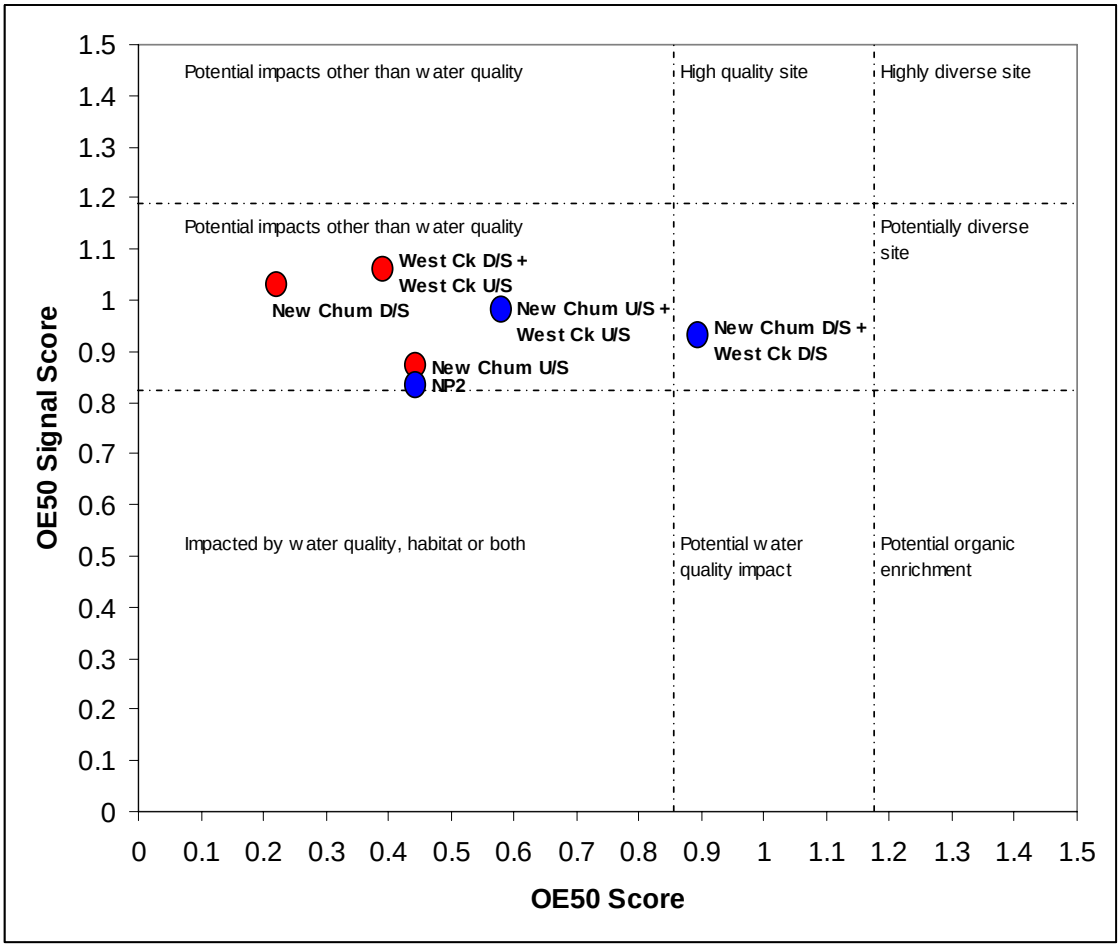

Figure 3.7 OE50 vs OE50Signal scores for the Millennium sites, March 2009.

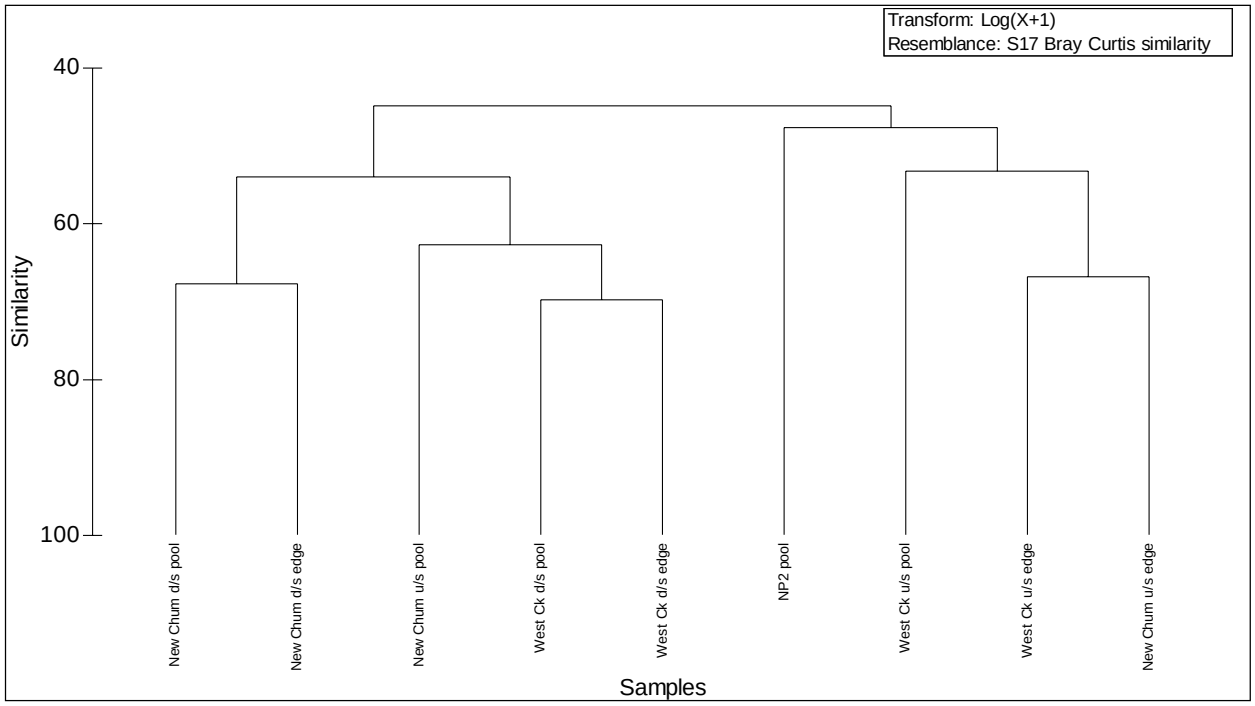

Figure 3.8 Dendogram of macroinvertebrate taxa at the Millennium sites based on Bray-Curtis similarity matrix, March 2009.

Aquatic Vertebrates (Exclusive of Fish)

No formal surveys of aquatic or semi-aquatic reptiles, mammals or amphibians were performed in the course of this assessment. During surveys of fish and aquatic macroinvertebrates two frog species were observed:

- *Limnodynastes peroni* (Striped marsh frog), New Chum U/S site.
- *Opisthodon ornatus* (Ornate burrowing frog), West Creek D/S and New Chum U/S sites.

The latter species was particularly common at the New Chum upstream site, with dozens of individuals observed on the streambanks.

Six turtle species are known to occur within the Fitzroy River catchment, including the EPBC listed (vulnerable) Fitzroy River turtle. The other species include:

- *Chelodina longicollis* (Eastern snake-necked turtle)
- *Elseya latisternum* (saw-shelled turtle)

- *Chelodina canni* (Cann's snake-necked turtle)
- *Chelodina longocillis x canni* (Styx River hybrid)
- *Emydura macquarii krefftii* (Krefft's River turtle)

No turtles, crocodiles or platypus were observed during the field surveys, and inspections of the banks did not reveal any slides, burrows, nests or pathways of these animals. Given the intermittent nature of the waterways at the site, lack of suitable aquatic habitat (deep permanent pools with macrophytes) and the absence of reliable aquatic food sources, it is unlikely that turtles, crocodiles or platypus would utilise waterways at the Millennium site in anything more than a transitory way, if at all.

4 Potential MEP Impacts on Aquatic Ecosystems

The Millennium Expansion Project has the potential to impact on aquatic communities both directly and indirectly.

Based on the staged mine plans provided in May 2009, the likely alterations to aquatic ecosystems at the Millennium site will largely revolve around alterations to surface water hydrology and stormwater water quality resulting from:

- **Stage 1, 2011**
  - North westerly advancement of Millennium Pit A and expansion of West Expit Dump, with subsequent loss of catchment to West Creek.
  - Commencement of Mavis Pit and External Dump 1, resulting in loss of catchment to NP1 as a result of the pit, potential water quality implications resulting from runoff from the external dump and potential depletion of groundwater resulting from pit dewatering.
  - Commencement of External Dump 2, with altered catchment hydrology and potential runoff water quality implications.

- **Stage 2, 2012**
  - South easterly advancement of Mavis pit with associated encroachment into catchment of NP1, potential hydrological implications.
  - North westerly advancement of Millennium Pit A, loss/diversion of major portion of West Creek catchment above the West Creek Environmental Control Dam, with diversion of clean runoff around mining impacts.
  - Recontouring of landscape at External Dump 2, External Dump 3, potential hydrological implications for New Chum Creek
  - Rehabilitation at External Dump 1, potential improved water quality of runoff, altered hydrology.
  - Reshaping of External Dump South West and External Dump South, potential hydrological alterations to West Creek, potential water quality implications (runoff).

- **Stage 3, 2015**
  - Continued south easterly advancement of Mavis Pit, loss or diversion of NP1, encroachment into the catchment of NP2. Significantly altered

hydrology/hydrogeology within both of these streams, as well as New Chum Creek.

- Rehabilitation of External Dump 3 and partial rehabilitation of External Dump 2, potential improved surface runoff quality, altered hydrology.
- Reshaping of Inpit Dump and use of Pit A as Input Dump. Altered hydrology and potential surface runoff quality issues.
- Rehabilitation of External Dump South West and External Dump south, potential altered hydrology and improved surface runoff quality.

- **Stage 4, 2020**
  - Advancement of Mavis Pit in south easterly direction, loss or diversion of both NP1 and NP2, potential hydrological and water quality implications for New Chum Creek reshaping and rehabilitation of north-western area of pit.
  - Reshaping and partial rehabilitation of Millennium Pit, potential altered hydrology and potential improved runoff quality.

- **Stage 5, 2026**
  - Completion of mining from Mavis Pit, advancement to south eastern extremity of lease. Potential altered hydrology/hydrogeology in New Chum Creek.
  - Reshaping and rehabilitation of remainder of Mavis Pit, contouring to return surface flow to approximate natural flow conditions. Potential improved water quality of runoff.
  - Rehabilitation of Millennium Pit, hydrological and water quality implications.

Potential impacts in addition to the above include:

- Poor water quality of surface runoff from haul roads, hard stand, processing and other mine site areas.
- Depletion of groundwater tables by mine dewatering, if there is exchange between ground and surface water systems at the site.

4.1 Impacts on Riparian Vegetation

Botanical surveys of the site have not revealed any threatened riparian vegetation communities within the Millennium Site (Spain pers. com., 2009). The small shrub *Cerbera dumicola* is not specifically a riparian species and does not rely on hydrological

patterns for the dispersion or germination of propagules. Changes in the hydrology or water quality of New Chum Creek are therefore unlikely to affect *C. dumicola*, if present in the riparian zone. Further, the current 100m buffer between areas to be actively mined and New Chum Creek could be expected to preserve riparian vegetation at the site.

4.2 Impacts on Aquatic Macrophytes

Aquatic macrophytes were absent from the site at the time of sampling, possibly due to the scouring effect of wet season flooding, although it is not uncommon for seasonal streams to have a low abundance and diversity of macrophytes. Macrophyte taxa recorded at the neighbouring Daunia Coal Mine (BMA, 2008), are probably representative of the species that may colonise the Millennium waterways when conditions permit. No species of conservation significance were recorded at that site.

4.3 Impacts on Aquatic Fauna

Aquatic faunal assemblages at the Millennium site are in relatively good condition by comparison to other ephemeral systems. However, they were dominated by hardy taxa that tolerate and readily adapt to a wide variety of environmental conditions.

Fish

Typical of intermittent systems, fish populations at the Millennium site are species poor and are dominated by hardy taxa that have an ability to penetrate into the systems during flood periods. None of the fish species either recorded at the site or identified through the database searches are of conservation, recreational or commercial fishing significance. Given the transitory nature of the waterways, it is likely that fish migrate into these systems during floods and become trapped when waters recede, although *M. splendida* (Eastern rainbowfish) were found to have spawned within the isolated pools in both West and New Chum Creeks.

The MEP will result in minor loss of habitat for the species that utilise these headwaters, although the area that will be lost is minor by comparison to the total available habitat of this type within the region. These systems are unlikely to represent high quality spawning or foraging habitat for any of the species captured or identified, hence their loss is extremely unlikely to influence downstream populations.

There is some potential for impacts on downstream fish populations as a result of altered flow hydrology or poor water quality resulting from surface runoff at the mine site. The

latter can largely be managed by the implementation of leading practice for stormwater management. It is anticipated that the MEP will result in a reduction in the overall catchment area for New Chum and West Creeks, with a resulting reduction in the volume of surface runoff entering these systems and potentially a reduction in the frequency, magnitude and/or duration of flood events. These outcomes will result in reduced opportunities for the fish species identified in this study to penetrate into and colonise the headwaters of these drainages, However, these streams are first order systems and represent a very small proportion of the available habitat of this type locally. The fish species recorded are ubiquitous and hardy; hence it is unlikely that the project will have a discernable impact on fish locally or regionally.

Given the tenacity of the fish species involved, it is highly likely that rehabilitation of the site following mine closure will result in their return to the newly established drainage system.

Macroinvertebrates

Macroinvertebrate communities were relatively diverse for an intermittent system, though the species present tended to be tolerant of both water quality and habitat decline. There was no discernable difference between assemblages at the bottom end of the catchment as compared with those at the top, suggesting that current mine management practices are not having a discernable impact on the taxa present.

Some loss of macroinvertebrate habitat will occur, notably with the loss of the upper end of West Creek and of NP1 and NP2. However, at this point in the catchment all of these creeks are essentially drainage lines of little or no environmental significance and represent a very small proportion of the overall habitat of this type within the region.

Given the paucity of higher aquatic fauna (fish, turtles, platypus), the macroinvertebrate assemblages don't represent a significant food source; hence no flow-on impacts to the trophic structure of the systems are likely. It is highly likely that many of the taxa recorded will re-establish when the mine is rehabilitated. Further, no species of conservation significance at a national or state level were identified.

The MEP is expected to reduce the volume of water entering these systems, which creates the potential for shifts in Macroinvertebrate assemblages. However, the taxa recorded from ephemeral systems tend to be somewhat more tolerant than those from more permanent water bodies, particularly with respect to hydrology and conductivity. It is therefore likely that such shifts would be within the normal range for these systems under annual wetting and drying cycles.

The macroinvertebrate assemblages in this instance are not critical to any higher animal communities of conservation significance (eg fish, turtles, platypus) and do not in themselves contain threatened species or communities. It is therefore considered unlikely that any changes to macroinvertebrate assemblages that might arise as a result of the MEP are inconsequential in a local or regional context.

Other Aquatic Fauna

No turtles, platypus or crocodiles were recorded during field surveys and no sign of burrows, nests or paths were noted. Given the intermittent nature of the waterways assessed it is considered unlikely that these animals would frequent the Millenium site as they tend to favour deep pools, relatively clear water, macrophytes and structural cover.

Two frog species were noted at the Millennium site:

- *Limnodynastes peroni* (striped marsh frog), New Chum U/S site.
- *Limnodynastes ornatus* (ornate burrowing frog), West Creek D/S and New Chum U/S sites.

Neither of these species is considered to be of conservation significance, with populations stable or suspected of being stable or increasing. The nominal 100m buffer between the proposed expansion project and New Chum Creek should be sufficient to minimise direct impacts of the operation on frog populations. However altered hydrology and/or water quality resulting from the expansion could impact on frogs at a local scale. Given that the species in question are common at a local and regional scale, and that there is significant similar habitat in the local area, it is very unlikely that the MEP will have a significant impact on these species on a local or regional scale.

Cumulative Impacts

Cumulative impacts refers to the potential for operations at the Millennium site to contribute minor impacts on downstream environments, but for significant impacts to occur when the sum of emanations from all mines, agricultural or industrial activities in the catchment is considered. In the context of the aquatic environment there are two potential contributions that the Millennium site may make to local and regional impacts:

- Altered catchment hydrology, with associated ecological and fluvial geomorphological implications.
- Poor water quality in the downstream environment, with associated ecological and social implications.

The reduction in the surface runoff intercepted by the conceptual Water Management System (WMS) will be greatest in year 17 (17.8% of the New Chum Creek catchment). Considering the relatively small size of the catchment and that all surface water running off undisturbed land will be diverted around the mine, it is considered unlikely to significantly alter the regional hydrology. The water within the MEP will be intercepted by the WMS and if properly retained and managed is unlikely to have a significant impact on water quality downstream of the site.

4.4 Mitigation of Impacts to Aquatic Ecosystems

Drainage areas that lie within the proposed excavation areas at Millennium Pit (i.e. West Creek headwaters) and Mavis Pit (NP1 and NP2) will be lost due to excavation; hence mitigation of these impacts is not possible. Whilst offsets or translocations could be considered, these systems represent a small area of marginal aquatic habitat that has negligible conservation value and does not support any threatened species or communities. No mitigation or offsets are therefore suggested for impacts on NP1, NP2 or the upper extent of West Creek.

Impacts on New Chum and West creeks may take the form of poor quality stormwater runoff, altered catchment hydrology and/or physical impacts such as creek crossings, vegetation clearing or construction of mining infrastructure.

The following measures should be adopted to avoid, minimise and/or mitigate impacts on aquatic ecosystems:

- Stormwater management:
  - Diversion of uncontaminated stormwater away from active mining areas and infrastructure to reduce potential for nutrient, sediment or pollutant (e.g. metals, oils etc) transport into watercourses.
  - Capture/diversion of runoff from active mine site areas into sedimentation basins, swales or other water treatment facilities as appropriate. These facilities must be constructed prior to earth breaking or infrastructure construction activities.
  - Wherever possible, construction activities and any works in, near or adjacent to watercourses should be performed during the dry season. If exposed soils cannot be rehabilitated prior to the wet season, appropriate barriers to sediment transport (e.g. silt curtains) must be in place well before significant rainfall occurs. Such measures must be adequate to cope with the very heavy rainfall events experienced at the site.

- The use of vegetation such as grasses and macrophytes as sediment filters should be considered where possible. Where this is not possible, geotextile, rip rap and stabilisation techniques should be considered.

- Catchment hydrology/hydrogeology:
  - Changes to the drainage characteristics of the site should be minimised as far as possible. For example, paved surfaces should be kept to a minimum and should be properly constructed with adequate table drains.
  - The impacts of mine dewatering on groundwater dependent ecosystems should be considered. Where dewatering of the pit is likely to also result in dewatering of watercourses, augmentation of natural flows with clean water may be required.
- Physical disturbance of drainage lines:
  - The use of machinery, plant or vehicles within or in close proximity to watercourses should be minimised. Wherever possible a buffer of at least 100m from the banks of New Chum Creek should be maintained.
  - Where machinery must operate in or close to waterways (e.g. during construction of roads and crossings), this should be kept to a minimum and should take place during the dryer months if at all possible. Leading practice sediment management protocols must be in place (e.g. silt curtains) and rehabilitation or protection of exposed or disturbed streambanks, beds or adjacent soils must be completed before significant rainfall events.
- Management of chemicals/waste:
  - Leading practice for the management of fuels, oils and chemicals on site must be adhered to at all times. The use of chemicals should be restricted to designated, bunded facilities. Stormwater from bunded areas must be appropriately treated prior to discharge.
  - In the event of fuel, chemical or oil spills outside of bunded areas the material must be contained to prevent transport into waterways. Removal and secure disposal of contaminated soils and rehabilitation of exposed soil should be performed.
  - Leading practice for the management of waste (including sewage and landfill) must be adhered to at all times. Facilities for the treatment or containment of such wastes must be sited an appropriate distance from watercourses. As all sewage and waste materials are disposed off-site at licenced facilities, there is no potential issue for this at Millennium.

5 References

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6 Appendix A Photographs of Sampling Sites

Figure 6.1

New Chum Creek Downstream

Figure 6.2

New Chum Creek Upstream (alternative site)

Figure 6.3

West Creek Downstream

Figure 6.4

West Creek Upstream

Figure 6.5

NP1

Figure 6.6

NP2

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F9:

INDIGENOUS CULTURAL HERITAGE

WOORA CONSULTING

Contact: Frank Budby Lot 1 Powell's Road, FARLEIGH QLD 4741 PH: (07) 4959 8822
Fax: (07) 4959 8387 E-Mail - budbahra@easynet.net.au
ABN# 11 073 996 689

25 November 2005

Dear Alan

This letter is to confirm that the ***Significant Cultural Heritage Site*** on Millennium Coal Lease has been collected and removed from site. Woora Consulting on behalf of the BBKY Native Title Claimants, give an approval of Cultural Clearance for the proposed works to start.

Yours Sincerely

Frank Budby
Manager

Woora Consulting

ABN: 83 113 624 918

8 Powells Road, Farleigh QLD 4741 Phone: (07)4959 8822 Fax: (07)4959 8387
Email: admin@woora.com.au

7 October 2008

Joseph Hughes
Environmental Advisor
Peabody Pacific Pty Limited
Millennium Coal Pty Ltd
Locked Bag 1005
Moranbah Qld 4744

Dear Joseph

RE: Cultural Heritage Approval of Areas on Mining Lease

I refer to the following areas on the Millennium Coal Mine where a Cultural Heritage collection of sites and artefacts was carried out and described as;

Mavis Downs

Further to the above, I would like to inform you of the results of the cultural heritage inspection carried out by members of our BBKY#3 Claim Group, as requested by yourself.

The items of Cultural Heritage Significance identified have been salvaged. However there may exist, subsurface Cultural material that was not readily identifiable during the initial survey. In the event of any Cultural material being found during disturbance, our Cultural coordinator should be contacted immediately.

This letter is to serve as confirmation by us, that we give Cultural Heritage Approval of the area inspected. If you have any queries please do not hesitate to contact me on the above.

Yours Sincerely

Stacey Budby

Manager

Woora Consulting

ABN: 83 113 624 918

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7 October 2008

Joseph Hughes
Environmental Advisor
Peabody Pacific Pty Limited
Millennium Coal Pty Ltd
Locked Bag 1005
Moranbah Qld 4744

Dear Joseph

RE: Cultural Heritage Approval of Areas on Mining Lease

I refer to the following areas on the Millennium Coal Mine where a Cultural Heritage collection of sites and artefacts was carried out and described as;

New Chum Road Pass Area

Further to the above, I would like to inform you of the results of the cultural heritage inspection carried out by members of our BBKY#3 Claim Group, as requested by yourself.

The items of Cultural Heritage Significance identified have been salvaged. However there may exist, subsurface Cultural material that was not readily identifiable during the initial survey. In the event of any Cultural material being found during disturbance, our Cultural coordinator should be contacted immediately.

This letter is to serve as confirmation by us, that we give Cultural Heritage Approval of the area inspected. If you have any queries please do not hesitate to contact me on the above.

Yours Sincerely

Stacey Budby

Manager

Woora Consulting

ABN: 83 113 624 918

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Email: admin@woora.com.au

7 October 2008

Joseph Hughes
Environmental Advisor
Peabody Pacific Pty Limited
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Locked Bag 1005
Moranbah Qld 4744

Dear Joseph

RE: Cultural Heritage Approval of Areas on Mining Lease

I refer to the following areas on the Millennium Coal Mine where a Cultural Heritage collection of sites and artefacts was carried out and described as;

North Poitrel

Further to the above, I would like to inform you of the results of the cultural heritage inspection carried out by members of our BBKY#3 Claim Group, as requested by yourself.

The items of Cultural Heritage Significance identified have been salvaged. However there may exist, subsurface Cultural material that was not readily identifiable during the initial survey. In the event of any Cultural material being found during disturbance, our Cultural coordinator should be contacted immediately.

This letter is to serve as confirmation by us, that we give Cultural Heritage Approval of the area inspected. If you have any queries please do not hesitate to contact me on the above.

Yours Sincerely

Stacey Budby

Manager

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F10:

EUROPEAN CULTURAL HERITAGE

EVERICK
Heritage Consultants Pty Ltd
ABN 78102206682

August 2010

HISTORIC CULTURAL HERITAGE ASSESSMENT

FOR THE

MILLENNIUM EXPANSION PROJECT ISAAC REGION, QLD

Prepared for Peabody Energy Australia Pty Ltd

Innovative Heritage Solutions

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Report Reference:

Robins, R. and T. Robins and H. Tomkins. 2010 *Historic Cultural Heritage Assessment: Millennium Expansion Project (August 2010)*. Everick Heritage Consultants unpublished report prepared for Peabody Energy Australia Pty Ltd.

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Kaye Nardella (Qld Department of Lands Survey Museum)
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EXECUTIVE SUMMARY

The following report presents the results of an assessment for historic (non indigenous) cultural heritage assessment undertaken in preparation for the proposed Millennium Expansion Project ('MEP'). The Subject Lands for this assessment are contained within ML 70313, MLA70401 and MDL136, as shown in Figure 1.

Prior to inspecting the Subject Lands, a desk based analysis was conducted in order to create a predictive model of potentially significant cultural heritage within the proposed mining area. This included searches of the Environmental Protection Agency (now Department of Environment and Resource Management ('DERM')) Heritage Register, interviews with the Department of Lands Survey Museum Staff, historic research undertaken at the Queensland State Archives and a review of past cultural heritage assessments in the region.

A survey of the Subject Lands was then undertaken by qualified archaeologist Dr Richard Robins on 10th June 2009. Potential items or features of interest were recorded and were subsequently mapped (Figure 10). One item, a surveyor's shield, was considered to be of potential cultural heritage significance. Further research was undertaken in this regard. Although a definitive answer was unable to be achieved, it is considered highly unlikely that the shield is of heritage significance and no further assessment is warranted (Section 8).

Results: No items of cultural heritage significance were identified in this assessment that may be impacted by the MEP. The likelihood of the MEP impacting any unidentified archaeological artefacts of State significance is considered to be low. Never-the-less, a number of cautionary strategies have been developed to ensure Peabody adequately fulfils their obligations under Section 89 of the *Queensland Heritage Act 1992* (Qld).

Recommended Cautionary Management Strategies

The following management recommendation is cautionary in nature. The proposed strategies outlined in Appendix F are modeled on the DERM *Draft Guidelines for Carrying Out an Archaeological Investigation: Standards and Guidance for Persons Carrying out an Archaeological Investigation* (External Consultation Draft: May 2010). At the time of publishing this report, these guidelines were yet to become official policy. Never-the-less, the draft Guidelines present a reasonable approach to historic cultural heritage management, and as such form the basis of the cautionary recommendations in this report. It is anticipated official guidelines will be Gazetted under Section 173(1)(d) of the *Queensland*

Heritage Act 1992 (Qld) in the near future. The review strategy listed as Section 3 in Appendix F addresses this issue.

Further historical studies are not considered necessary prior to implementation of the MEP.

Strategy 1: Cultural Heritage Management Plan

It is recommended that the terms in the Cultural Heritage Management Plan provided in Appendix F of this report are adopted into the Environmental Management Plan for the Project. The management practises should include, as a minimum:

(a) the general principles of historic heritage management;
(b) responsibilities and channels of communication;
(c) a find strategy for items of potentially significant cultural heritage;
(d) archaeological monitoring standards;
(e) archaeological investigative standards;
(f) conservation and interpretation standards
(g) the appointment of a cultural heritage advisor;
(h) periodic review requirements; and
(i) requirements for the approval of DERM.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... - 2 -
1. INTRODUCTION ..... - 6 -
1.1 PROPERTY DESCRIPTION ..... - 6 -
1.2 PROJECT BACKGROUND (MET SERVE 2009) ..... - 8 -
1.3 REPORT AUTHORSHIP ..... - 9 -
2. LEGISLATIVE AND POLICY ASSESSMENT FRAMEWORK ..... - 9 -
2.1 APPROVAL PROCESS ..... - 10 -
2.2 *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999* (CTH) ..... - 11 -
2.3 *QUEENSLAND HERITAGE ACT 1992* (QLD) ..... - 12 -
2.4 ICOMOS BURRA CHARTER ..... - 13 -
3. METHODOLOGY OVERVIEW ..... - 13 -
4. HISTORICAL CONTEXT ..... - 14 -
4.1 REGIONAL HISTORY ..... - 14 -
4.2 HISTORY OF LAND TENURE AND LAND USE OF THE MEP (SUBJECT LANDS) ..... - 18 -
4.3 HISTORICAL THEMES ..... - 24 -
5. HERITAGE CONTEXT ..... - 25 -
5.1 PREVIOUS ARCHAEOLOGICAL/CULTURAL HERITAGE ASSESSMENTS ..... - 25 -
5.2 SEARCH OF THE HERITAGE REGISTERS ..... - 27 -
5.3 REVIEW OF HISTORIC AERIAL PHOTOGRAPHY ..... - 27 -
6. ARCHAEOLOGICAL FIELD ASSESSMENT ..... - 30 -
6.1 SURVEY STRATEGY - METHODS ..... - 30 -
6.2 CONSTRAINTS TO SITE DETECTION ..... - 31 -
6.3 RESULTS ..... - 32 -
7. SIGNIFICANCE ASSESSMENT ..... - 35 -
7.1 SURVEYOR'S SHIELD ..... - 35 -
8. HERITAGE IMPACT STATEMENT ..... - 37 -
9. RECOMMENDED MANAGEMENT STRATEGY ..... - 37 -
BIBLIOGRAPHY ..... - 38 -
APPENDIX A: EPA HERITAGE SEARCHES ..... - 41 -
APPENDIX B: SAMPLE OF RESOURCES CONSULTED IN THIS ASSESSMENT ..... - 44 -
APPENDIX C: DEFINITIONS USED IN THE REPORT (BURRA CHARTER (1999) ..... - 56 -
APPENDIX D: BURRA CHARTER ASSESSMENT PROCESS ..... - 58 -
APPENDIX E: SURVEYOR'S SHIELD ON RED MOUNTAIN ..... - 59 -
APPENDIX F: HISTORIC CULTURAL HERITAGE MANAGEMENT PLAN ..... - 60 -

FIGURES

FIGURE 1: REGIONAL LOCALITY OF THE SUBJECT LANDS ..... - 7 -
FIGURE 2: AERIAL VIEW OF SUBJECT LANDS (SHOWN IN RED) & SURROUNDING MINING LEASE BOUNDARIES .. - 8 -
FIGURE 3: 1885 QUEENSLAND 16 MILE MAP SHOWING PASTORAL RUNS AND STOCK ROUTES ..... - 19 -
FIGURE 4: 1914 QUEENSLAND STOCK ROUTES MAP (SHOWN IN RED) (QSA ITEM ID629865) ..... - 20 -
FIGURE 5: 1951 QLD LANDS DEPARTMENT SURVEY MAP (POITREL HOMESTEAD CIRCLED IN RED) ..... - 21 -
FIGURE 6: 1957 AERIAL PHOTOGRAPH SHOWING THE EASTERN PORTION OF THE SUBJECT LANDS ..... - 28 -
FIGURE 7: 1957 AERIAL PHOTOGRAPH SHOWING THE WESTERN PORTION OF THE SUBJECT LANDS ..... - 29 -
FIGURE 8: SURVEY COVERAGE ..... - 31 -
FIGURE 9: LOCALITY OF THE SURVEYOR'S SHIELD ..... - 32 -
FIGURE 10: LOCALITY OF THE SURVEYORS SHIELD RELATIVE TO A NEARBY MODERN SURVEY MARKER ..... - 33 -
FIGURE 11: BLAZED TREE ON RED MOUNTAIN ..... - 34 -
FIGURE 12: CLOSE UP OF BLAZED TREE SHOWING BROAD ARROW ..... - 34 -
FIGURE 13: CEMENTED STEEL DROPPER ..... - 34 -
FIGURE 14: STATE RECORDS OF SURVEYORS SHIELD ON RED MOUNTAIN ..... - 36 -
FIGURE 15: MAP FROM 1892 PROPERTY BOUNDARIES FOR "ANNANDALE RUN" (QSA ITEM ID26676) ..... - 45 -
FIGURE 16: PUBLIC NOTICE 1906 PROPERTY BOUNDARIES FOR "ANNANDALE RUN" (QSA ITEM ID26676) .. - 46 -
FIGURE 17: MAP FROM 1906 PROPERTY BOUNDARIES FOR "ANNANDALE RUN" (QSA ITEM ID26676) ..... - 47 -
FIGURE 18: MINISTERS' RECOMMENDATION IN 1920 FOR LAND RESUMPTION (QSA ITEM ID26676) ..... - 48 -
FIGURE 19: MAP FROM 1920 SHOWING AREA OF LAND TO BE RESUMED (QSA ITEM ID26676) ..... - 48 -
FIGURE 20: SURVEY MAP FROM 1920 SHOWING NEW BOUNDARIES FOR G.H. 1832 (QSA ITEM ID26676) .. - 49 -
FIGURE 21: SURVEY MAP FROM 1920 SHOWING NEW BOUNDARIES FOR G.H. 1815 (QSA ITEM ID26676) .. - 49 -
FIGURE 22: LIST OF IMPROVEMENTS FOR G.H. 1832 "POITREL STATION" (QSA ITEM ID184008) ..... - 50 -
FIGURE 23: LIST OF IMPROVEMENTS FOR G.H. 1815 "MAVIS DOWNS STATION" (QSA ITEM ID69692) ..... - 51 -
FIGURE 24: CONVERSION OF TENURE FOR "MAVIS DOWNS" IN 1970 TO G.H.F.L. 3981 ..... - 52 -
FIGURE 25: NOTICE FOR 1971 PROPOSED LAND RESUMPTION FROM "MAVIS DOWNS" FOR RAILWAY LINE ..... - 53 -
FIGURE 26: MAP SHOWING 1971 EASEMENT TO BE RESUMED (QSA ITEM ID194446) ..... - 53 -
FIGURE 27: DEED OF GRANT ISSUED IN 1985 FOR LOT 1 ON PLAN GV119 (QSA ITEM ID194446) ..... - 54 -
FIGURE 28: SURVEY MAP ISSUED FOR LOT 1 ON PLAN GV119 (QSA ITEM ID194446) ..... - 55 -

1. INTRODUCTION

Everick Heritage Consultants has been engaged by Peabody Energy Australia Pty Ltd ('Peabody') to conduct an assessment of known and potential historical cultural heritage values of the proposed Millennium Expansion Project ("MEP'). The assessment is being undertaken to inform an Environmental Impact Statement ('EIS') being prepared in anticipation of expanding mining operations at the Millennium Coal Mine.

The assessment involved a literature review, heritage register searches, review of historic aerial photography, consultation with relevant government agencies and a field inspection. Heritage assessments have been undertaken on many of the surrounding lands in preparation for other mining activities, and have provided a valuable resource for this assessment.

1.1 Property Description

The Subject Lands lie within the Isaac Regional Council Local Government Area, formerly part of the Belyando Shire in Central Queensland. They are approximately 22 km east of Moranbah and 16 km southwest of Coppabella (Figure 1). The Subject Lands boundaries are shown in Figure 2 in red, being those parts of the mining lease that will be disturbed by the MEP. The tenement and property descriptions within which the Subject Lands fall are shown in Table 1.

Table 1: Subject Lands tenure description

MEP Land Tenures	
ML 70313	Lot 2 GV165
	Easement P SP184913
MLA 70401	Lot 2 GV165
	Easement B SP178453
	Easement E SP1902563
MDL 136	Lot 3 SP190266
	Lot 2 GV165

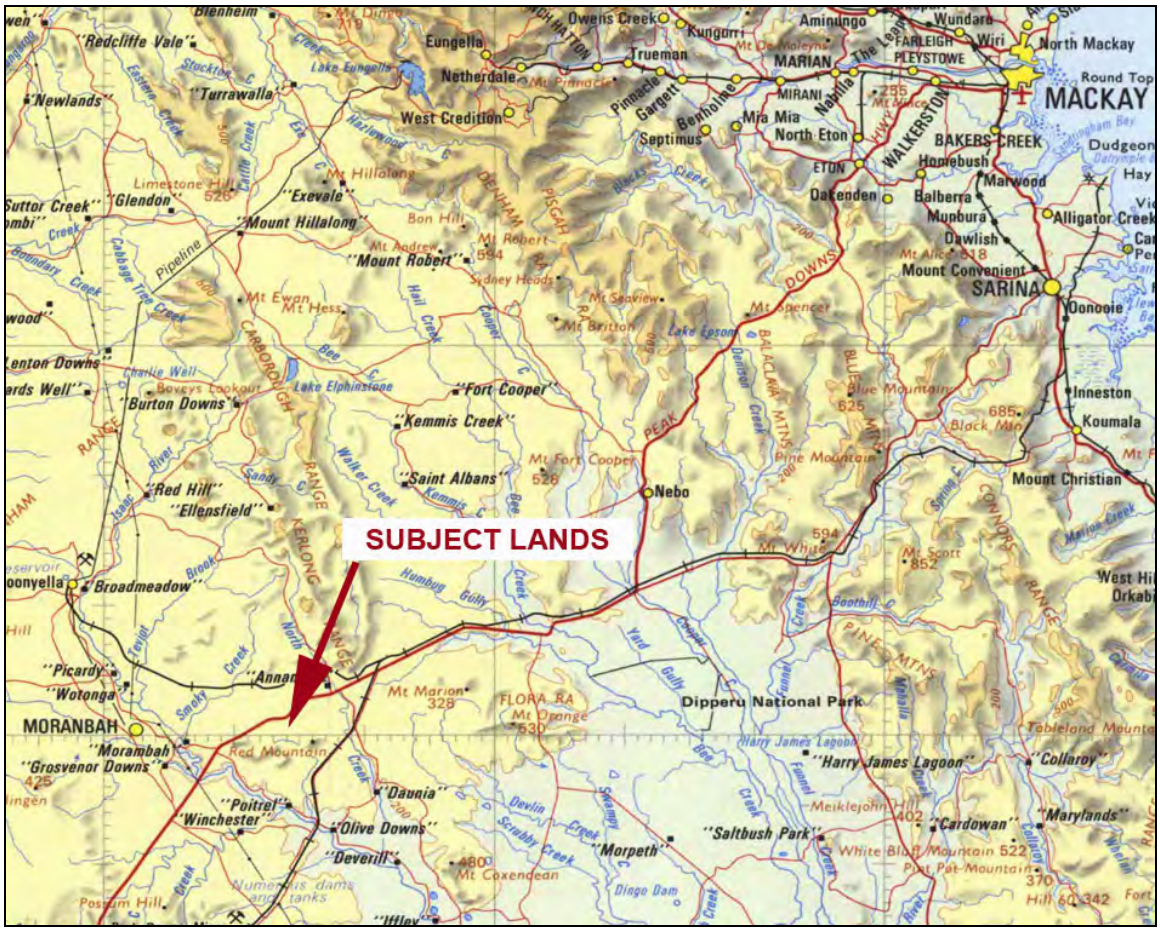


Figure 1: Regional locality of the Subject Lands

The literature review extended beyond the physical boundaries of the Subject Lands to the surrounding areas. However, the management strategies contained in this report apply exclusively to the Subject Lands.

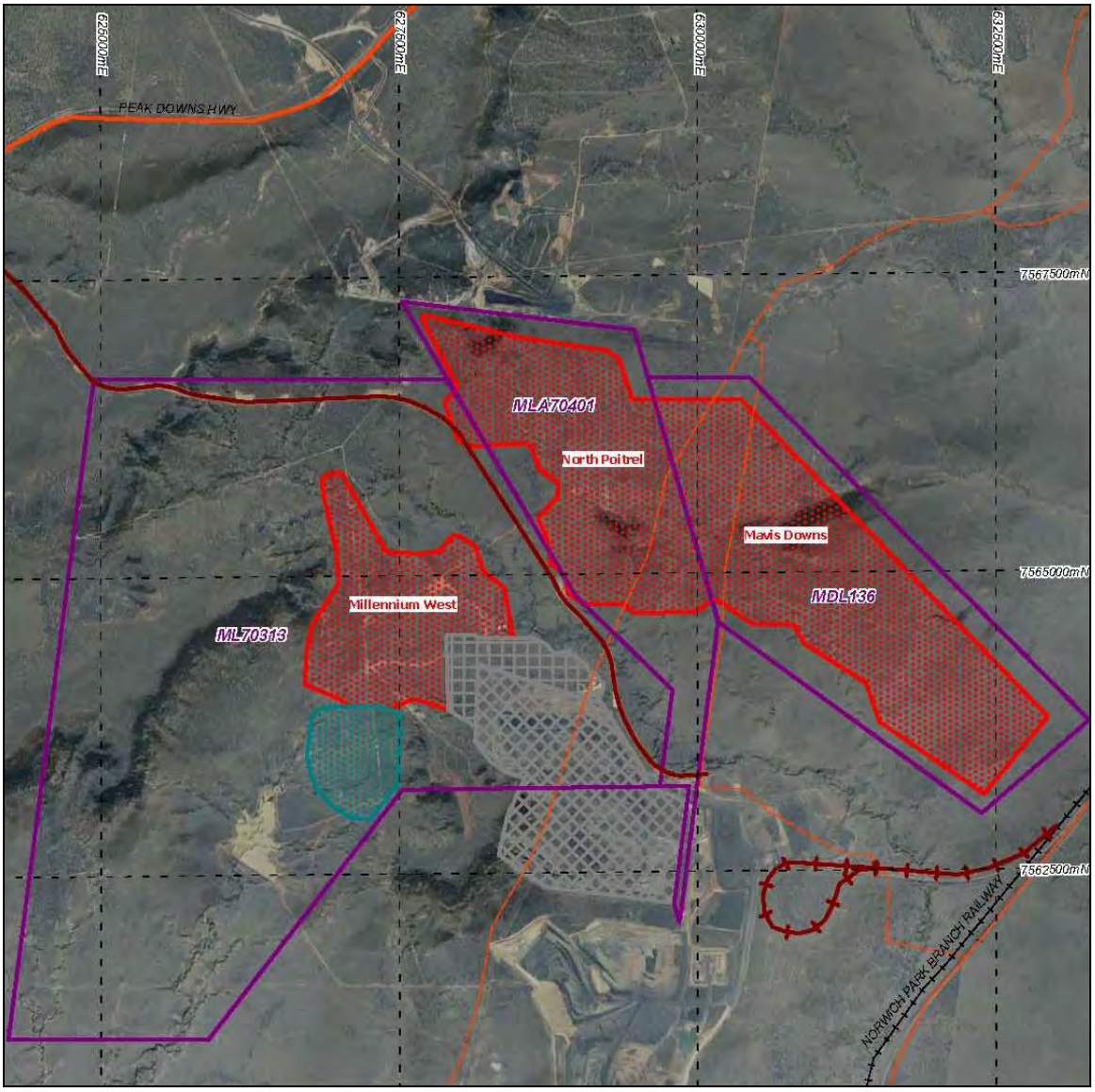


Figure 2: Aerial view of Subject Lands (shown in red) and surrounding mining lease boundaries

1.2 Project Background (MET Serve 2009)

The Millennium Coal Mine is an existing open-cut coal mine, operated by Millennium Coal Pty Limited ('MCPL'), a wholly owned subsidiary of Peabody Pacific Pty Limited. The Mine has been operating since 2005 with approval to produce at a rate of 2.0 Million tonnes per annum. The Run-of-Mine ('ROM') coal is currently extracted from two granted Mining Leases ('ML') namely, ML 70313 "Millennium West" and ML 70344 "Mountain Pit". The ROM coal is washed in a Coal Handling and Preparation Plant ('CHPP') on an adjoining infrastructure lease, ML 70312 "Millennium East".

Peabody proposes to extend the current open-cut mining operation into two new lease areas namely, Mineral Development Licence ('MDL') 136 "Mavis Downs" and Mining Lease Application ('MLA') 70401 "North Poitrel". Mining will continue within ML 70313. The proposed expansion areas are collectively referred to as the "Millennium Expansion Project" ('MEP').

Mining activities will involve both an extension of open cut operations and the coal will be hauled to the existing CHPP located on the ML 70312 for processing. Other impacts to the Subject Lands may include the development of tailings facilities and water management infrastructure. For the purposes of this assessment, it has been assumed that all parts of the Subject Lands will be heavily disturbed.

1.3 Report Authorship

The site survey was undertaken by Dr Richard Robins, assisted by Joseph Hughes, Environmental Advisor for Peabody Pacific Pty Ltd at the Millennium Mine. The desktop study was undertaken by Helene Tomkins (Qualified Archaeologist). This report was written by Dr Richard Robins.

2. LEGISLATIVE AND POLICY ASSESSMENT FRAMEWORK

In Australia, for ease of the management of heritage places, we have created an arbitrary framework whereby items are divided into 'world,' 'national,' State' or 'local' heritage significance. Each is governed by a different statutory and regulatory framework, which is overseen by the different levels of government. One of the common misconceptions with these categorisations is that such places are hierarchically ranked in their order of importance. Many would naturally assume that a 'world' heritage place is far more important and worthy of conservation than a 'local' heritage place. Indeed if you look at the importance as being in sheer numbers of people who find a place significant, this may indeed be true. But that is a misconstruction of what cultural heritage is about. The whole concept of what constitutes 'cultural heritage' is based around a place or item's significance to a particular group of people. In keeping with this principle, this assessment has followed the *Burra Charter* framework for heritage management.

2.1 Approval Process

This report has been commissioned in preparation for an Environmental Impact Statement for the MEP. The MEP is a controlled action that requires approval under the *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act'). The State's EIS process has been accredited for assessment under Part 8 of the EPBC Act in accordance with the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland (2004). Everick understands that Peabody applied for, and has been granted, approval to prepare a voluntary environmental impact statement ('the EIS') for the project.

As part of the EIS process, the Environmental Protection Agency ('the EPA'; now Department of Environment and Resource Management 'DERM') has provided Peabody with their Terms of Reference ('the TOR'). The TOR provides for the minimum standard of acceptable reporting information and standards for the project. In relation to historic cultural heritage, the specific requirements of the TOR (Section 4.9) can be summarised as:

(a) a description of the known and potential historical cultural heritage values of the affected area (including the cultural landscape);
(b) a desktop study, involving:
    i. searches of the Queensland Heritage Register, local government heritage registers, and other lists or inventories;
    ii. a review of the results of previous cultural heritage studies conducted within the region of the MEP;
(c) an archaeological study (survey) of the affected lands, guided by the desktop study, and undertaken by a qualified archaeologist; and
(d) the production of a report that outlines:
    i. the potential impacts to any identified cultural heritage;
    ii. any mitigation measures for those potential impacts; and (if required); and
    iii. a Historic Cultural Heritage Management Plan (CHMP) for the site.

The Historic CHMP is to address the potential impacts on non-indigenous cultural heritage values and any required avoidance or mitigation measures. The CHMP must establish, as a minimum:

(a) The processes for the mitigation, management and protection of identified non-indigenous cultural heritage values during excavations of the construction, operational, rehabilitation and decommissioning phases of the MEP.

(b) The processes for reporting, as required by section 89 of the *Queensland Heritage Act 1992*, the discovery of any archaeological artefact not previously identified in the historical cultural heritage study.

(c) Any procedures for the collection of any artefact material, including appropriate storage and conservation.

(d) A historical cultural heritage awareness training or programs for project staff.

The historical heritage management plan will be incorporated into the MEP's draft EM plan.

The EPA advises that while the TOR provides guidance on the scope of the EIS studies, they should not be seen as exhaustive or limiting. Accordingly, Everick has undertaken research beyond the strict terms of the TOR, conducting a thorough literature review, which has been used to develop a predictive model of site locations and contextualise the site inspection.

2.2 *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

In relation to cultural heritage, the EPBC Act is the principle legislation concerning heritage places of national or world significance. Actions that are likely to significantly impact on those matters are prohibited, without the Commonwealth Environment Minister's approval under the EPBC Act. The objectives of the EPBC Act relevant to cultural heritage are to:

(a) provide for the protection of the environment, especially matters of National Environmental Significance;
(b) conserve Australian biodiversity;
(c) provide a streamlined national environmental assessment and approval process;
(d) enhance the protection and management of important natural and cultural places; and
(e) promote Environmentally Sustainable Development through the conservation and ecologically sustainable use of natural resources.

Under the EPBC Act, certain actions — projects, development, undertakings, activities or a series of activities, or an alteration to any of these — require an assessment under the EPBC Act and an approval from the Commonwealth Environment Minister. This includes actions which may have an impact on World Heritage Properties or National Heritage Places and may include both historic and Indigenous cultural heritage items.

The MEP is a controlled action under the EPBC Act, requiring approval from the Federal Minister for the Environment, Heritage and the Arts. A controlled action is an action that is likely to have a significant impact on a matter of national environmental significance and/or Commonwealth land. The controlling

provisions for the MEP under Division 1, Part 3 of the EPBC Act are: section 18 and 18A (listed threatened species and communities). The EPBC Act allows the Commonwealth to enter into agreements with the States which allow a State approval to be recognised for the purposes of the EPBC Act. Such agreements are called "Approval Bilateral Agreements". The State's EIS process has been accredited for the assessment under Part 8 of the EPBC Act in accordance with the Bilateral Agreement between the Commonwealth of Australia and the State of Queensland (2004). However, the controlling provisions for the MEP do not relate to issues of cultural heritage. Should a place or item of national or world heritage significance be identified during this assessment, the EPBC Act remains the relevant legislation and the consent authority will be the Federal Minister for the Environment, Heritage and the Arts.

2.3 *Queensland Heritage Act 1992* (Qld)

The *Queensland Heritage Act 1992* (Qld) ('the QHA') is the principle piece of legislation controlling actions on objects or places of state heritage significance. The primary protection for such places is provided through nomination and registration for entry onto the Queensland Heritage Register. Once entered onto the register, the statutory body formed under the QHA, the Queensland Heritage Council, have a range of decision making powers over subsequent development applications. The Cultural Heritage body of the EPA is also given responsibilities over the management of cultural heritage in Queensland. The powers granted by the QHA have recently been extended to include maintenance provisions, ensuring owners do not let heritage listed places deteriorate to such an extent they can no longer be conserved, repaired or restored.

The QHA provides a set of criteria for measuring the significance of a site or place. Under Section 35(1) a place may be entered in the Queensland Heritage Register if its cultural heritage significance satisfies one or more of the following criteria:

(a) the place is important in demonstrating the evolution or pattern of Queensland's history;
(b) it demonstrates rare, uncommon or endangered aspects of Queensland's culture;
(c) has potential to yield information that will contribute to an understanding of Queensland's history;
(d) it is important in demonstrating the principal characteristics of a particular class of cultural places;
(e) it is important because of its aesthetic significance;
(f) it is important in demonstrating a high degree of creative or technical achievement at a particular period;
(g) the place has a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; and

(h) it has a special association with the life or work of a particular person, group or organisation of importance in Queensland's history.

Following recent amendments to the QHA in 2007, should any potentially significant archaeological artefacts or archaeological places be identified during this assessment or subsequently during the course of undertaking the MEP, Peabody must comply with Part 9 of the QHA. Section 89 requires any person who discovers a thing the person knows or ought reasonably to know is an archaeological artefact that is an important source of information about an aspect of Queensland's history to notify the DERM.

2.4 ICOMOS Burra Charter

The Australia ICOMOS (International Council on Monuments and Sites), the peak body of professionals working in heritage conservation, has adopted the *Burra Charter* as a guide to acceptable standards with regard to the assessment and management of items of cultural heritage significance in Australia. The *Burra Charter* has no effect at Queensland or Commonwealth Law. However, it has been adopted by the Queensland Heritage Council as the principle guide to heritage decision makers making decisions under the QHA. It is widely regarded as the acceptable best practice standard for heritage practitioners, and as such has been followed in this assessment. A set of standard heritage management provisions, adopted from the *Burra Charter*, is provided in Appendix B of this report.

The central principle of the *Burra Charter* is that assessment of the significance of any potential heritage items must come before any management decisions are made (Article 6). In assessing a given place or objects significance, it requires not just an assessment of the item itself, but the items setting (Article 8), location (Article 9) and an understanding of how it may be linked to any related items (Article 11). This should all be documented in a written statement on the items significance. Once the significance of an item has been established, the *Burra Charter* process provides for acceptable standards on the conservation, preservation, maintenance, change, restoration, reconstruction and/or alteration of an item based on this significance. Importantly, those to whom the item is significant should be involved in the decision making process. A flow chart outlining the *Burra Charter* process is contained in Appendix D of this report.

3. METHODOLOGY OVERVIEW

The methodology for this assessment was undertaken in two parts. The first was a desktop review, involving:

(a) searches of applicable heritage registers;
(b) interviews with local landholders and relevant government experts;
(c) a review of heritage assessments from the region held by the EPA;
(d) review of historic aerial photography; and
(e) a search of the Queensland State Archives for information on the heritage values of the Subject Lands and surrounds.

This information was used to identify the heritage themes of the region and to create a predictive model of potential locations of items of cultural heritage significance. This model was then used to guide the second part of the assessment, an archaeological site survey.

4. HISTORICAL CONTEXT

4.1 Regional History

What is known of the region's history comes from the following sources:

(a) accounts in journals and diaries of early explorers and settlers in the region (eg. Leichhardt 1847; Murray 1860, 1862; de Satge 1901);
(b) ethnographic and linguistic information on the traditional Aboriginal people in the region (eg. Tindale 1974);
(c) historical Crown Lands documents retained at the Queensland State Archives; and
(d) academic archaeological and historical works relevant to this area (eg. Brayshaw 1990).

4.1.1 Exploration and Settlement

In 1844-45 the first known Europeans passed through the area. German born explorer Ludwig Leichhardt and his party set out from the Darling Downs in October 1844 searching for an overland route to Port Essington on the north coast. Leichhardt travelled northwest across the Dawson and Mackenzie River valleys and upstream along the Isaac River, which Leichhardt named in honour of a Darling Downs man, Mr Frank Isaac who had offered Leichhardt bullocks for his journey. The physical and cultural landscapes including landforms, geology, soils, flora and fauna along the course of this river are recorded in Leichhardt's journal (1847), and locations in the vicinity of the Subject Lands are specifically mentioned in entries from February 15 to early March 1845. Leichhardt notes that he had observed 'beds of coal indistinguishable from those on the Hunter or Newcastle' near the current location of the town of Blackwater. Leichhardt also reports on encounters with Aboriginal people and describes his observations of their material culture in the immediate region. In the journal reference is

made to an Aboriginal camp that was located somewhere near the junction of Isaac River and Cherwell Creek:

> *'24th Feb.…Towards sunset we heard the noisy jabbering of natives, which promised the neighbourhood of water. I dismounted and cooeed; they answered; but when they saw me , they took such of their things as they could and crossed to the opposite side of the river in great hurry and confusion... they were unwilling to approach us. Their camp was in the bed of the river amongst some small Casuarinas. Their numerous tracks… soon led me to two wells, surrounded by high reeds, where we quenched our thirst. After filling our calabash, we returned to the camp of the natives, and examined the things they left behind; we found a shield, four calabashes, of which I took two, leaving in their place a bright penny, for payment; there were also, a small watertight basket containing acacia gum; some unravelled fibrous bark, used for straining honey; a firestick, neatly tied up in te-tree bark; a kangaroo net; and two tomahawks, one of stone, and a smaller one of iron, made apparently of the head of a hammer: a proof they had some communication with the sea coast…'* (Leichhardt 1847:162-3).

As Leichhardt continued north along the Isaac River he encountered a human skull at a creek on the eastern side of the Isaac River which he named 'Skull Creek' (Leichhardt 1847:165). He notes that:

> *'… another deep scrub creek was found, full of water. Its bed was overgrown with reeds, and full of pebbles of concretions of limestone, and curious fossil trunks of trees, and on its bank a loose sandstone cropped out. Here we found a skull of a native, the first time that we had seen the remains of a human body during our journey. Near the scrub, and probably in old camping places of the natives, we frequently saw the bones of kangaroos and emus'.* Charlie, one of the two Aboriginal members of the team was also approached when he was alone, by people who:*'… made him several presents, among which were two fine calabashes which they had cleaned and used for carrying water; the larger one was pear shaped, about a foot in length, and nine inches in diameter in the broadest part and held about three pints. The natives patted his head, and hair, and clothing… '* (Leichhardt 1847:159).

Unfortunately, the complex nature of the Aboriginal societies' cultural organisation was not adequately portrayed in descriptions by Leichhardt and other nineteenth century European visitors to the region. The land units would have been named countries owned by Clans with their own distinctive rights and responsibilities. Aboriginal people used and moved within these lands in customary ways according to complex systems of law and spiritual associations, following hunter-gatherer/fisher economies which entailed seasonal cycles of economic, social and ceremonial activities. Tindale recorded the study area

as being in the vicinity of the northern boundaries of the Barna and Barada people. It is believed that neighbouring Aboriginal clans included the Wirin, Jangaa, Jambina, Wangan, Kalabarra and Barada. From Tindale's interpretation of the traditional tribal estates and boundaries, these territories are described as the '… *headwaters of the Isaac River, west to the Denham Range; south to Cotherstone at Grosvenor Downs…* ' (Tindale 1974:165).

During the time of Leichhardt's expedition the region was experiencing a period of a severe drought. He often mentioned in his journal that thirst and dehydration were commonplace amongst members in the party. He reported however that several creeks in the region still had deep pools of water and that the Aboriginal people had fenced waterholes and dug wells in the bed of the Isaac River. Leichhardt's favourable impressions of this area encouraged the Crown to open up land for new settlers in the region.

4.1.2 Pastoralism and Agriculture

Following a pattern of settlement throughout Queensland, European settlers made their way into the area in the 1860s. Graziers established pastoral runs around the Isaac River that offered permanent water and beef cattle and grazing continued to be a major industry in the region for over 150 years. The *Unoccupied Crown Lands Occupation Act 1860* repealed New South Wales legislation as it related to Queensland, and enabled a more orderly occupation of the Waste Lands of the Crown in the unsettled Districts. A run was described as 'a large area of land rented for a fixed period of time from the Crown for pastoral purposes'.

In 1860 Andrew Murray journeyed with John McKay and a team from Uralla New South Wales to Mackay Queensland in search of pastoral land. Near the Isaac River he noted in his journal that thick Brigalow hampered the journey. Murray observed evidence of Aboriginal subsistence activities around the creeks and streams, including 'black's fires still burning near the bank of the creek…, harvested yams and lily tubers…, a kangaroo net…, and old camps with numerous mussel shells' (A. Murray 1860). When Murray returned to the region some years later with his family he noted that strong conflict existed between the new settlers and the Aborigines.

As was the case in the newly settled districts, a unit of Native Mounted Police was installed by the mid 1860s at Fort Cooper (Nebo), and at some stage there was also a police camp at North Creek (Evans 1971:26). These Native Mounted Police units were required to 'protect' white settlement by 'dispersing' Aborigines who caused trouble for the settlers. Andrew Murray recorded that in retaliation for the murder of a cook on Conway station, Fred Murray (of the Native Mounted Police) tracked down and 'shot eight of them (Aborigines)' (A. Murray 1863:11). The brutal policing methods are also relayed in Oscar De Satge's description of a reprisal following the murder in 1863 of a shepherd on Peak Downs

Station, allegedly by a group of Aborigines who had been allowed by a manager to 'come in' to the station: 'The police waited until sundown for their attack, which did not result in the expected slaughter, owing to the dense scrub and small attacking force'. At the 'blacks camp' De Satge found 'a couple of big blacks shot in the act of running, and partly supported by the dense scrub, gave ghastly evidence of the disturbed feast' (De Satge 1901:172).

In Queensland the Crown Lands Act underwent several changes over the next decades and by 1910, as was the policy of the times, after each pastoral lease expired the run was divided into two parts and one was resumed for closer settlement. The land tenure for these smaller blocks was referred to as a Selection that was still to be used for agricultural or grazing purposes, although most types of Selections were convertible to freehold tenure after a fixed number of years providing the selector fulfilled certain conditions, such as improvements to a certain value. The Brigalow Development Scheme from 1962 saw the break up of large stations into smaller blocks (Fitzroy Basin Association 2007:8). These were made profitable through the use of bulldozers for clearing and development. By 1983 40-60% of the naturally occurring woody vegetation had been cleared and acceleration of clearing rates continued into the 1990s (Fitzroy Basin Association 2007:8).

4.1.3 Coal Mining Industry

When copper and particularly gold were found in the area prospectors arrived in droves. In the subsequent decades the region became 'Australia's own wild-west' with battles between Chinese and European miners ensuing (Molloy 2008:48). Although the first coal deposit was found at Blair Athol homestead in 1864 by accident when a well borer digging for water struck coal just 20m below the surface, coal mining was not a significant activity in the 1800s (Molloy 2008:48). Distance and development costs inhibited large scale mining in the Bowen Basin until the 1960s (Fitzroy Basin Association 2007:8). In 1961 Utah Construction and Mining Company engaged U.S. geologist Richard Ellett to start mineral exploration in Australia for sites with coking coal deposits sufficient for large scale mining operations (Molloy 2008:50). Ellett was enthusiastic about the potential of the Bowen Basin, and Utah Construction and Mining Company geared up for a significant exploratory operation. Since then many mines have begun producing coal for the domestic market and export and coal mining has been a major economic activity in the Queensland Bowen Basin (Fitzroy Basin Association 2007:8). Several towns such as Moranbah and Coppabella have been built to support mining developments.

Moranbah is a purpose built mining town located approximately 200 km south west of Mackay. In 1968 the Utah Development Company Ltd ('UDCL') put forward a proposal to the Belyando Shire Clerk, Mr Peter Lawrence, which recommended the construction of a new town that would house approximately 400 employees of the Goonyella Coal Mine. Shortly after, 1100 acres of land was purchased from Mrs

E.M. Hannan's "Moranbah" lease, which then became Crown Land that was issued under a special priority Coal Mining Lease to UDCL (Isaac Regional Council 2009).

Coppabella town was built at the junction of two railway lines to house the control, maintenance and train crews that would service the lines from Goonyella Mine and Saraji Mine. The railway line would then continue on to the sea at Hay Point. The Goonyella to Hay Point railway and the Coppabella Railway Station were opened on 5 November, 1971. A portion from “Annandale Run” was resumed for the construction of Coppabella, which also required an entire creek to be relocated several hundred metres to one side because it was in the way of the town plan (Mayes 1991). Coppabella today is still a “closed town” in that it exists only because of the railway and only employees of Queensland Railways live there (Mayes 1991).

4.2 History of Land Tenure and Land Use of the MEP (Subject Lands)

A review of the available historical literature has found no direct evidence at this stage that significant European historical heritage sites are located within the Subject Lands, although some historical items can be found in the surrounding vicinity of the study area. Physical evidence which might be encountered in the study area would be limited to pastoral activities and might include old structures, fences, camps and tracks.

The 1885 Queensland 16 Mile Map of the Kennedy and Leichhardt Districts study area indicates there were four major Pastoral Holding Runs in the study area, these being “Annandale”, “Lenton Downs”, “Grosvenor Downs” and “Burton Downs” (Figure 3). The Subject Lands occupy an area that was once a part of “Annandale” Run. A 1914 Queensland stock route map clearly shows that the stock route passing through the “Annandale” Holding just to the north of the Subject Lands (Figure 4).

Figure 3: 1885 Queensland 16 Mile Map showing pastoral runs and stock routes (QSA Item ID532771)

The policy of the times required that after each pastoral lease expired, the run was divided into two parts and one was resumed for closer settlement. Land that was resumed in 1920 from “Annandale Run” provided for two grazing selections: G.H.1815 & G.H.1832. Improvements listed for “Mavis Downs” on a 1944 ‘Appraisement of Rent’ document include: boundary fencing; holding paddock; tailing yard; water bore; engine; well, tank, troughing and pump engine (QSA Item ID69692). Improvements listed for “Poitrel” on a 1950 ‘Appraisement of Rent’ document include: a homestead; bathroom; butchers shop; tool shed; men’s quarters; stockyards comprising 6 yards; dip and draining pen (concrete); round yards; cow-yards and bails. Water wells and mills are also listed as improvement structures (QSA Item ID184008).

Figure 4: 1914 Queensland Stock Routes Map (shown in red) (QSA Item ID629865)

The boundaries of the two grazing selections can be seen on the 1951 Survey Map produced by the Department of Public Lands (Figure 5). The map confirms that the “Poitrel” homestead was situated on the Isaac River outside of the mine expansion area and no homestead existed for “Mavis Downs”. In 1969 both of the properties were converted to Grazing Homestead Freehold Leases: G.H.F.L.3981 and G.H.F.L.3951, and by 1985 Deeds of Grant were issued for the properties. Table 2 below provides a timeline of land tenure changes for the properties that occupied the area where the Subject Lands are today. Until the Subject Lands came to be under the Land Use / Tenure category of a Special Lease for Mining purposes, the land was used throughout its European history for the grazing and agistment of livestock, mainly cattle and horses.

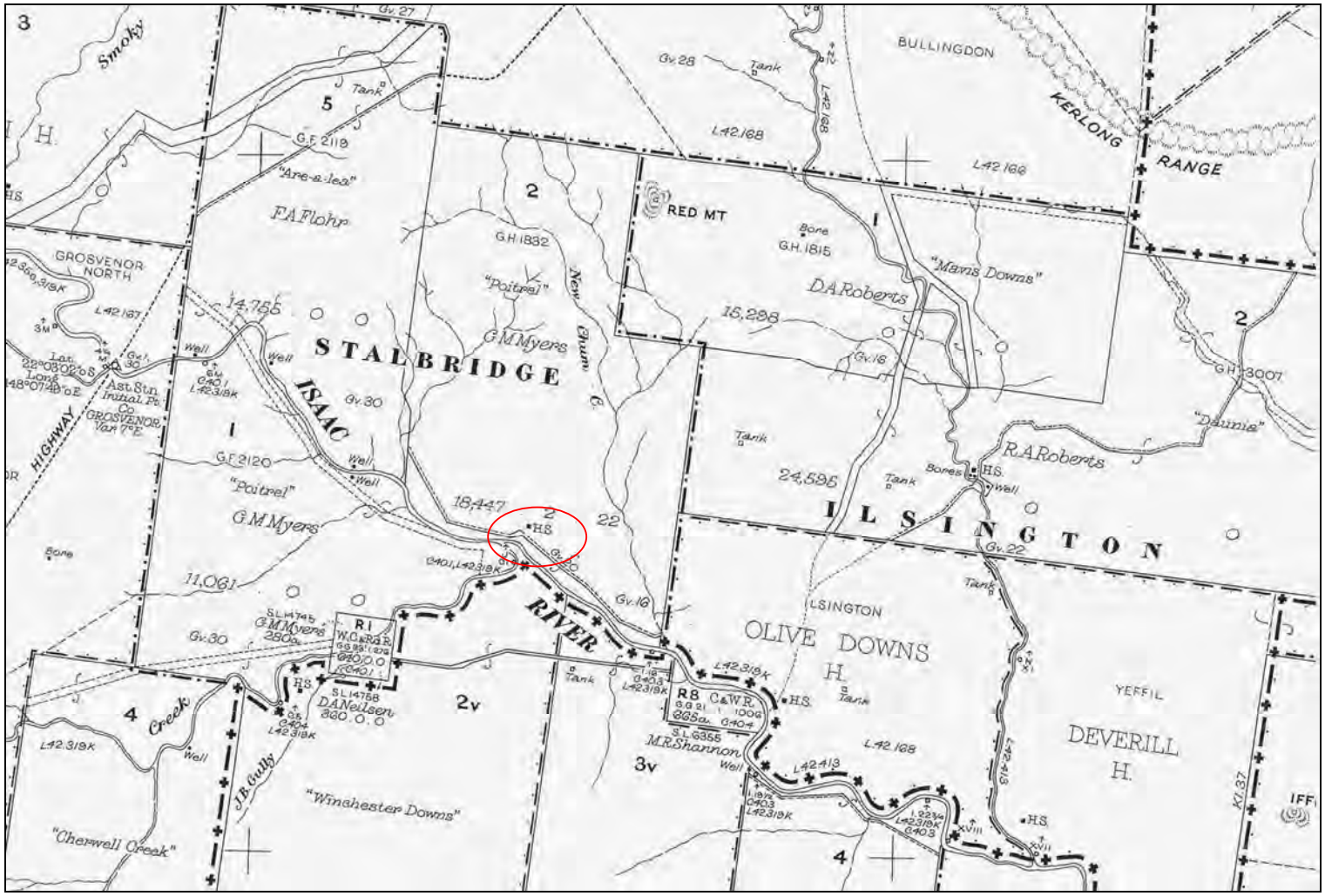


Figure 5: 1951 Qld Lands Department Survey Map (Poitrel Homestead circled in red)

Table 2: Timeline History of Land Tenure and Land Use for Subject Lands

LAND TENURE	DATE	DETAILS OF OWNERSHIP AND LAND USE	POTENTIAL HISTORICAL HERITAGE ISSUES/VALUES	REFERENCE
ANNANDALE STATION Pastoral Run	1886	John Arthur MaCartney takes on lease of "Annandale" for the purpose of grazing livestock on the property. Property = 354 ¼ sq. miles. Boundaries described in 1892 public notice / map and shown on a map.	No evidence of any potential structures on this property at this time	See Appendix B Figure 14 QSA Item ID26676
	1906	John Bertmoore Shannon takes on lease of "Annandale". As was the policy of the times, lease divided into two parts upon expiration. Property = 234 sq. miles described in 1906 public notice. Valuation Feb 1906 lists Improvements as a cottage, kitchen, outhouses, stockyards etc.	None of these improvements, apart from boundary fences are located on area occupied by present day Subject Lands	See Appendix B Figures 15 & 16 QSA Item ID26676
	1920	Land Court effects resumption of 54 ¼ sq. miles portion at the southern end of the property "in satisfaction of right 1 [of the Act]". Resumption provides for two grazing selections: G.H.1815 & G.H.1832.	No evidence of any potential structures apart from boundary fences are located on area occupied by Subject Lands	See Appendix B Figures 17 & 18 QSA Item ID26676
POITREL G.H. 1832	1921	Lease area of 18456 acres allocated to Gerald Murray Myers as Grazing Homestead 1832 for period of 28 yrs	No evidence of any potential structures apart from boundary fences are located on area occupied by Subject Lands	See Appendix B Figure 19 QSA Item ID184008
	1927	Inspection by land commissioner reports improvements as: about 7 miles of fence along Isaacs River, about 10 miles of boundary fences, about 4 miles of horse paddock and subdivision fences, homestead and yards.	No evidence of any potential structures apart from boundary fences are located on area occupied by Subject Lands	QSA Item ID184008
	1950	Appraisement of rent for the fourth period of the term of the lease. Improvements listed include: Homestead, bathroom, butchers shop, tool shed, men's quarters, stockyards comprising 6 yards, dip and draining pen (concrete), round yards, cowyards and bails. Water wells and mills are also listed as improvement structures.	No evidence of any potential structures apart from boundary fences are located on area occupied by Subject Lands. Homestead is located much further south on Isaac River.	See Appendix B Figure 21 QSA Item ID184008
POITREL G.H.F.L. 3951	1969	Converted to a Grazing Homestead Freehold Lease.		QSA Item ID194446
	1985	Deed of grant over Lot 2 on plan GV165 parish of Islington issued to Beryl Ann Neilson		QSA Item ID194446

Timeline History of Land Tenure and Land Use for Subject Lands (cont.)

LAND TENURE	DATE	DETAILS OF OWNERSHIP AND LAND USE	POTENTIAL HISTORICAL HERITAGE ISSUES/VALUES	REFERENCE
MAVIS DOWNS G.F. 1815	1921	Lease area of 15298 acres allocated to Dudley Arthur Roberts as Grazing Homestead for period of 28 yrs	No evidence of any potential structures apart from boundary fences are located at this time on the land occupied by Subject Lands	See Appendix B Figure 22 QSA Item ID69692
	1944	Improvements listed in valuation for appraisement of rent include: Boundary fencing; Holding paddock; Tailing yard; Water Bore; Engine; Well, tank, troughing and pump engine.	Structures listed have no significant heritage value. No structures or equipment were sighted during the field survey of the Subject Lands.	See Appendix B Figure 23 QSA Item ID69692
	1969	Converted to a Grazing Homestead Freehold Lease. Now owned by I.R. and M.J. Roberts (descendants of DA Roberts). Correspondence notes that the selection forms part of an aggregated area worked by members of the Roberts family totalling 102,000 acres approx and property does not constitute a living area in its present state. The present capacity is 546 head- potential 765 head.	No evidence of any potential structures apart from boundary fences are located on area occupied by Subject Lands	See Appendix B Figure 24 QSA Item ID194446
MAVIS DOWNS G.H.F.L. 3981	1971	Resumption for railway purposes area (52 acres 0 roods 10 perches) for the Peak Downs Railway Project (see 1972/3 letters and maps). This Railway line is to the east of the Subject Lands.		See Appendix B Figures 25 & 26 QSA Item ID194446
	1975	Notice for resumption of easement for road of access to red mountain siding. (31 acres 1 rood 37 perches)		QSA Item ID194446
	1984	Transfer of special lease from I.R. and M.J. Roberts to R.D. Hutley, P.M. Hutley and M.J. Roberts. Area= 6169.3692 hectares GHFL3981		QSA Item ID194446
	1985	Deed of grant over Lot 1 on plan GV119 parish of Islington issued to R.D. Hutley, P.M. Hutley and M.J. Roberts		See Appendix B Figures 27 & 28 QSA Item ID194446
	1986	27 Oct 1986: at some stage prior to this date Utah Development Company Ltd holds S.C. Mining Lease no 244 over Lot 1 on plan GV119.		QSA Item ID194446

4.3 Historical Themes

The Australian Heritage Commission has produced a set of Historical Themes relevant to Australia that provide a historical context within which the heritage values of a place can be examined (Australian Heritage Commission 2001). A number of themes are relevant to the Study Area; these include settlement, pastoral development, mining infrastructure (including rail and roads) and the abandonment of farms. The themes are summarised in Table 3 below.

Table 3: Historical Themes

National Theme Groups	National Themes	National Sub Themes	State Themes	Local Themes/Application
3. Developing local, regional and national economies	3.3 Surveying the continent	3.3.4 Looking for land with agricultural potential	Pastoralism	Pastoralism
		3.3.5 Laying out boundaries	Land Tenure	Land Tenure – Annandale Run Mavis Downs and Poitrel Stations
	3.4 Utilising natural resources	3.4.3 Mining	Mining	Mining
	3.5 Developing primary production	3.5.1 Grazing stock 3.5.2 Breeding animals	Pastoralism	Pastoralism
	3.8 Moving goods and people	3.8.5 Moving goods and people on land 3.8.6 Building and maintaining railways 3.8.7 Building and maintaining roads	Transport	Old Coach Road Stock Routes Goonyella to Hay Point Railway Peak Downs Railway
4. Building settlements, towns and cities	4.5 Making settlements to serve rural Australia	4.5.1 Selecting township sites	Land Tenure Towns, Suburbs and Villages	Land Tenure – Annandale Run Mavis Downs and Poitrel Stations
	4.6 Remembering significant phases in the development of settlements, towns and cities	4.6.1 Selecting township sites	Towns, Suburbs and Villages	Coppabella township Moranbah township
5. Working	5.8 Working on the land; organising workers and workplaces	No sub themes in this category	Labour	Pastoralism Mining

5. HERITAGE CONTEXT

5.1 Previous Archaeological/Cultural Heritage Assessments

Much of the archaeological information relating to the local region can be found in consultancy reports undertaken for Environmental Impact Studies relating to the development of coal and gold mines and associated infrastructure (e.g. railway lines, roads, powerlines, water and gas pipelines). Being project specific, EIS studies are restricted to a specific time and place, but they have the potential, collectively, to contribute valuable archaeological background data.

Archaeological reports produced as part of EIS studies extend back about 30 years and include extensive early work by Brayshaw (1976a and 1976b) and Hill (1980, 1982). Work was continued in the 1990s by Alfredson (1990, 1991, 1992, 1994, 1995) and Hatte (1994 to 2008). These studies also tend to reflect the different approaches which have been adopted in dealing with cultural heritage in this period.

Brayshaw (1976) surveyed areas of Poitrel on foot and by means of vehicle traverses. Evidence of Aboriginal occupation was sparse at the northern end of the mining lease closest to the MEP Subject Lands. Brayshaw suggested that a lack of archaeological evidence around the creeks and riverbeds is due to evidence being washed downstream in the wet season. Brayshaw noted trees where sections of bark appear to have been removed, however did not report anything of European heritage.

Hill (1980) undertook an archaeological study of the Daunia Mine lease area (to the immediate south-east of the Subject Lands) on behalf of Utah Development Company. Though he does not state the actual area involved it appeared to include a far larger area than the Daunia Mine site. It extended to the riparian zone of the Isaac River and west to New Chum Creek and included a central downs (savannah) zone, a flat wooded zone and a steeply folded zone which consisted entirely of the access road to the Peak Downs Highway. At that stage, apart from some areas of cleared Brigalow most of the native vegetation was intact. The cleared areas were covered in thick regrowth. Hill found no evidence of fireplaces along the Isaac River or New Chum Creek. A grave headstone was recorded by Hill (1980) and noted in the files of the mining leaseholder. In his report Hill noted that the then owner John Neilson was aware of the existence of the grave and stated that it belonged to a descendent of the Beresfords, Graham Stuart, who had lived at Oxford Downs The sergeant of police at Moranbah received advice from his superior that the grave should be exhumed prior to any mining disturbance and re-interred in the nearest cemetery. The gravestone lies about 1 km east of Olive Downs homestead and several hundred metres south of an old stock route that runs in a north-east / south-west direction. This item of European heritage was later fully investigated by Hatte (2008).

Hatte (1997) undertook a survey in 1996 in conjunction with representative of the Barna Baranda people under Permit Number CC/11/EIS/96. This survey covered an area of 7,500 ha of mining leases which covered the majority of the Poitrel project site (to the immediate south of the MEP Subject Lands). Hatte found only one site containing artefacts of European heritage being the abandoned Poitrel Homestead. The site includes remains of the old homestead, collapsed station sheds and cattle yards previously recorded on a high western ban of the Isaac River. The homestead is a fibro and wood structure and appears to date from the late 1950's to early 1960's. The homestead buildings which range from a state of extreme disrepair to total collapse consist of several originally walled or open sheds containing a variety of debris associated with pastoral life. At least one of the sheds is a former bathroom, as indicated by the remains of plumbing fixtures and floor drainage. Another contained dairying equipment. Another was possibly used to store saddles and associated equipment. The roof of one large collapsed structure had been constructed with beams which had been adzed by hand, indicating that it predates the homestead.

Hatte (2004) undertook cultural heritage surveys in July and August 2004 within the Carborough Downs ML area (to the immediate north of the MEP Subject Lands) with members from the BBKY#3 Traditional Owner Group. A range of cultural materials and locally occurring resources were identified. Cultural heritage surveys of the northern expansion area of Carborough Downs were undertaken in November and December 2006 and found the area to be significantly disturbed from the historic broadscale clearing for pastoral purposes. Clearing for water pipeline and powerline corridors has exposed cultural materials along the creek and gully corridors. Hatte reports that survey maps dated 1866 indicate the location of a historic police barracks and a coach road to the east of MDL 354. An old stock route follows west-east within MDL 354 and eventually joins the coach road. Remains of the stock route and associated relics were located in the course of the original surveys carried out in 2004.

Hatte (2008) and representatives of the Barada / Barna / Kabelbara / Yetimarala (BBKY) people undertook cultural heritage investigations in May and July 2008 at the Daunia Mine site. The highly disturbed nature of the project site, together with very thick ground cover, and consequent minimal ground surface visibility, required that all spots with some ground visibility by inspected. An initial vehicle reconnaissance of the project site was undertaken to enable the team to view the landscape, followed by a foot survey. Existing vehicle tracks, drill lines, gully and drainage lines and animal pads were targeted. A particularly thorough inspection was undertaken in the vicinity of watercourses. This region has been devoted to pastoralism from the earliest days of European arrival and this continues to be the case with the entire Project Site devoted to the grazing of cattle. During the survey carried out by Hatte a broken marble headstone with sandstone base was observed in the middle of a paddock (at E.635263/N.7553175 Datum AGD84). Previously reported by Hill (1980) the gravestone stands approximately 150cm tall when reassembled. Recently a collection of old metal objects (horse shoe

nails, a spur and other pieces) was found between the gravestone and the stock route by the manager of Olive Downs.

5.2 Search of the Heritage Registers

A search was undertaken of the following heritage registers listing historic cultural heritage:

(a) The World Heritage Register;
(b) The Register of the National Estate;
(c) The National Heritage List;
(d) The Commonwealth Heritage List; and
(e) The State Heritage Register.

No items were identified within or close to the Subject Lands in any of these registers. The Register of the National Estate lists eight items within the former Belyando Shire boundaries, three indicative places and five registered. None was close (within 100 km) of the Subject Lands. The search results for the State Heritage Register are contained in Appendix A. The Isaac Regional Council is required by the QHA to develop a heritage register. However, Everick understands that as yet this has not been published.

5.3 Review of Historic Aerial Photography

Aerial photographs from 1957 were reviewed in order to ascertain if any potential heritage items would be visible. When reviewing these photos, we were looking for items such as the footings of old homestead sites, damns, fencing, retaining walls and terracing.

Very little was identified as part of this review. Evident in the western half of the eastern photograph (Figure 6) are tracks, although no farming or grazing infrastructure associated with these tracks is evident. A northern portion of the western photograph and other portions in the south show evidence of clearing for grazing purposes. However, given the typical Brigalow scrub/grassland associated with this region, definitive proof of clearing in other parts of the Subject Lands is difficult to find. There is some clearing along the track running from north to south in the southeast portion of Figure 7. This track may potentially have been used as a stock route, possibly the one shown in Figure 14. However, further research would be needed to confirm this.

No evidence of any former homesteads within the Subject Lands was identified as part of this assessment.

Figure 6: 1957 Aerial photograph showing the eastern portion of the Subject Lands (Higher resolution photographs were used for assessment purposes)

Figure 7: 1957 Aerial photograph showing the western portion of the Subject Lands (higher resolution photograph used for assessment)

6. ARCHAEOLOGICAL FIELD ASSESSMENT

6.1 Survey Strategy - Methods

In accordance with the TOR, a survey was conducted by the Consultant and the Environmental Officer Joseph Hughes on the 10th June 2009. The survey strategy focused on as much of the Subject Land as possible in the available time, but targeted areas that had some potential to contain historic sites, particularly watercourses. Prior to the inspection, historic aerial photographs and recent high resolution aerial photographs were examined for evidence of historic features such as old roads, yards, homesteads, dams and fences. Available historic accounts and maps were also consulted for indications of historic events that might leave archaeological traces. Prior to the survey Everick had also been informed by MET Serve of the existence of a blazed tree with a survey mark on top of Red Mountain.

The survey was conducted primarily by vehicle, following existing tracks and roads. The aim of the inspection was to inspect as much land as possible and to obtain an appreciation of the scale and degree of development these lands have undergone. Particular attention was made to locate and record the blazed tree. Photographs were taken as a record of general features and conditions, to indicate the degree of surface visibility and the content of any sites found. GPS points were taken as a log of the areas covered (shown in black in Figure 8) as well as a record of specific locations. Overviews of surface conditions and site detection conditions are given in Section 7.2. All the road areas indicated in Figure 8 were inspected. In all, 23 km of road and track was used during the inspection. Particular attention was paid to the area within the proposed expansion, but areas outside this were also covered.

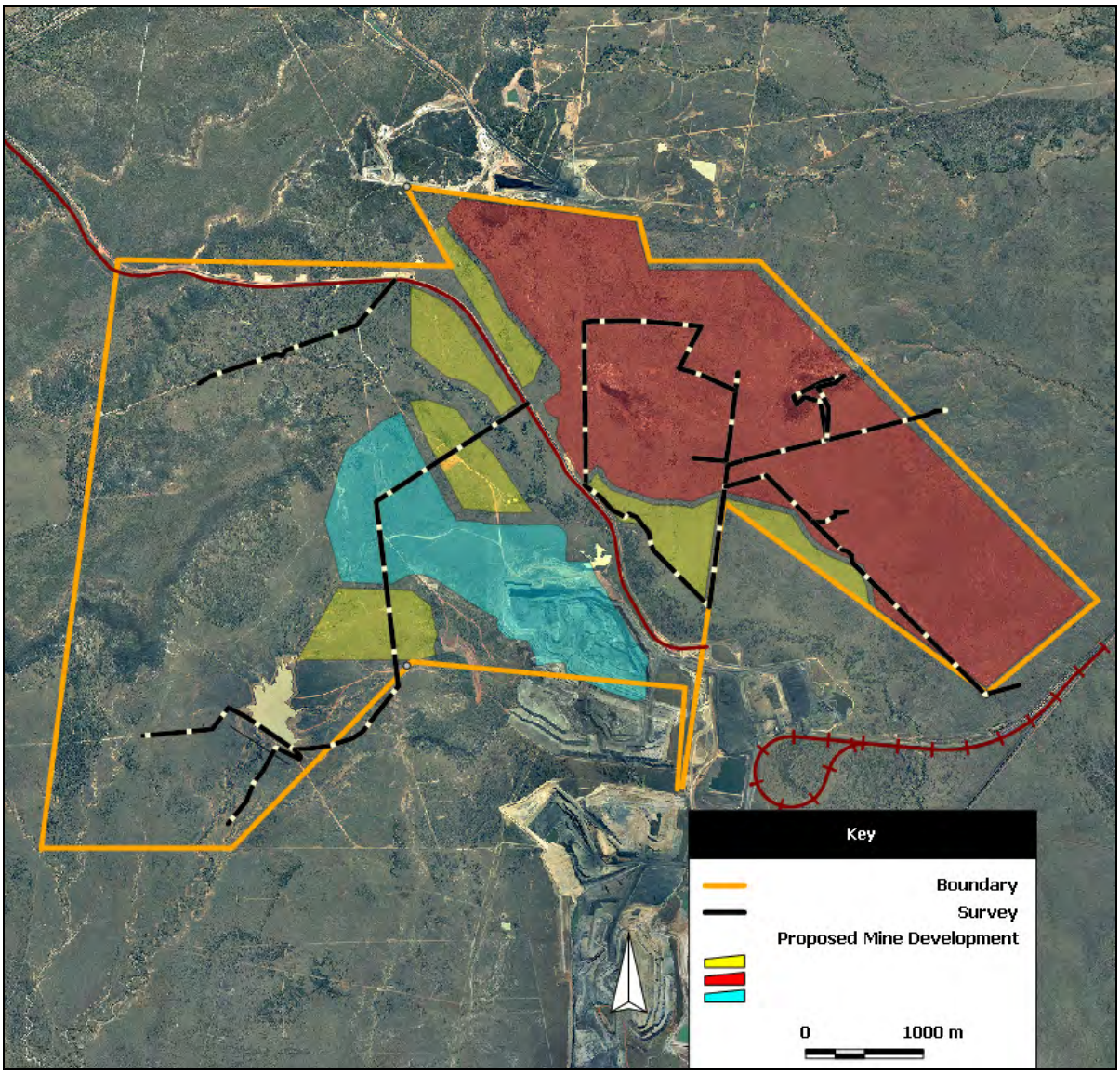


Figure 8: Survey coverage

6.2 Constraints to Site Detection

The constraints to site detection are influenced by previous European land uses. Significant sections of the Subject lands under Brigalow had been extensively cleared with bulldozers in the 1960's and 70's. Regrowth has subsequently been cleared and the land pastured with buffel grass. The groundcover of buffel grass makes identification of small scale historic sites, such as campsites or building footings difficult to detect from a distance. However, given the degree of disturbance of the Brigalow, and the fact that prior to clearing it was not an environment extensively used by early settlers, it is unlikely that

such sites, if they had existed away from water sources, survive to the present day. Areas that were not originally Brigalow, such as the grasslands on the eastern side of the subject land, also had a dense grass groundcover. Rough conditions away from the tracks made both vehicular and pedestrian survey difficult.

6.3 Results

No features that were of historic significance were found during the survey. Most of the land within the projected expansion area consisted of extensively cleared Brigalow cleared during the period 1950's to 1980's.

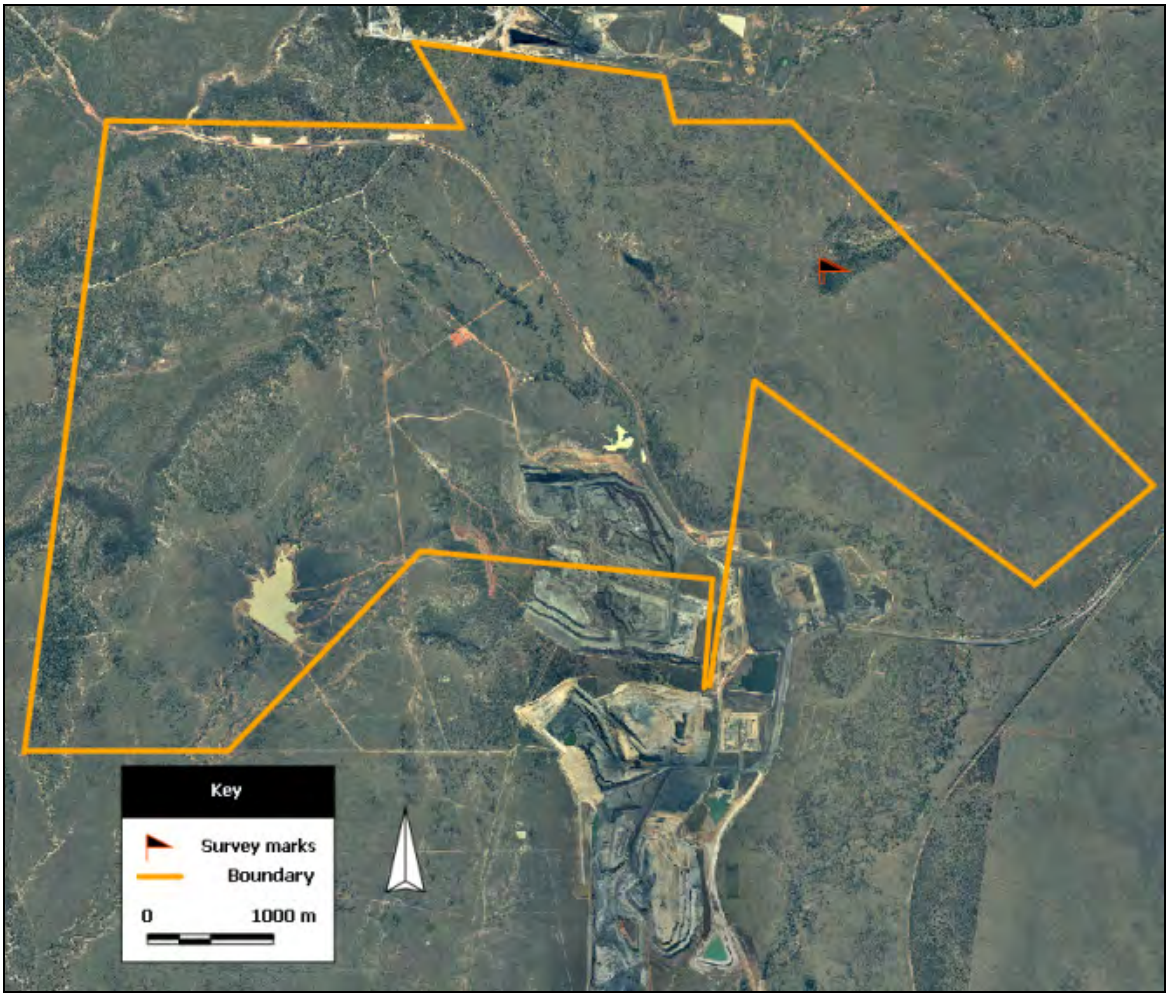


Figure 9: Locality of the surveyor's shield

The blaze tree (Figures 11 and 12) identified on top of Red Mountain was relocated, and recorded. The tree is located in the centre of the south-eastern part of the mountain. The blaze is located on the westernmost trunk of a multi-stemmed tree. The trunk has a 45 cm diameter trunk. The scar faces 220°, and is 74 cm long and 18 cm wide. The scar is 116 cm from the ground. The blaze is 50 cm long by 18 cm wide. A broad arrow has been (10 cm x 8cm) has been carved into the trunk (Figure 11). A 135 cm high steel dropper cemented into place was located 20 m to the west on the edge of the escarpment (Figure 13). A further discussion of the research relating to the shield is contained in Section 7 below.

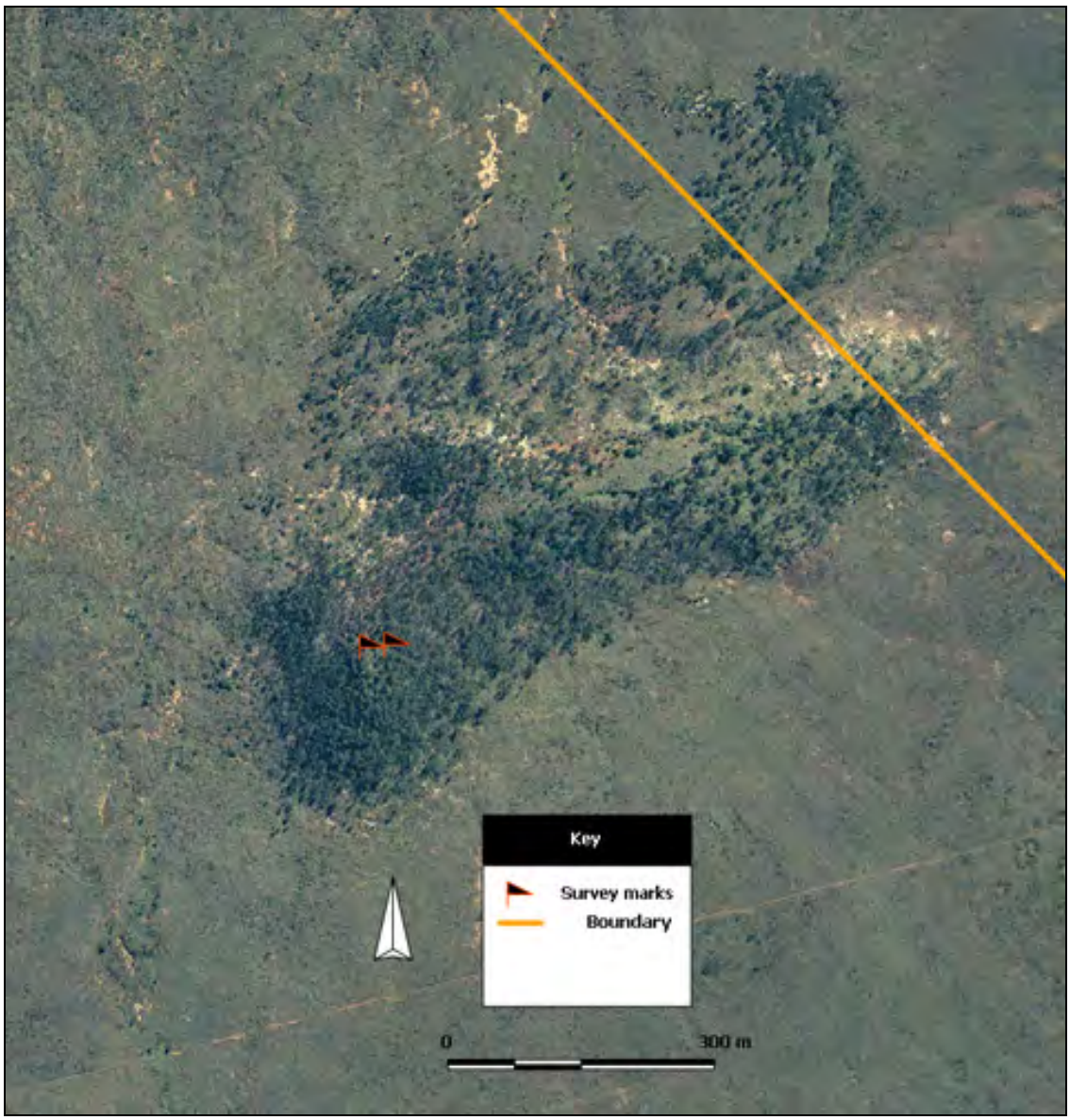


Figure 10: Locality of the surveyor's shield relative to a nearby modern survey marker

Figure 11: Blazed tree on Red Mountain

Figure 12: Close up of blazed tree showing broad arrow

Figure 13: Cemented steel dropper

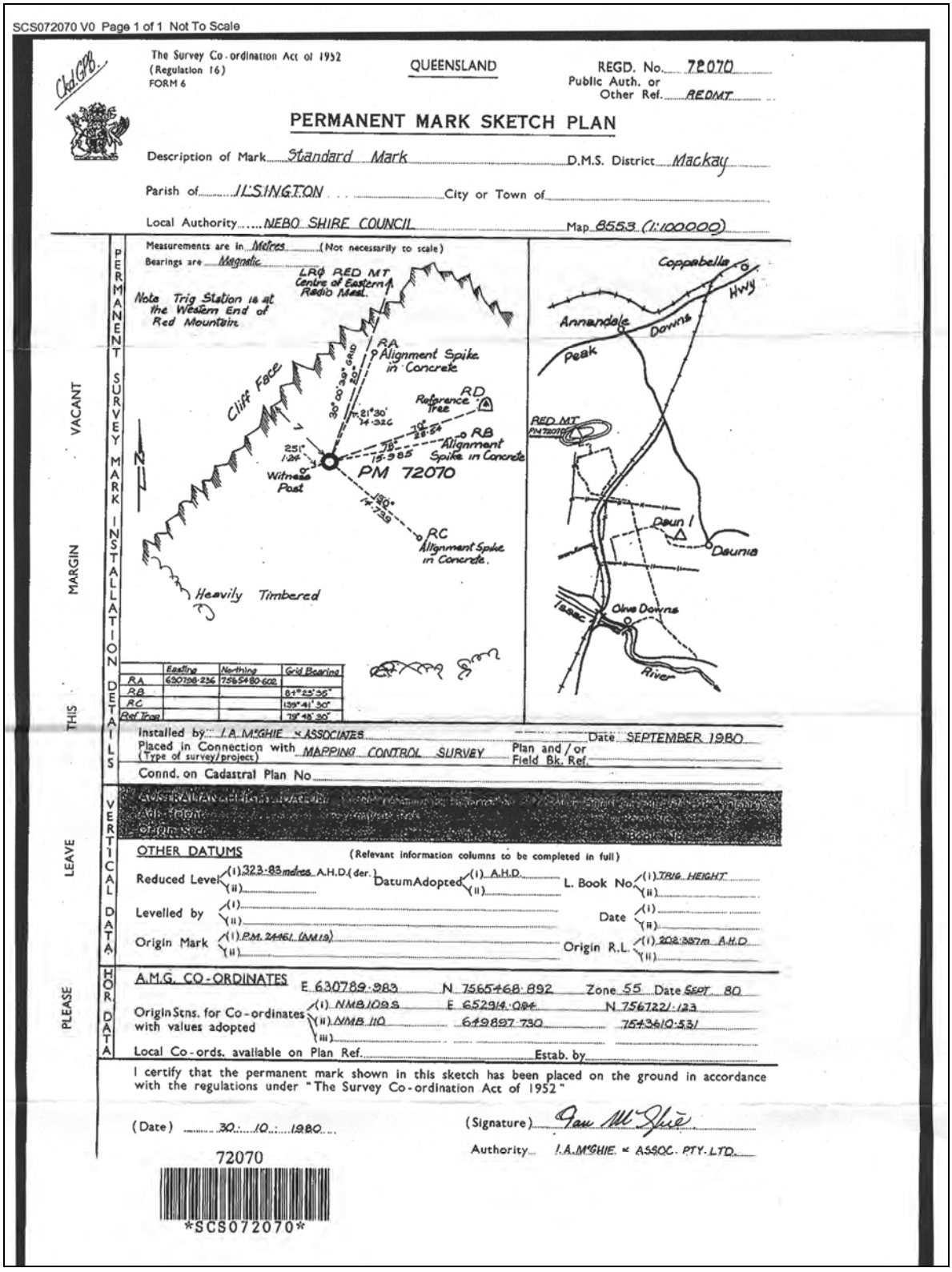
7. SIGNIFICANCE ASSESSMENT

The heritage significance of an item should always be distinguished as independent of any practical management considerations. This significance assessment has been guided by the *Burra Charter* and the criteria for entry onto the Queensland Heritage Register (refer to Section 2). A place or item needs to only be significant in one of these criteria to be considered of heritage significance.

Only one item considered of potential historic heritage significance was identified during this assessment, a surveyor's shield on Red Mountain.

7.1 Surveyor's Shield

Discussions with William Kitson (Curator of the Survey Museum, DERM), indicate that the scar was made in 1980 and used as a trig station for general surveying (Figure 14). Such scars are common throughout the Queensland countryside, and are not considered of National, State or local heritage significance.



SCS072070 V0 Page 1 of 1 Not To Scale

Chd GPB

The Survey Co-ordination Act of 1952
(Regulation 16)
FORM 6

QUEENSLAND

REGD. No. 72070
Public Auth. or Other Ref. REDMT

PERMANENT MARK SKETCH PLAN

Description of Mark Standard Mark D.M.S. District Mackay

Parish of ILSINGTON City or Town of

Local Authority NEBO SHIRE COUNCIL Map 8553 (1:100000)

PERMANENT SURVEY MARK INSTALLATION DETAILS

Measurements are in Metres (Not necessarily to scale)
Bearings are Magnetic

	Easting	Northing	Grid Bearing
RA	630708·236	7565480·602	
RB			84°23'36"
RC			139°41'30"
Ref Tree			79°48'30"

Installed by I.A. M'GHIE & ASSOCIATES Date SEPTEMBER 1980

Placed in Connection with MAPPING CONTROL SURVEY (Type of survey/project) Plan and / or Field Bk. Ref.

Connd. on Cadastral Plan No

VERTICAL DATA

OTHER DATUMS (Relevant information columns to be completed in full)

Reduced Level (i) 323·83 mdocs A.H.D.(der.) (ii) Datum Adopted (i) A.H.D. (ii) L. Book No (i) TRIG HEIGHT (ii)

Levelled by (i) (ii) Date (i) (ii)

Origin Mark (i) P.M. 24461 (AM19) (ii) Origin R.L. (i) 202·387m A.H.D. (ii)

HOR DATA

A.M.G. CO-ORDINATES E 630789·983 N 7565468·892 Zone 55 Date SEPT. 80

Origin Stns. for Co-ordinates with values adopted (i) NMB109S E 652914·084 N 756722!·123 (ii) NMB 110 649897·730 7543610·531 (iii)

Local Co-ords. available on Plan Ref. Estab. by

I certify that the permanent mark shown in this sketch has been placed on the ground in accordance with the regulations under "The Survey Co-ordination Act of 1952"

(Date) 30:10:1980 (Signature) Ian M'Ghie

Authority I.A. M'GHIE & ASSOC. PTY. LTD.

72070

SCS072070

VACANT MARGIN THIS LEAVE PLEASE

Figure 14: State records of Surveyor's Shield on Red Mountain

8. HERITAGE IMPACT STATEMENT

Based on the literature review and site survey undertaken as part of this historical cultural heritage assessment, no known historical cultural heritage items or places were identified or are expected to be impacted as a result of the MEP.

There is considered a low possibility that significant heritage items may exist within the Subject Lands that have not been identified as part of this assessment. Cautionary management strategies are contained within this report allow for the identification and protection of such items.

9. RECOMMENDED MANAGEMENT STRATEGY

The following management recommendation is cautionary in nature. The proposed strategies outlined in Appendix F are modeled on the DERM *Draft Guidelines for Carrying Out an Archaeological Investigation: Standards and Guidance for Persons Carrying out an Archaeological Investigation* (External Consultation Draft: May 2010). At the time of publishing this report, these guidelines were yet to become official policy. Never-the-less, the draft Guidelines present a reasonable approach to historic cultural heritage management, and as such form the basis of the cautionary strategies recommended in this report. It is anticipated official guidelines will be Gazetted under Section 173(1)(d) of the *Queensland Heritage Act 1992* (Qld) in the near future. The review strategy listed as Section 3 in Appendix F addresses this issue.

Further historical studies are not considered necessary prior to implementation of the MEP.

Strategy 1: Cultural Heritage Management Plan

It is recommended that the terms in the Cultural Heritage Management Plan provided in Appendix F of this report are adopted into the Environmental Management Plan for the Project. The management practises should include, as a minimum:

(a) the general principles of historic heritage management;
(b) responsibilities and channels of communication;
(c) a find strategy for items of potentially significant cultural heritage;
(d) archaeological monitoring standards;
(e) archaeological investigative standards;
(f) conservation and interpretation standards
(g) the appointment of a cultural heritage advisor;
(h) periodic review requirements; and
(i) requirements for the approval of DERM.

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Evans, R.L. 1971	Queensland's First Aboriginal Reserve. Part 1 - The Promise of Reform and Part 2 - The Failure of Reform. *Queensland Heritage*. Vol. 2. No. 4.
FBA (Fitzroy Basin Association Inc.) 2007	*Mining Coal and Protecting Biodiversity: A solutions and options report for Queensland's Bowen Basin.* Fitzroy Basin Association Inc. Rockhampton.
Hatte, E.K. and Birri Gubba Gutha Bimbi Aboriginal Corporation 1997a	An archaeological assessment of Poitrel Mine lease, Central Queensland on behalf of BHP Coal Pty Ltd.
Hatte, E.K. 1997b	A cultural heritage assessment of a proposed open cut coal mine (EPC 531, EPC 646 and Prospecting Permit 70932), Coppabella, Central Queensland, on behalf of Ison Environmental Planners. Permit No. CC22/EIS/97.
Hatte, E.K. 1998a	A cultural heritage assessment of a proposed easement containing a deviation to an existing BHP water pipeline and other facilities, and three proposed return airshafts, at Moranbah North Coal mine. Unpublished report on behalf of Moranbah North Coal Management.

Hatte, E.K. 1998b — Report of an archaeological salvage of artefacts, at the proposed Coppabella Coal Mine on behalf of Australian Premium Coals Pty Ltd, Brisbane. Permit No. N5/EIS/98.

Hatte, E.K. 1999 — An assessment of two areas proposed for mine expansion and a proposed road diversion at Burton Coal Mine, Central Queensland. Unpublished report for Matthew Palmer Consulting Engineers Pty Ltd on behalf of Burton Coal Pty Ltd.

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Molloy, F. 2008 — Back in Black in the Bowen. *Australian Mining* July 2008: 48-54.

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Tindale, N.B. 1974 — Aboriginal Tribes of Australia. Canberra. A.N.U. Press.

APPENDIX A: EPA HERITAGE SEARCHES

Queensland Government Environmental Protection Agency

Level 9, 160 Ann St ● Brisbane, Queensland ● PO Box 15155 ● CITY EAST ● QLD 4002 ● AUSTRALIA
Telephone (07) 3227 8542 ● Facsimile (07) 3227 7803
http://www.epa.qld.gov.au/ecoaccess/cultural_heritage/

CERTIFICATE OF AFFECT
QUEENSLAND HERITAGE REGISTER (QHR)

Client Reference: Certificate Number: CA41533

Helen Tomkins
Everick Heritage Consultants Pty Ltd
Everick Heritage Consultants
PO Box 146
Red Hill QLD 4059

This is a Certificate issued under Section 33(1)(b) of the *Queensland Heritage Act 1992* (the "Act") as to whether a place is affected by an entry in the Heritage Register or is otherwise affected by the provisions of the Act.

QHR RESULT

This response certifies that the place described as,
Property Name: None
Lot: 2 Plan: GV165
Located at: PORTRELL ROAD, COPPABELLA

is not affected by the provisions of the Act.

ADDITIONAL ADVICE

Note: This certificate is valid at the date of issue only

If you have any queries in relation to this search please phone (07) 3227 8542.

Issued on behalf of the Chief Executive,
Environmental Protection Agency

Date of issue: 21 May 2009
Receipt No: 12586610-281307-81307

page 1 of 1

Queensland Government Environmental Protection Agency

Level 9, 160 Ann St ● Brisbane, Queensland ● PO Box 15155 ● CITY EAST ● QLD 4002 ● AUSTRALIA
Telephone (07) 3227 8542 ● Facsimile (07) 3227 7803
http://www.epa.qld.gov.au/ecoaccess/cultural_heritage/

CERTIFICATE OF AFFECT
QUEENSLAND HERITAGE REGISTER (QHR)

Client Reference: EV112 Certificate Number: CA41743

Everick Heritage Consultants Pty Ltd
Everick Heritage Consultants
PO Box 146
Red Hill QLD 4059

This is a Certificate issued under Section 33(1)(b) of the *Queensland Heritage Act 1992* (the "Act") as to whether a place is affected by an entry in the Heritage Register or is otherwise affected by the provisions of the Act.

QHR RESULT

This response certifies that the place described as,
Property Name: None
Lot: 3 Plan: SP190266
Located at: NO STREET ADDRESS, ADDRESS NOT RECORDED

is not affected by the provisions of the Act.

ADDITIONAL ADVICE

Note: This certificate is valid at the date of issue only

If you have any queries in relation to this search please phone (07) 3227 8542.

Issued on behalf of the Chief Executive,
Environmental Protection Agency

Date of issue: 23 June 2009
Receipt No: 12761534-380457-80457

page 1 of 1

APPENDIX B: SAMPLE OF RESOURCES CONSULTED IN THIS ASSESSMENT

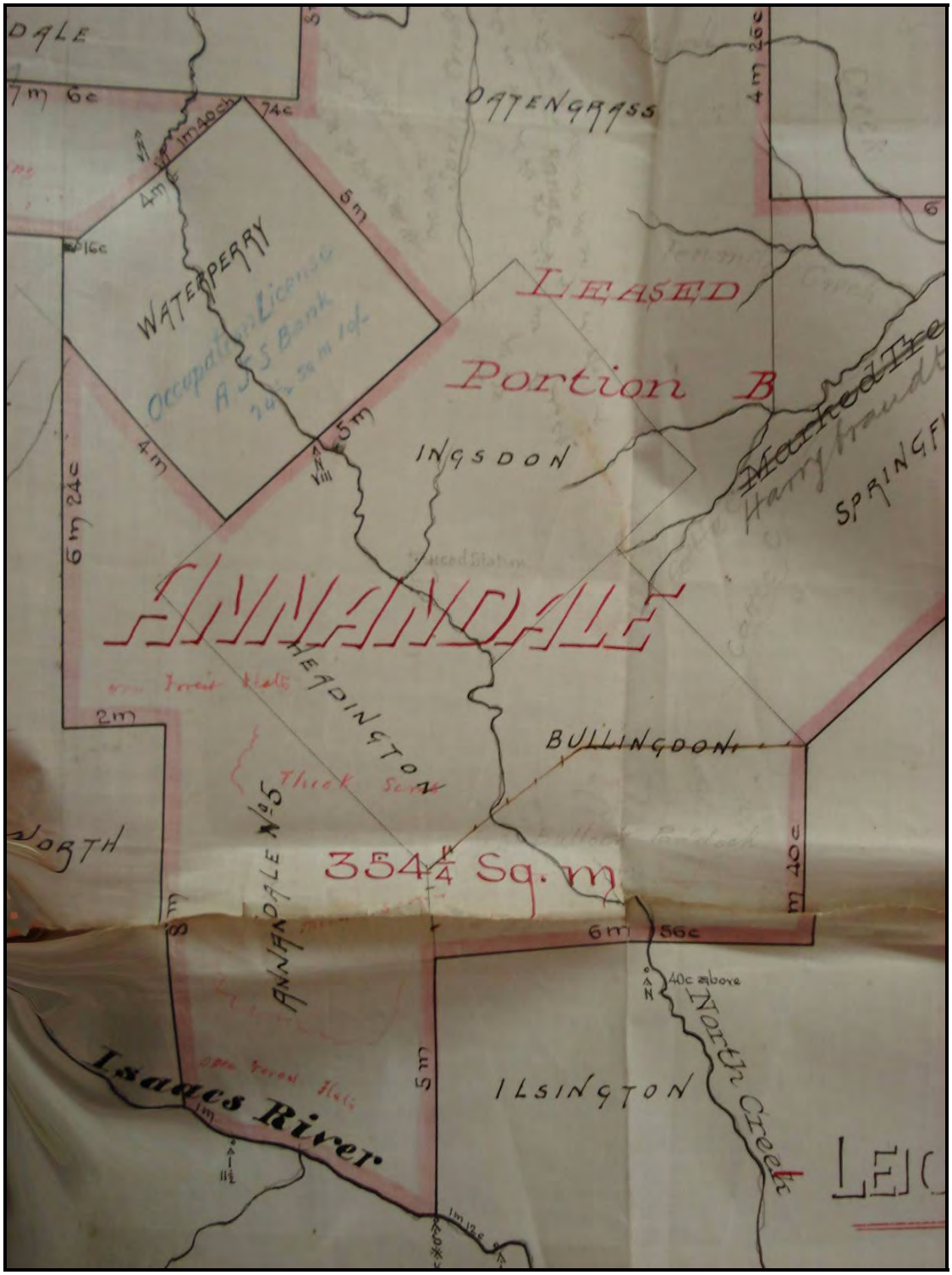
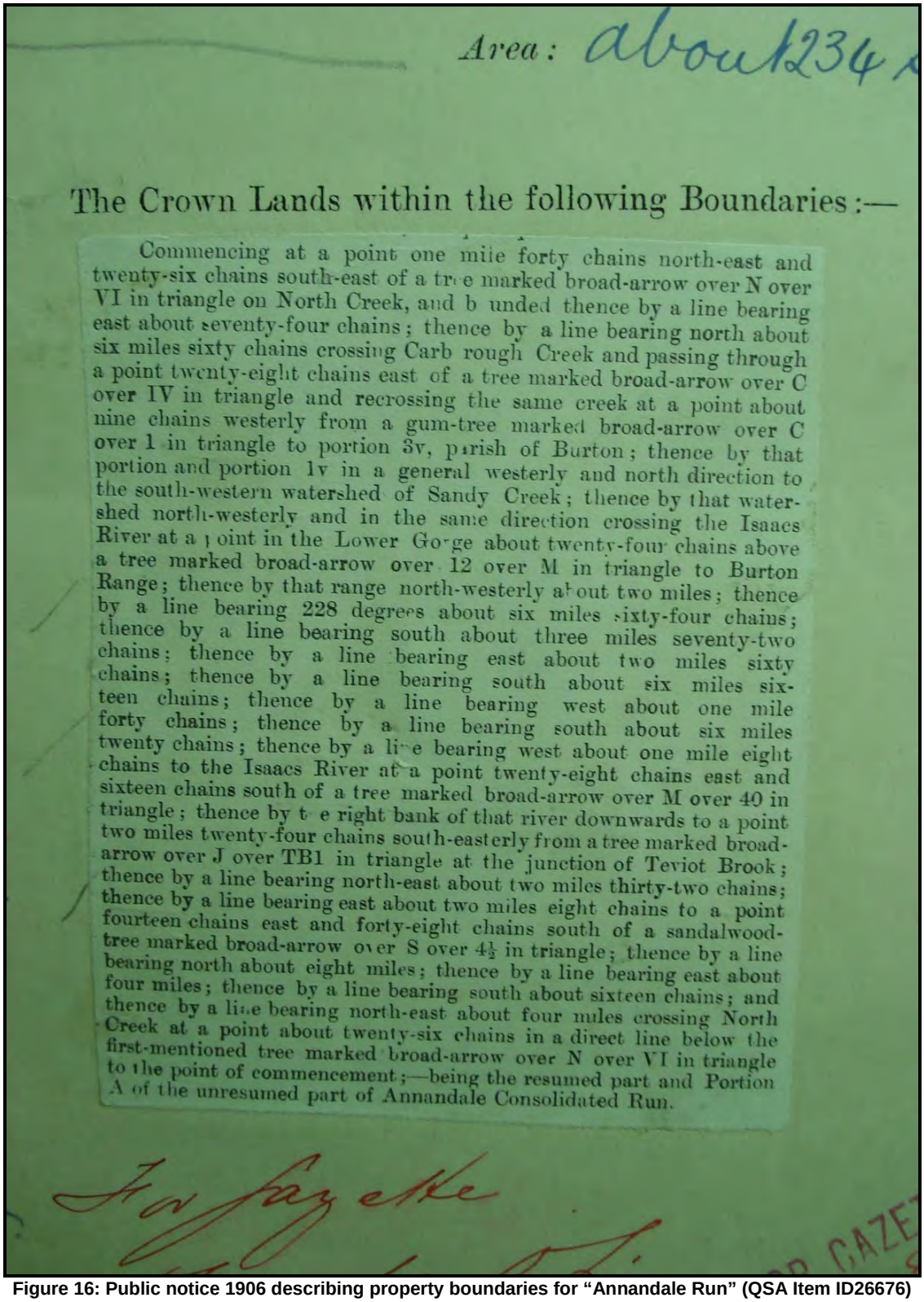


Figure 15: Map from 1892 showing property boundaries for "Annandale Run" (QSA Item ID26676)



Area: about 1234

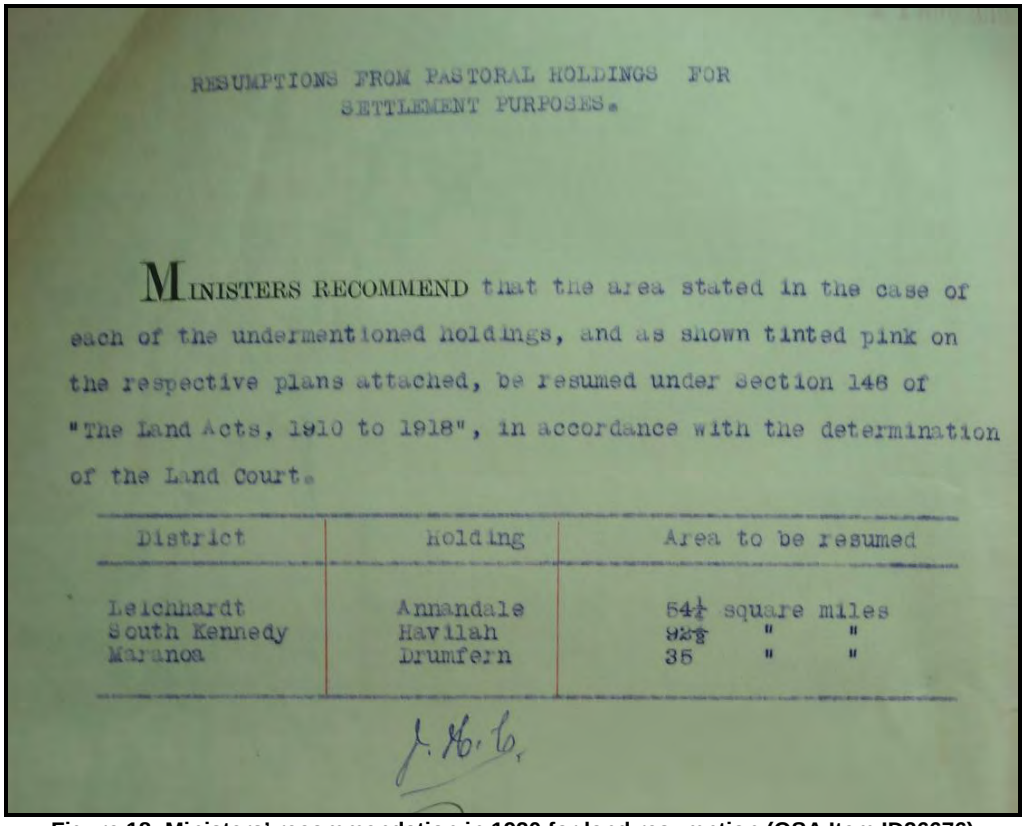
The Crown Lands within the following Boundaries:—

Commencing at a point one mile forty chains north-east and twenty-six chains south-east of a tree marked broad-arrow over N over VI in triangle on North Creek, and bounded thence by a line bearing east about seventy-four chains; thence by a line bearing north about six miles sixty chains crossing Carbrough Creek and passing through a point twenty-eight chains east of a tree marked broad-arrow over C over IV in triangle and recrossing the same creek at a point about nine chains westerly from a gum-tree marked broad-arrow over C over 1 in triangle to portion 3v, parish of Burton; thence by that portion and portion 1v in a general westerly and north direction to the south-western watershed of Sandy Creek; thence by that watershed north-westerly and in the same direction crossing the Isaacs River at a point in the Lower Gorge about twenty-four chains above a tree marked broad-arrow over 12 over M in triangle to Burton Range; thence by that range north-westerly about two miles; thence by a line bearing 228 degrees about six miles sixty-four chains; thence by a line bearing south about three miles seventy-two chains; thence by a line bearing east about two miles sixty chains; thence by a line bearing south about six miles sixteen chains; thence by a line bearing west about one mile forty chains; thence by a line bearing south about six miles twenty chains; thence by a line bearing west about one mile eight chains to the Isaacs River at a point twenty-eight chains east and sixteen chains south of a tree marked broad-arrow over M over 40 in triangle; thence by the right bank of that river downwards to a point two miles twenty-four chains south-easterly from a tree marked broad-arrow over J over TB1 in triangle at the junction of Teviot Brook; thence by a line bearing north-east about two miles thirty-two chains; thence by a line bearing east about two miles eight chains to a point fourteen chains east and forty-eight chains south of a sandalwood-tree marked broad-arrow over S over 4½ in triangle; thence by a line bearing north about eight miles; thence by a line bearing east about four miles; thence by a line bearing south about sixteen chains; and thence by a line bearing north-east about four miles crossing North Creek at a point about twenty-six chains in a direct line below the first-mentioned tree marked broad-arrow over N over VI in triangle to the point of commencement;—being the resumed part and Portion A of the unresumed part of Annandale Consolidated Run.

For Gazette

Figure 16: Public notice 1906 describing property boundaries for "Annandale Run" (QSA Item ID26676)

Figure 17: Map from 1906 showing property boundaries for "Annandale Run" (QSA Item ID26676)



RESUMPTIONS FROM PASTORAL HOLDINGS FOR SETTLEMENT PURPOSES.

MINISTERS RECOMMEND that the area stated in the case of each of the undermentioned holdings, and as shown tinted pink on the respective plans attached, be resumed under Section 146 of "The Land Acts, 1910 to 1918", in accordance with the determination of the Land Court.

District	Holding	Area to be resumed
Leichhardt	Annandale	54¼ square miles
South Kennedy	Havilah	92⅝ " "
Maranoa	Drumfern	35 " "

J. H. L.

Figure 18: Ministers' recommendation in 1920 for land resumption (QSA Item ID26676)

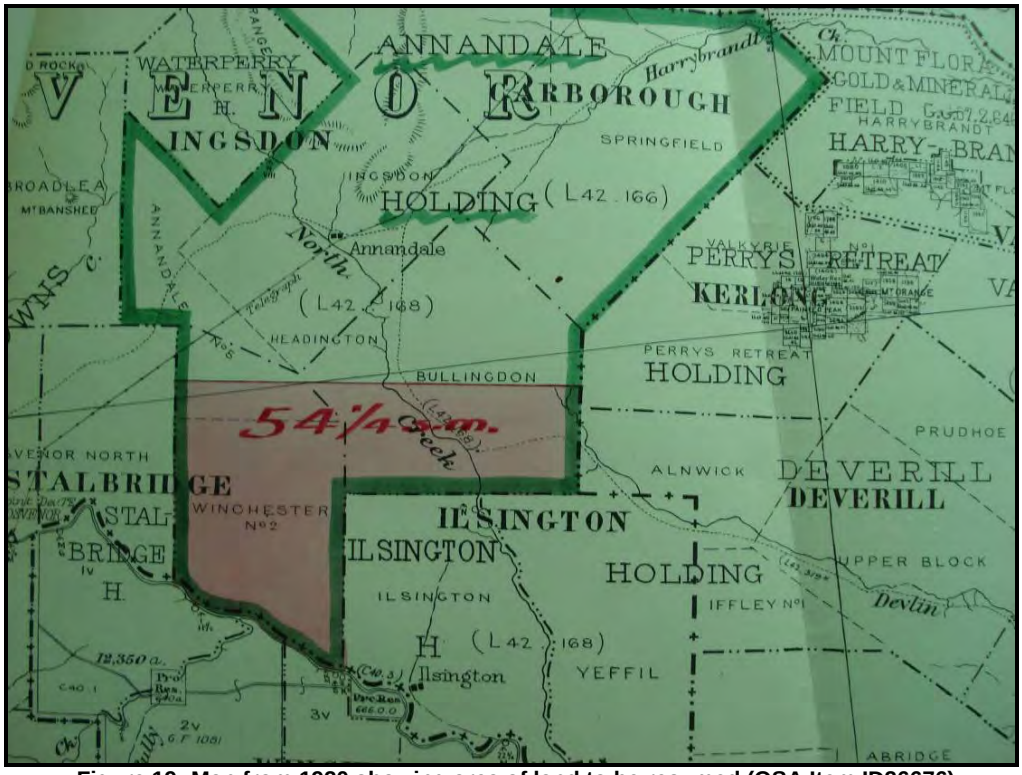


Figure 19: Map from 1920 showing area of land to be resumed (QSA Item ID26676)

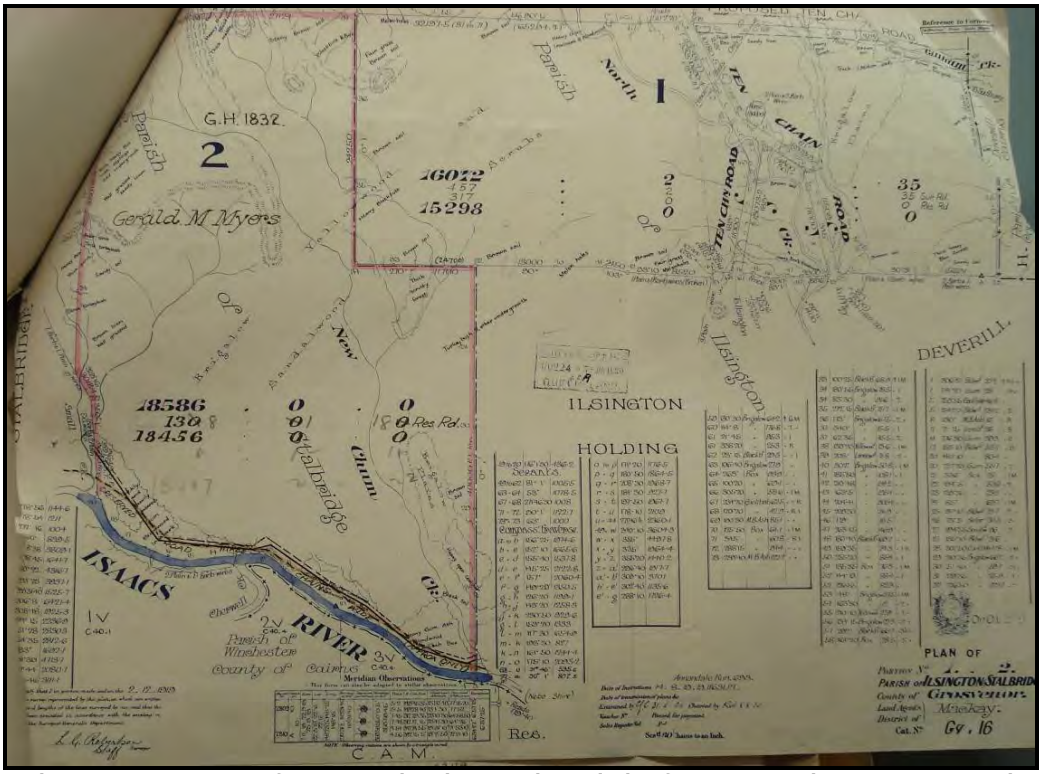
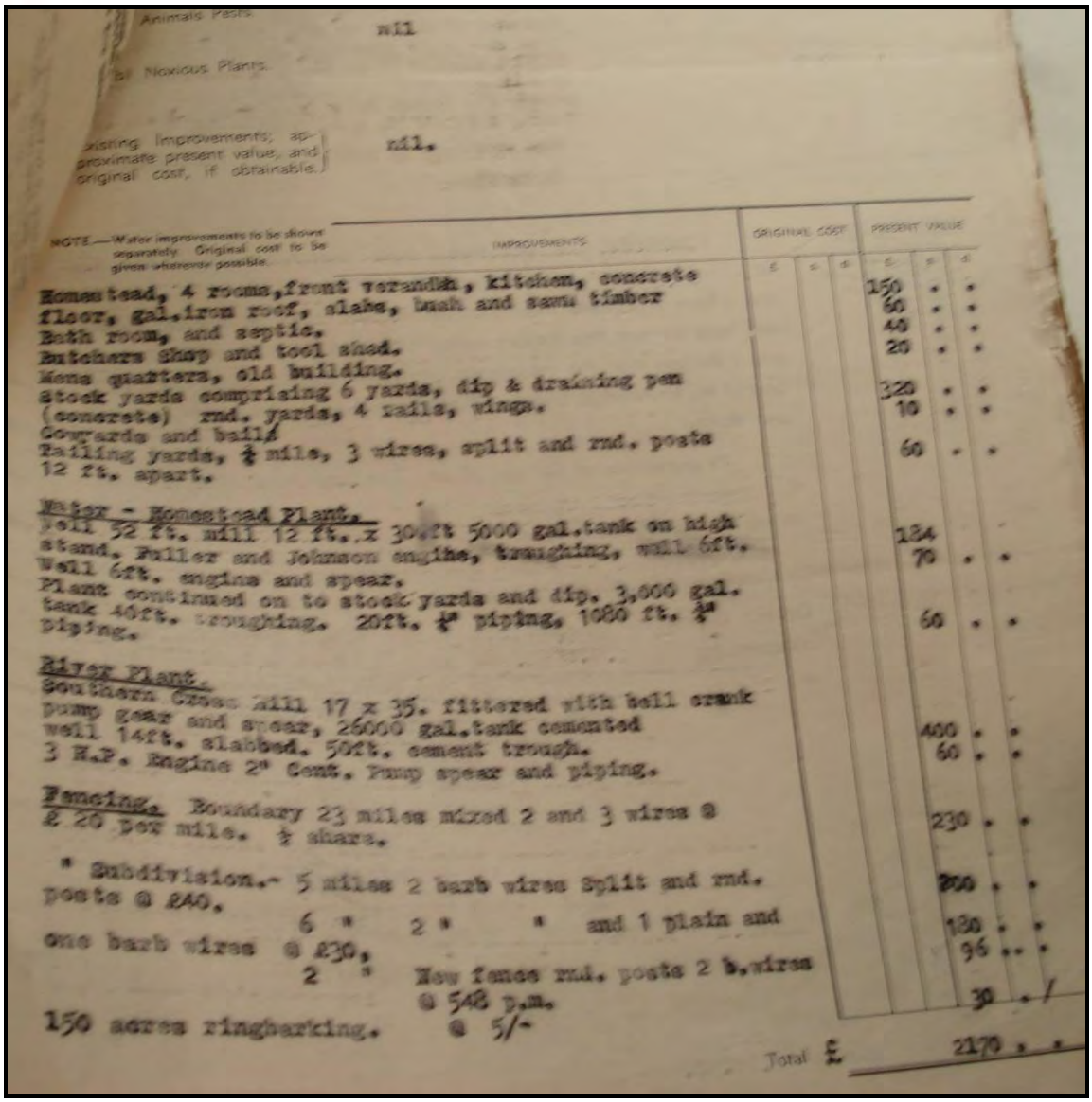


Figure 20: Survey map from 1920 showing new boundaries for G.H. 1832 (QSA Item ID26676)

Figure 21: Survey map from 1920 showing new boundaries for G.H. 1815 (QSA Item ID26676)



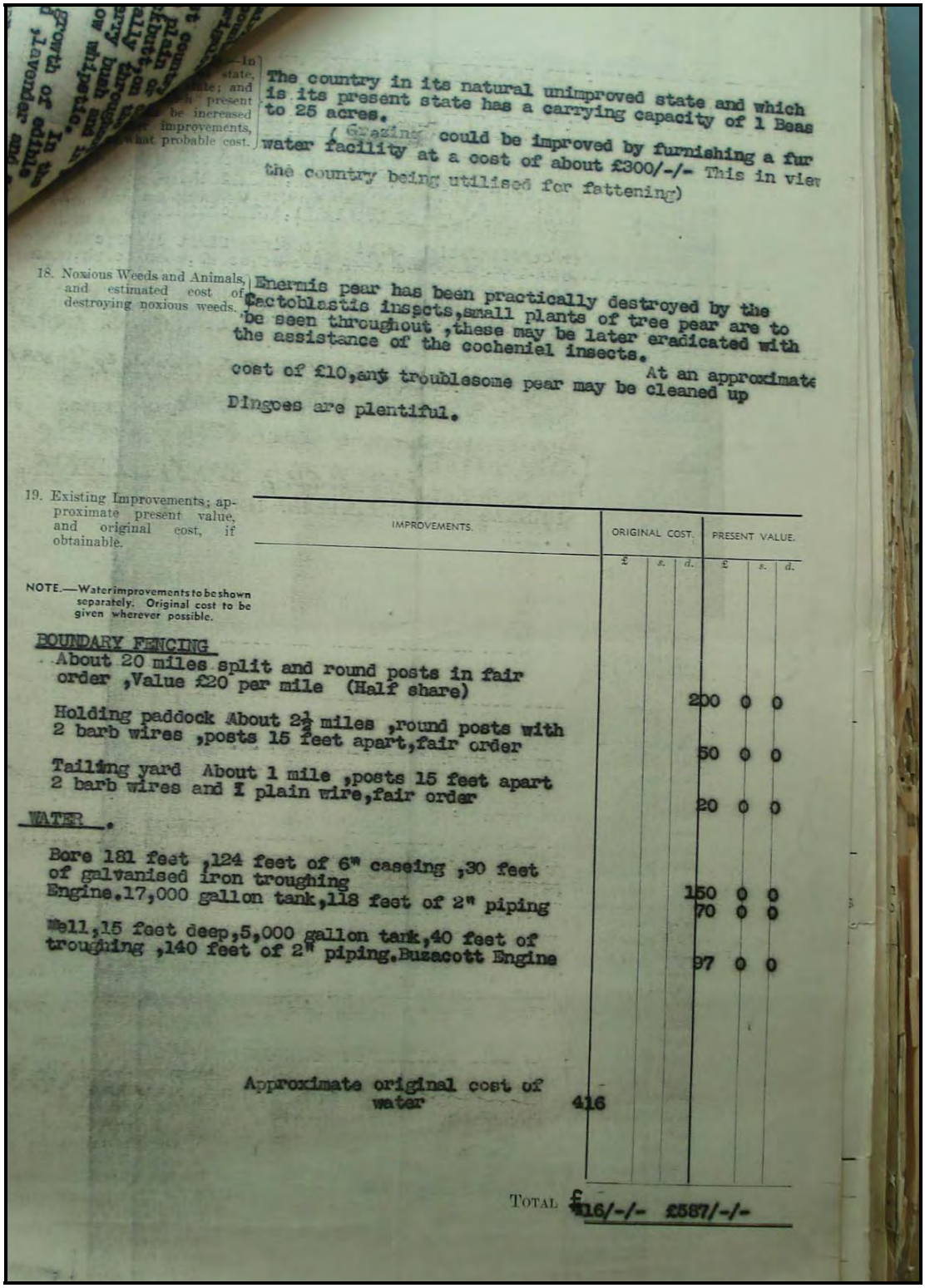
Animals Pests nil

(b) Noxious Plants

(c) Existing improvements; approximate present value, and original cost, if obtainable. nil.

NOTE.—Water improvements to be shown separately. Original cost to be given wherever possible.	IMPROVEMENTS	ORIGINAL COST £ s. d.	PRESENT VALUE £ s. d.
	Homestead, 4 rooms, front verandah, kitchen, concrete floor, gal. iron roof, slabs, bush and sawn timber		150 . .
	Bath room, and septic.		60 . .
	Butchers Shop and tool shed.		40 . .
	Mens quarters, old building.		20 . .
	Stock yards comprising 6 yards, dip & draining pen (concrete) rnd. yards, 4 rails, wings.		320 . .
	Cowyards and build		10 . .
	Railing yards, ½ mile, 3 wires, split and rnd. posts 12 ft. apart.		60 . .
	Water - Homestead Plant. Well 32 ft. mill 12 ft. x 30 ft 5000 gal. tank on high stand. Fuller and Johnson engine, troughing, well 6ft. Well 6ft. engine and spear.		184 70 . .
	Plant continued on to stock yards and dip. 3,000 gal. tank 40ft. troughing. 20ft. 4" piping. 1080 ft. 3" piping.		60 . .
	River Plant. Southern Cross Mill 17 x 35. fittered with bell crank pump gear and spear, 26000 gal. tank cemented well 14ft. slabbed. 50ft. cement trough. 3 H.P. Engine 2nd Cent. Pump spear and piping.		400 . . 60 . .
	Fencing. Boundary 23 miles mixed 2 and 3 wires @ £ 20 per mile. ½ share.		230 . .
	" Subdivision.- 5 miles 2 barb wires split and rnd. posts @ £40.		200 . .
	6 " 2 " " and 1 plain and one barb wires @ £30,		180 . .
	2 " New fence rnd. posts 2 b. wires @ 548 p.m.		96 . .
	150 acres ringbarking. @ 5/-		30 . .
		Total £	2170 . .

Figure 22: List of improvements for G.H. 1832 "Poitrel Station" from 1950 Appraisement of Rent document (QSA Item ID184008)



The country in its natural unimproved state and which is its present state has a carrying capacity of 1 Beas to 25 acres.

(Grazing could be improved by furnishing a fur water facility at a cost of about £300/-/- This in view the country being utilised for fattening)

18. Noxious Weeds and Animals, and estimated cost of destroying noxious weeds.

Enermis pear has been practically destroyed by the Cactoblastis insects,small plants of tree pear are to be seen throughout ,these may be later eradicated with the assistance of the cocheniel insects.

At an approximate cost of £10,any troublesome pear may be cleaned up

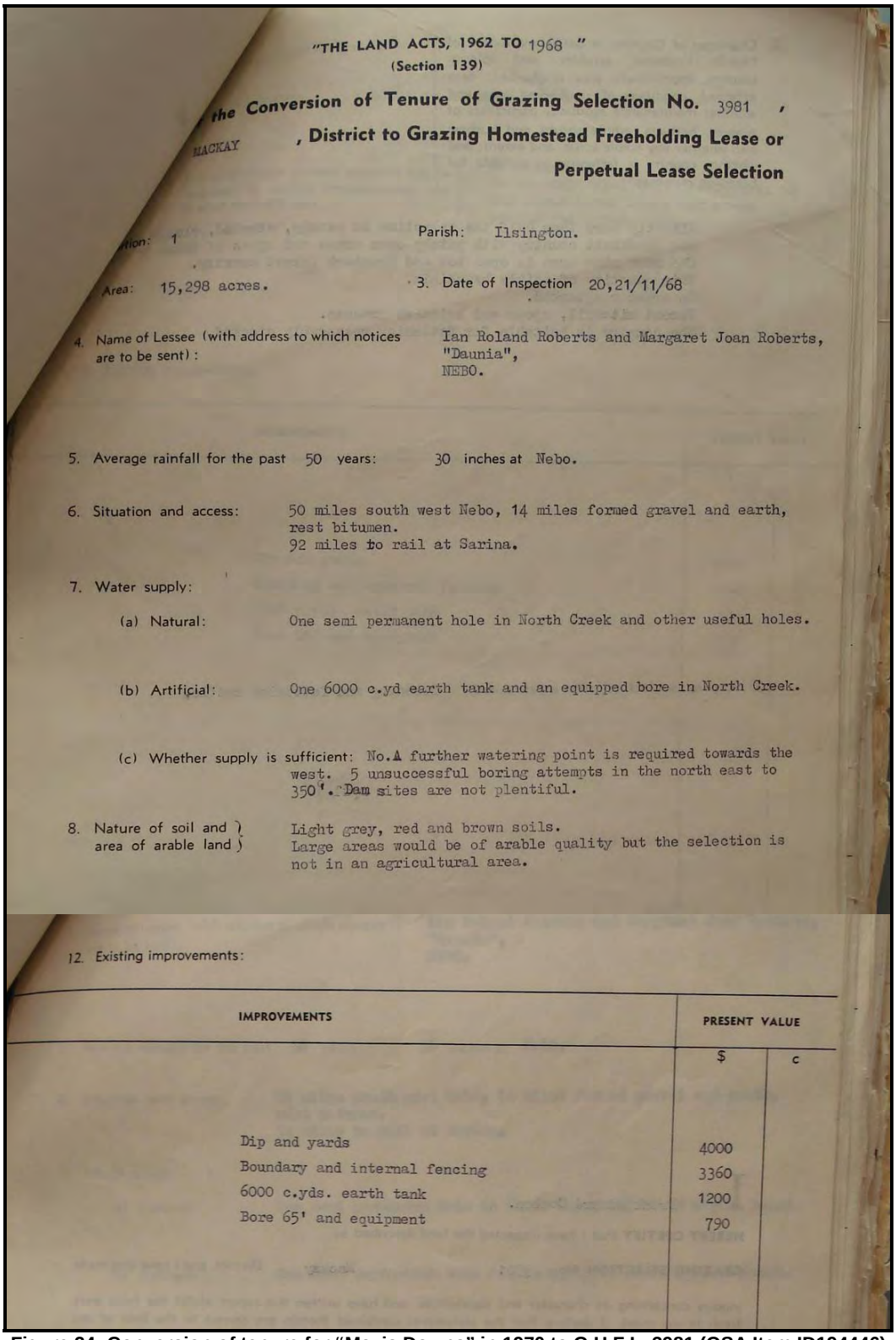
Dingoes are plentiful.

19. Existing Improvements; approximate present value, and original cost, if obtainable.

NOTE.—Water improvements to be shown separately. Original cost to be given wherever possible.

IMPROVEMENTS.	ORIGINAL COST. £ s. d.	PRESENT VALUE. £ s. d.
BOUNDARY FENCING		
About 20 miles split and round posts in fair order ,Value £20 per mile (Half share)		200 0 0
Holding paddock About 2½ miles ,round posts with 2 barb wires ,posts 15 feet apart,fair order		50 0 0
Tailing yard About 1 mile ,posts 15 feet apart 2 barb wires and 1 plain wire,fair order		20 0 0
WATER.		
Bore 181 feet ,124 feet of 6" caseing ,30 feet of galvanised iron troughing		150 0 0
Engine.17,000 gallon tank,118 feet of 2" piping		70 0 0
Well,15 feet deep,5,000 gallon tank,40 feet of troughing ,140 feet of 2" piping.Buzacott Engine		97 0 0
Approximate original cost of water	416	
TOTAL	£416/-/-	£587/-/-

Figure 23: List of improvements for G.H. 1815 "Mavis Downs Station" from 1944 Appraisement of Rent document (QSA Item ID69692)



"THE LAND ACTS, 1962 TO 1968 "
(Section 139)

the Conversion of Tenure of Grazing Selection No. 3981 ,
MACKAY , District to Grazing Homestead Freeholding Lease or
Perpetual Lease Selection

tion: 1 Parish: Ilsington.

Area: 15,298 acres. 3. Date of Inspection 20,21/11/68

4. Name of Lessee (with address to which notices are to be sent): Ian Roland Roberts and Margaret Joan Roberts, "Daunia", NEBO.

5. Average rainfall for the past 50 years: 30 inches at Nebo.

6. Situation and access: 50 miles south west Nebo, 14 miles formed gravel and earth, rest bitumen.
92 miles to rail at Sarina.

7. Water supply:

(a) Natural: One semi permanent hole in North Creek and other useful holes.

(b) Artificial: One 6000 c.yd earth tank and an equipped bore in North Creek.

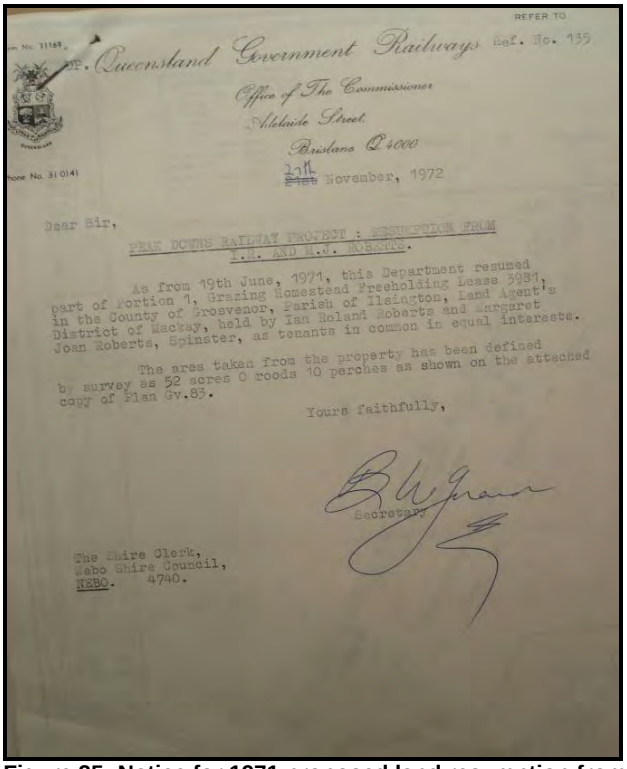
(c) Whether supply is sufficient: No. A further watering point is required towards the west. 5 unsuccessful boring attempts in the north east to 350'. Dam sites are not plentiful.

8. Nature of soil and area of arable land: Light grey, red and brown soils.
Large areas would be of arable quality but the selection is not in an agricultural area.

12. Existing improvements:

IMPROVEMENTS	PRESENT VALUE $	c
Dip and yards	4000	
Boundary and internal fencing	3360	
6000 c.yds. earth tank	1200	
Bore 65' and equipment	790	

Figure 24: Conversion of tenure for "Mavis Downs" in 1970 to G.H.F.L. 3981 (QSA Item ID194446)



REFER TO

Queensland Government Railways Ref. No. 135

Office of The Commissioner
Adelaide Street
Brisbane Q 4000

Phone No. 31 0141

~~21st~~ November, 1972

Dear Sir,

PEAK DOWNS RAILWAY PROTEST : RESUMPTION FROM
I.R. AND M.J. ROBERTS.

As from 19th June, 1971, this Department resumed part of Portion 1, Grazing Homestead Freeholding Lease 3991, in the County of Grosvenor, Parish of Ilsington, Land Agent's District of Mackay, held by Ian Roland Roberts and Margaret Joan Roberts, Spinster, as tenants in common in equal interests.

The area taken from the property has been defined by survey as 52 acres 0 roods 10 perches as shown on the attached copy of Plan Gv.85.

Yours faithfully,

Secretary.

The Shire Clerk,
Nebo Shire Council,
NEBO. 4740.

Figure 25: Notice for 1971 proposed land resumption from "Mavis Downs" for railway line (QSA Item ID194446)

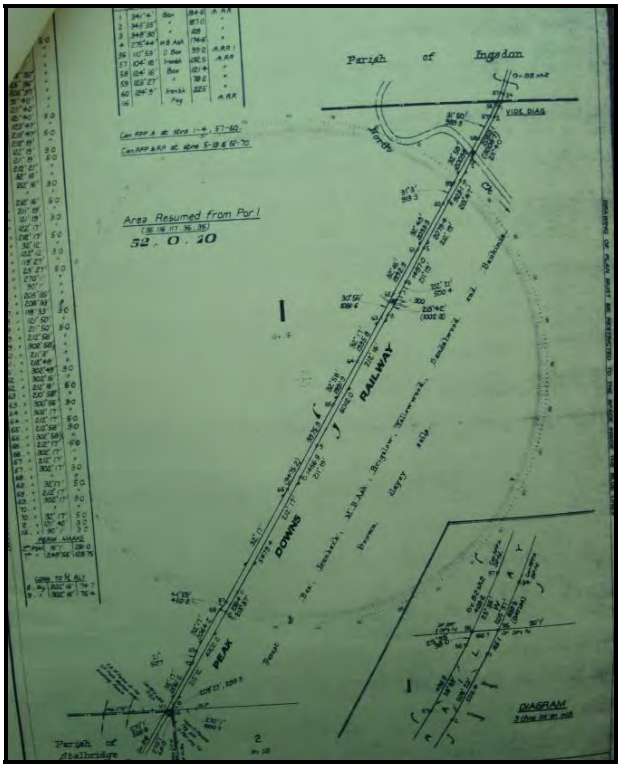
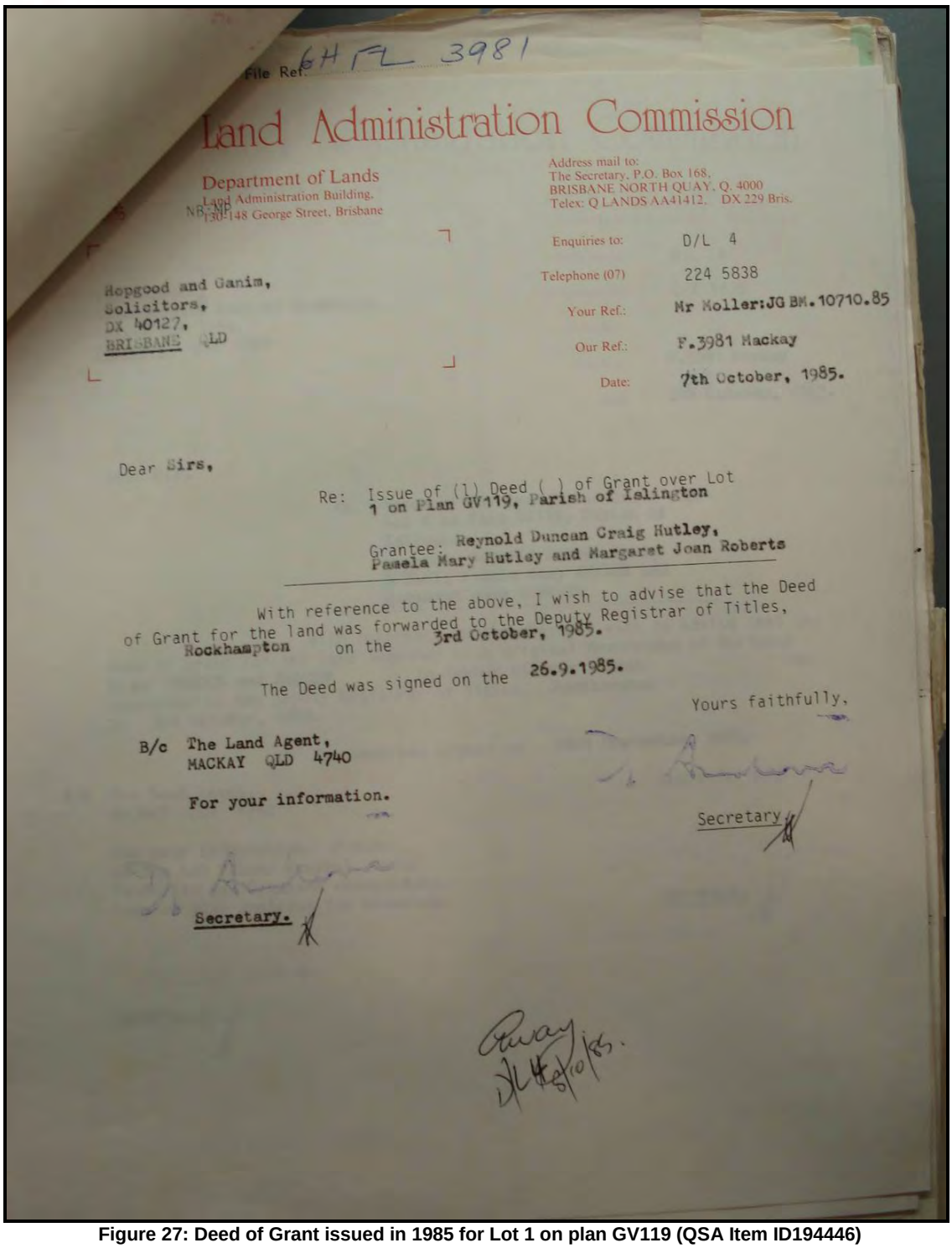


Figure 26: Map showing 1971 easement to be resumed (QSA Item ID194446)



File Ref. 6HFL 3981

Land Administration Commission

Department of Lands
Land Administration Building,
NBC/MP 340 George Street, Brisbane

Address mail to:
The Secretary, P.O. Box 168,
BRISBANE NORTH QUAY, Q. 4000
Telex: Q LANDS AA41412. DX 229 Bris.

Enquiries to: D/L 4

Telephone (07) 224 5838

Your Ref.: Mr Moller:JG BM.10710.85

Our Ref.: F.3981 Mackay

Date: 7th October, 1985.

Hopgood and Ganim,
Solicitors,
DX 40127,
BRISBANE QLD

Dear Sirs,

Re: Issue of (1) Deed ( ) of Grant over Lot 1 on Plan GV119, Parish of Islington

Grantee: Reynold Duncan Craig Hutley, Pamela Mary Hutley and Margaret Joan Roberts

With reference to the above, I wish to advise that the Deed of Grant for the land was forwarded to the Deputy Registrar of Titles, Rockhampton on the 3rd October, 1985.

The Deed was signed on the 26.9.1985.

Yours faithfully,

Secretary

B/c The Land Agent,
MACKAY QLD 4740

For your information.

Secretary.

Figure 27: Deed of Grant issued in 1985 for Lot 1 on plan GV119 (QSA Item ID194446)

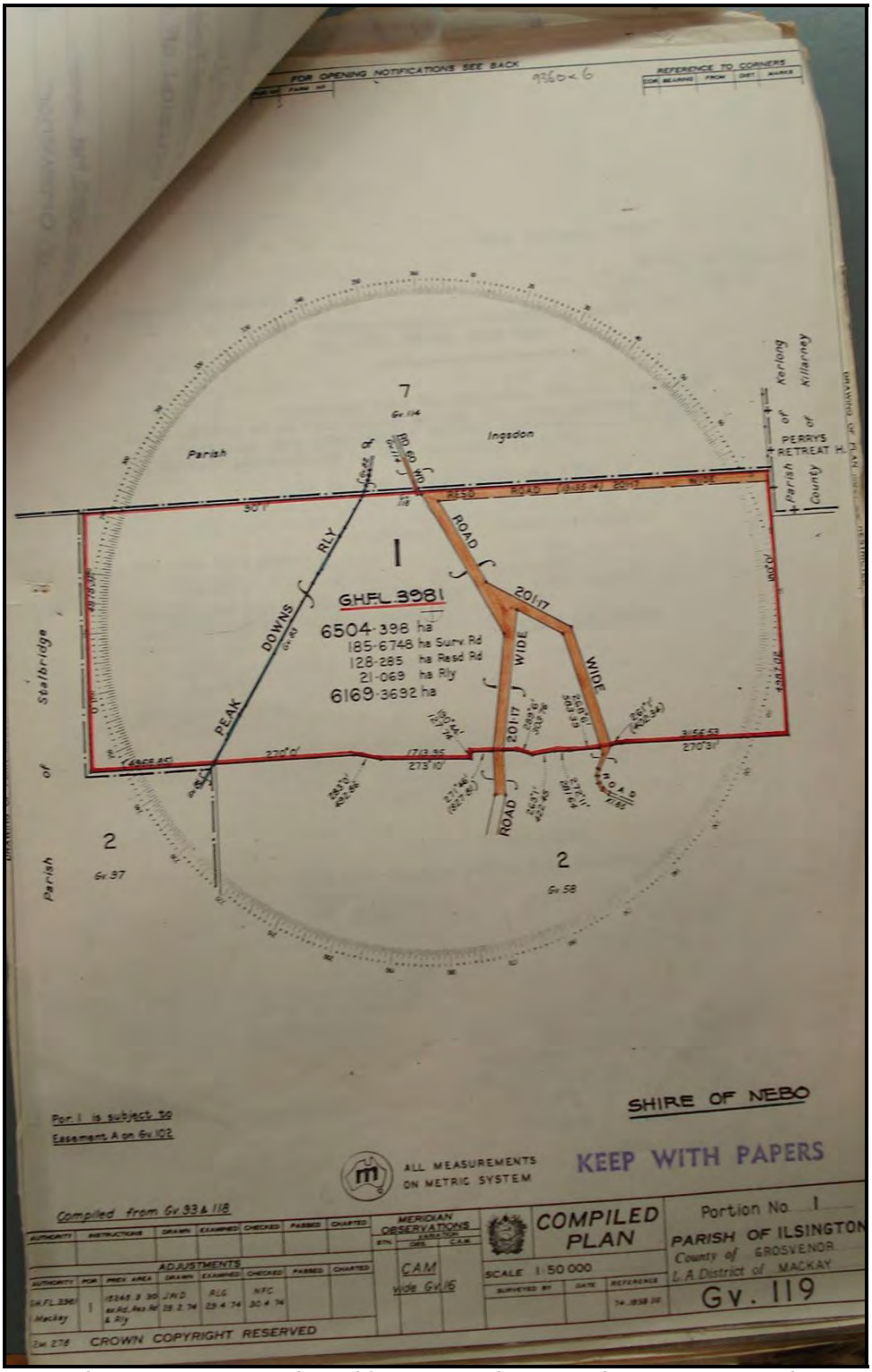


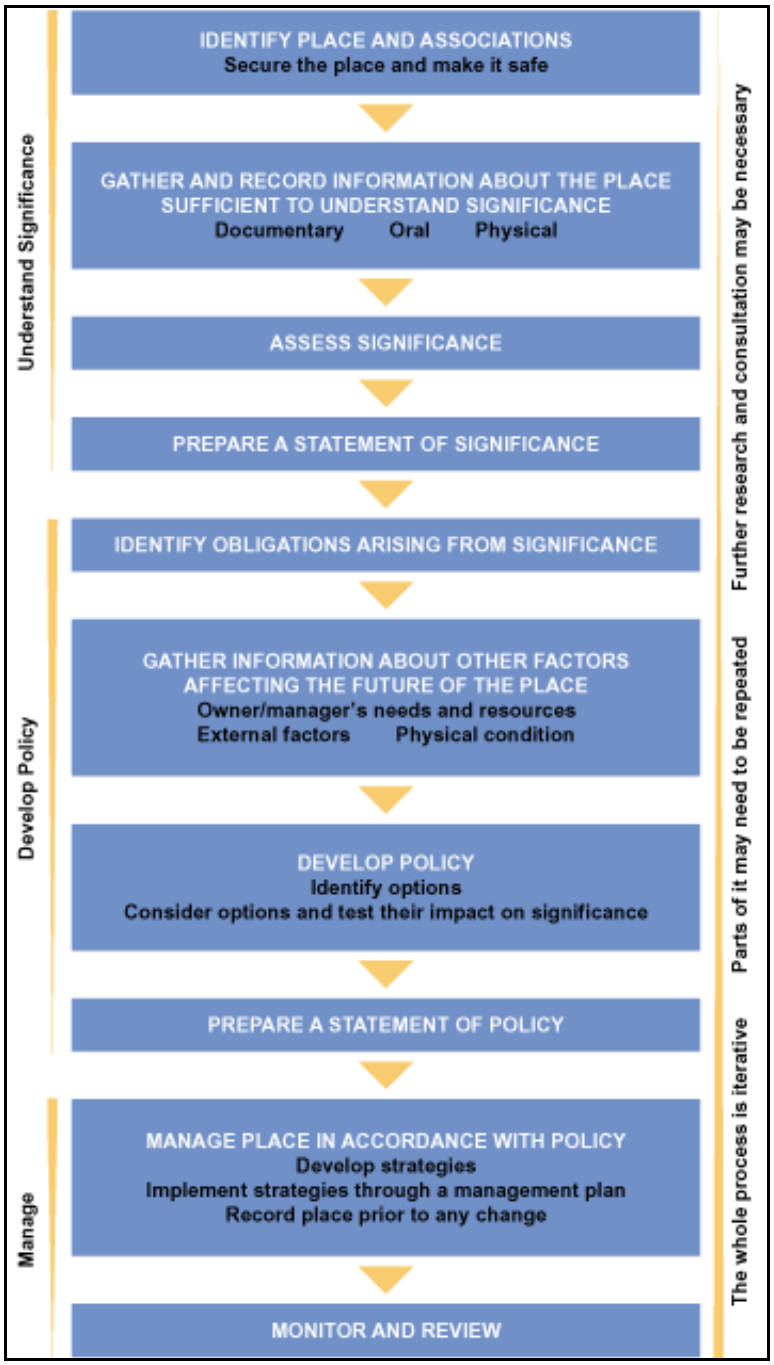
Figure 28: Survey map issued for Lot 1 on plan GV119 (QSA Item ID194446)

APPENDIX C: DEFINITIONS USED IN THE REPORT (BURRA CHARTER (1999)

1.1	*Place* means site, area, land, landscape, building or other work, group of buildings or other works, and may include components, contents, spaces and views.	The concept of place should be broadly interpreted. The elements described in Article 1.1 may include memorials, trees, gardens, parks, places of historical events, urban areas, towns, industrial places, archaeological sites and spiritual and religious places.
1.2	*Cultural significance* means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the *place* itself, its *fabric*, *setting*, *use*, *associations*, *meanings*, records, *related places* and *related objects*. Places may have a range of values for different individuals or groups.	The term cultural significance is synonymous with heritage significance and cultural heritage value. Cultural significance may change as a result of the continuing history of the place. Understanding of cultural significance may change as a result of new information.
1.3	*Fabric* means all the physical material of the *place* including components, fixtures, contents, and objects.	Fabric includes building interiors and sub-surface remains, as well as excavated material. Fabric may define spaces and these may be important elements of the significance of the place.
1.4	*Conservation* means all the processes of looking after a *place* so as to retain its *cultural significance*.	
1.5	*Maintenance* means the continuous protective care of the *fabric* and *setting* of a *place*, and is to be distinguished from repair. Repair involves *restoration* or *reconstruction*.	The distinctions referred to, for example in relation to roof gutters, are • maintenance Ñ regular inspection and cleaning of gutters; • repair involving restoration Ñ returning of dislodged gutters; • repair involving reconstruction Ñ replacing decayed gutters.
1.6	*Preservation* means maintaining the *fabric* of a *place* in its existing state and retarding	It is recognised that all places and their components change over time

	deterioration.	at varying rates.
1.7	*Restoration* means returning the existing *fabric* of a *place* to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material.	
1.8	*Reconstruction* means returning a *place* to a known earlier state and is distinguished from *restoration* by the introduction of new material into the *fabric*.	New material may include recycled material salvaged from other places. This should not be to the detriment of any place of cultural significance.
1.9	*Adaptation* means modifying a *place* to suit the existing *use* or a proposed use.	
1.10	*Use* means the functions of a place, as well as the activities and practices that may occur at the place.	
1.11	*Compatible use* means a *use* which respects the *cultural significance* of a *place*. Such a use involves no, or minimal, impact on cultural significance.	
1.12	*Setting* means the area around a *place*, which may include the visual catchment.	
1.13	*Related place* means a *place* that contributes to the *cultural significance* of another place.	
1.14	*Related object* means an object that contributes to the *cultural significance* of a *place* but is not at the place.	
1.15	*Associations* mean the special connections that exist between people and a *place*.	Associations may include social or spiritual values and cultural responsibilities for a place.
1.16	*Meanings* denote what a *place* signifies, indicates, evokes or expresses.	Meanings generally relate to intangible aspects such as symbolic qualities and memories.
1.17	*Interpretation* means all the ways of presenting the *cultural significance* of a *place*.	

APPENDIX D: BURRA CHARTER ASSESSMENT PROCESS



APPENDIX E: SURVEYOR'S SHIELD ON RED MOUNTAIN

Queensland Government
Natural Resources and Water

Survey Search Detail Report
Details of Registered Number: 72070

Page: 1 of 1

Current Information			
Administrative			
Alternate Name(s)	RED MT		
Parish	ILSINGTON		
Town			
Local Authority	ISAAC REGIONAL		
Locality Description	RED MOUNTAIN		
Related Information			
Mark Details			
Mark Type	STAND	**Mark Condition**	GOOD
Installed By	I MCGHIE	**Installed Date**	01/09/1980
Last Visited	01/09/1980	**Sketch Available**	YES
Connection(s)			
Horizontal			
Datum	GDA94		
Latitude	22°0' 31.9526" S	**Longitude**	148°16' 5.4734" E
Easting	630902.931	**Northing**	7565647.659
Zone	55		
Order	NO ORDER	**Class**	NO CLASS
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	SCALED
Prominent Feature	NO		
Vertical			
Height	323.900	**Datum**	AHD D
Order	NO ORDER	**Class**	NO CLASS
Fixed By	TRIG	**Origin**	24461
Geoid/Ellipsoid Separation(N)	0.000		
Model			

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au

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Page: 1 of 1

25 June, 2009

APPENDIX F: HISTORIC CULTURAL HERITAGE MANAGEMENT PLAN

A Historic Cultural Heritage Management Plan should be incorporated into the Environmental Management Plan for the Project. It is recommended that the management principles and procedures in this Appendix F form the basis of the management plan.

1. General Principles of Cultural Heritage Management

No places or items of historic Cultural Significance have been identified within the Project Area. It is considered unlikely that the Project will impact on unidentified places or items of Cultural Significance.

Although unlikely, it is acknowledged that there remains the potential for Culturally Significant items to exist within the Project Area, primarily being limited to archaeologically (located below the ground surface) significant items. The purpose of this CHMP is to provide a cautionary approach to ensuring there is the opportunity to identify, record, assess, excavate or collect Culturally Significant items or places, and to conserve, manage and interpret these items or places.

2. Definitions

Archaeological Investigation or ***Archaeological Excavation*** means a physical investigation of a place carried out by an appropriately qualified person for the purpose of investigating, recording and/or conserving archaeological artefacts on the place.

Archaeological Monitoring means the monitoring of initial ground surface and subsurface disturbance in accordance with the principles and procedures detailed in Section 6 of this CHMP.

CHMP means this Cultural Heritage Management Plan.

Conservation means protection, maintenance, preservation, restoration, reconstruction and adaptation; see *Queensland Heritage Act* 1992, Schedule, Dictionary, and Section 4.

Cultural Heritage Advisor means Everick Heritage Consultants or such other consultancy as nominate by Peabody from time to time to provide expert Historic Cultural Heritage and archaeological advice for the Project.

Cultural Significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.

Historic Cultural Heritage means an item, objects, artefact and/or place of Cultural Significance, but does not include a thing that is Aboriginal Cultural Heritage under the *Aboriginal Cultural Heritage Act 2003* (Qld).

DERM means the Cultural Heritage Unit of the Queensland Department of Environment and Resource Management.

EMP means the Environmental Management Plan for the Project.

Find means an archaeological find of Cultural Significance.

Find Procedure means the Historic Cultural Heritage Find Procedure detailed in Section 5 of this CHMP.

GCAI means the *Draft Guidelines for Carrying Out an Archaeological Investigation: Standards and Guidance for Persons Carrying out an Archaeological Investigation* (External Consultation Draft: May 2010) or such document as may supersede these guidelines under Section 173(1)(d) of the QHA.

Induction means the induction on cultural heritage in accordance with Section 4 of this CHMP.

Interpretation means all the ways of presenting the Cultural Significance of a place.

Peabody means Peabody Energy Australia Pty Ltd and employees, contractors or subcontractors duly authorised to operate on their behalf.

Project *or* ***MEP*** means the Millennium Expansion Project.

Project Area means ML 70313, MLA 70401 and MDL 136.

QHA means the *Queensland Heritage Act 1992* (Qld).

Site(s) means any defined or readily identifiable area within which important archaeological artefacts are found, or have a reasonable likelihood to be found based on an assessment by an archaeologist.

3. Review of Historic Cultural Heritage Management Procedures

Peabody should conduct an internal review of this EMP at at regular intervals applicable to the operations and potential risk of the Project encountering items of areas of Cultural Significance. If, in Peabody's opinion, any aspects of this EMP have become unworkable due to operational concerns, the Cultural Heritage Advisor and DERM should be consulted in order to find an acceptable, alternative solution.

Peabody should review the status of the *Draft Guidelines for Carrying Out an Archaeological Investigation: Standards and Guidance for Persons Carrying out an Archaeological Investigation* (External Consultation Draft: May 2010) at regular intervals applicable to the operations and potential risk of the Project encountering items of areas of Cultural Significance. At such time as official guidelines under Section 173(1)(d) of the *Queensland Heritage Act 1992* (Qld) come into force, the management strategies detailed in this CHMP should be reviewed to ensure compliance. Where inconsistencies are identified, the methods and procedures of the official Guidelines should apply.

Should a revised CHMP be required, a copy of the updated version should be forwarded on to DERM.

4. Induction Training

Prior to any person undertaking works that may involve initial clearing or ground breaking activities within the Project Area, he/she will undergo a general Induction. The Induction should reference the potential for significant Aboriginal and Historic Cultural Heritage to be located within the Project Area. The Induction should outline the general requirement to stop work and seek professional cultural heritage advice, in accordance with the Historic Cultural Heritage Find Procedure.

5. Historic Cultural Heritage Find Procedure

In the event that any staff or contractors of Peabody suspect that they have identified a Culturally Significant object or place, the following measures should apply:

- All work at the location must cease immediately and reasonable efforts to secure the site should be made. Note that the material should not be removed or disturbed but barriers or temporary fences can be erected. A buffer zone of 20 metres in all directions should be marked around the Find.
- Appropriate Peabody managers should be notified and if they are in doubt as to the nature of the Find then the Cultural Heritage Advisor should be engaged to inspect the site.

- Work should not resume until a Cultural Heritage Advisor has confirmed the significance of the Find.
- Should the Find not be Culturally Significant, work can recommence within the buffer zone immediately.
- Should the Find be Culturally Significance, appropriate mitigation strategies should be developed in consultation with DERM officers, which may include following the:
    - Archaeological Excavation Principles and Procedures;
    - Archaeological Monitoring Principles and Procedures; and
    - Conservation and Interpretation Principles and Procedures.
- All archaeological standards and procedures should be in accordance with the DERM GCAI.

6. Archaeological Monitoring Principles & Procedures

In the event of a suspected Find, Archaeological Monitoring may be an appropriate strategy for identifying, recovering, protecting and/or documenting significant archaeological artefacts, features and deposits. DERM should be consulted prior to implementing Archaeological Monitoring to ascertain if the methods proposed are appropriate.

6.1 Purpose

Archaeological Monitoring must only be undertaken by an appropriately qualified archeologist. The purpose of the monitoring will be to:

- allow the presence of archaeological deposits to be adequately established in advance of development or other potentially disruptive works;
- provide an opportunity to record and possibly collect, before destruction or damage, archaeological artefacts; and
- provide opportunities to initiate other mitigation strategies, if appropriate and agreeable between all affected parties.

Archaeological Monitoring is not to be used as a substitute for controlled Archaeological Investigations due to monitoring's limited potential for thorough analysis or recording of archaeological artefacts, features and deposits.

6.2 Monitoring Plan

An Archaeological Monitoring plan should be developed, which is informed by the construction schedule of the development project. The monitoring plan should include:

- protocols for the storage, curation and treatment for all archaeological artefacts recovered during the monitoring programme;
- outline the scope of the monitoring activities, especially whether the monitor needs to maintain a comprehensive (present at all ground disturbance), intensive (present during sensitive ground disturbance), intermittent (viewing trenches after machining), or partial (as and when seems appropriate) presence;
- a discovery management protocol, in accordance with DERM's recommended *Find, Stop, Notify, Manage* protocol; and
- provision for the immediate notification of DERM.

6.3 Monitoring Report

All Archaeological monitoring activities should be accompanied by a monitoring report. The report should, as a minimum, detail the following:

- the scope of the Project;
- the dates and related administrative details of the monitoring activity;
- aims of the monitoring activity;
- monitoring methodology, including justification of the methods employed, the monitoring plan, including actual methods used, and justifications for any changes made to the agreed monitoring plan;
- monitoring results;
- a description of the final destination of archaeological artefacts collected during the course of the monitoring programme;
- a Critique/Analysis of the success or failure of the methods used; and
- recommendations for any proposed follow-up work, including the update of the Historic Cultural Heritage Management Plan (or EMP).

A copy of the monitoring report should be provided to DERM as soon as practicable.

7. Archaeological Investigation Principles & Procedures

An Archaeological Investigation or Excavation is a programme of controlled, intrusive fieldwork with defined research objectives that examines, records and interprets archaeological artefacts, features and deposits, and as appropriate, retrieves materials within a specified area, place or site. In the event of a Find, Archaeological Excavations may be an appropriate strategy for identifying, recovering, protecting and/or documenting Culturally Significant archaeological artefacts, features and deposits.

DERM must be consulted prior to implementing Archaeological Excavations to ascertain if the methods proposed are appropriate. Any discoveries of Culturally Significant archaeological Finds must also be reported to DERM.

7.1 Purpose

In the context of the Project, Archaeological Excavations may be for the purpose of testing for the existence of Culturally Significant objects and/or for recording and salvaging those objects in the event that they would otherwise be destroyed by the Project. Archaeological test excavations must only be undertaken by an appropriately qualified archaeologist.

7.2 Excavation Plan

Prior to undertaking any Archaeological Excavation, an excavation plan (or archaeological management plan to similar effect) must be drafted and provided to DERM. The excavation plan must, as a minimum:

- provide a theoretical justification for undertaking the excavations, including evidence of any survey results or related studies;
- detail the methods proposed and relate them back to the theoretical justification;
- include details of any arrangements for storage and curation of the artefacts collected; and
- outline any contingency arrangements in the event of an unexpected find.

The methods for archaeological investigation will only be finalised following consultation with DERM.

7.3 Excavation Report

All Archaeological Excavation activities should be accompanied by an excavation report. The report should, as a minimum, detail the following:

- the scope of the project;
- the dates of the excavation;
- results of previous assessments relevant to the excavation;
- aims of the excavation;
- excavation methodology, including justification of the methods employed;
- the excavation plan, including actual methods used, and justifications for any changes made to the agreed excavation plan;
- excavation results; including:

  - detailed descriptions of all discoveries made, including locations;
  - descriptions of stratigraphy/soil profiles encountered;
  - photographs of excavation in progress and discoveries made; and
  - deposition location of artefacts collected;
- analysis of the results, including how the excavations contributed to our understanding of the:
  - place;
  - identified potential of the place; and
  - importance of the place in Queensland's history;
- a description of the final destination of archaeological artefacts collected during the course of the excavation programme;
- a critique/analysis of the success or failure of the methods used; and
- recommendations for any proposed follow-up work, including the update of the Historic CHMP (or EMP).

A copy of the excavation report should be provided to DERM as soon as practicable.

8. Conservation and Interpretation

Conservation is the retention of important archaeological artefacts, features, or deposits in place, and all the processes of looking after those archaeological artefacts, features, or deposits to retain their importance and/or potential. It is recognised that for open cut coal mining activities, such as the present Project, *in situ* conservation is generally considered inappropriate. Never-the-less, due consideration should still be given to this option as the preferred option.

Interpretation reveals the meaning and relationships of objects and places through use of original objects, by reporting first-hand experience, and by use of illustrative media. Interpretation aims to educate rather than simply communicate factual information.

8.1 Guiding Principles

Conservation projects are to be guided by Articles of *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (1999). Conservation techniques should be carefully researched before being selected and implemented.

Important archaeological artefacts, features and/or deposits should be interpreted wherever practicable. It is anticipated that any interpretation would be limited to off-site interpretation, due the Operational Health and Safety Requirements of Project.

Conservation and interpretative works should only be undertaken under the guidance of the Cultural Heritage Advisor, and with the approval of DERM.

8.2 Post Investigation Reporting

The specific contents in post-investigation reports, regarding conservation and interpretation, will vary according to the scope, nature and results of the work. DERM considers addressing the following issues as the minimum standard for post-investigative reports:

- scope of the project (e.g. the place/s being investigated);
- dates of the conservation work (including completion date);
- results of previous assessments, including a summary of findings and recommendations (e.g. history, archaeological potential, management);
- methodology, including the techniques employed, Conservation strategy, Interpretation strategy and the Initiatives identified;
- results of the conservation/interpretation works, including detailed descriptions of all conservation and interpretive works undertaken and photographs of conservation and interpretive works before, during and on completion;
- analysis of the results, including gauging the Project's successfulness for:
    - conserving the place for future generations;
    - informing our understanding of the place;
    - communicating and educating the public; and
- recommendations, including any follow-up work such as ongoing or additional conservation works and changes to the archaeological management plan if applicable.

A copy of the post investigative report should be provided to DERM as soon as practicable.

9. Appointment of a Cultural Heritage Advisor

Peabody is to nominate an independent Cultural Heritage Advisor for the Project. The contact details of the Cultural Heritage Advisor are to be included in the EMP. The role of the Cultural Heritage Advisor will be to:

- provide expert advice on the significance of any archaeological Finds; and
- assist in the implementation of the Archaeological Monitoring Procedure, Archaeological Excavation Procedure and any Conservation or Interpretative works (if required).

10. Approval of DERM

All management recommendations contained in this CHMP are subject to the approval of the Cultural Heritage Unit of DERM.

Millennium Expansion Project

Environmental Impact Statement

APPENDIX F11:

SOCIAL

Millennium Expansion Project

Appendix F11

Social Environment

This report has been prepared solely for the benefit of Peabody Energy Australia Pty Ltd. Mining & Energy Technical Services Pty Limited (MET Serve) accepts no liability for the use or interpretation of any information contained in this report for any other purpose other than intended, or for its use by any party other than the above named Client.

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TABLE OF CONTENTS

1 INTRODUCTION 1
2 METHODOLOGY 3
3 STAKEHOLDER AND COMMUNITY ENGAGEMENT 3
4 BACKGROUND 3
5 REGIONAL COUNCIL REFORMS 4
6 STUDY AREAS 4
6.1.1.1 Local Study Area (LSA) 4
6.1.1.2 Regional Study Area (RSA) 6
6.1.1.3 Mackay Study Area (MSA) 6
6.1.1.4 The State of Queensland Study Area 6
7 ECONOMIC CLIMATE 6
8 STATE GOVERNMENT INITIATIVES 7
9 POPULATION AND DEMOGRAPHIC PROFILE 8
9.1.1 Population 8
9.1.2 Demography 11
9.1.3 Age 12
9.1.4 Ethnicity 13
9.1.5 Marital Status 14
9.1.6 Family and Household Structure 15
9.1.7 Dwelling Structure 16
10 LOCAL COMMUNITY VALUES, VITALITY AND LIFESTYLE 17
11 COMMUNITY INFRASTRUCTURE, SERVICES, ACCESS AND MOBILITY 19
11.1.1 Transport 19
11.1.1.1 Vehicles 20
11.1.1.2 Road 20
11.1.1.3 Rail 21
11.1.1.4 Port 21
11.1.1.5 Air 21
11.1.2 Water 22
11.1.3 Telecommunications 22
11.1.4 Sewerage 22
11.1.5 Emergency Services 22
11.1.5.1 Police Service 22
11.1.5.2 Ambulance Service 23
11.1.5.3 Fire Service 23
11.1.5.4 State Emergency Service 23
11.1.6 Community Services 23

11.1.6.1 Emergency and Long-term Accommodation in Moranbah 23
11.1.6.2 Domestic Violence Resource Service (Mackay and Region) 24
11.1.6.3 Moranbah and District Support Services 24
11.1.6.4 Support Services 24
11.1.7 Services and Facilities 25
12 RECREATIONAL, CULTURAL, LEISURE AND SPORTING FACILITIES AND ACTIVITIES 27
13 HEALTH 28
13.1.1 Hospitals 28
13.1.2 Allied Health Services and Specialists 30
13.1.3 Aged Care Facilities 30
14 EDUCATION 31
14.1.1 Day Care Centres 31
14.1.2 Kindergarten and Preparatory Schooling 31
14.1.3 Schools 32
14.1.4 Tertiary Education 32
15 AGRICULTURAL/ON FARM ACTIVITIES 34
16 HOUSING AND ACCOMMODATION 35
16.1.2 Short-Term/Temporary Accommodation 39
17 EMPLOYMENT AND INCOME 40
18 PROPOSED WORKFORCE 46
19 SUMMARY OF KEY FINDINGS 49
20 POTENTIAL IMPACTS AND MITIGATION MEASURES 50
21 POTENTIAL DEMOGRAPHIC CHANGES IN THE PROFILE OF THE REGION 50
22 SUFFICIENCY OF CURRENT INFRASTRUCTURE AND SERVICES 51
23 IMPACTS ON TRAINING AND EMPLOYMENT 52
23.1.1 Construction Workforce 52
23.1.2 Operational Workforce 52
24 HOUSING AND ACCOMMODATION 54
25 IMPACTS ON LOCAL COMMUNITY VALUES, VITALITY AND LIFESTYLE 55
26 IMPACTS ON HEALTH AND SOCIAL SERVICES 58
27 LOCAL SERVICE REVENUE 58
28 LOCAL LAND USE 59
29 EDUCATIONAL IMPACTS 60
30 MINE CLOSURE 60
31 CUMULATIVE IMPACTS 61
32 DRAFT SOCIAL IMPACT MANAGEMENT PLAN 63
32.1.1 Action Plans 64

32.1.2 Accountability and Resources 64
32.1.3 Monitoring 65
32.1.4 Reporting Mechanisms 65
32.1.5 Evaluation of Community Engagement Processes 65
32.1.6 Public Enquiries and Complaints 65
32.1.7 Dispute Resolution Mechanism 66
33 SUMMARY 66
34 REFERENCES 67

FIGURES

Figure 1 MEP Social Study Areas 2
Figure 2 Location of Homesteads near the MEP 5
Figure 3 Resident population in the RSA from 1991-2006 9
Figure 4 Resident population in the MSA from 1991-2006 10
Figure 5 Resident population in Queensland from 1991-2006 10
Figure 6 Median House prices in Coppabella and Moranbah from 2004 to 2008 35
Figure 7 Median Housing Loan Repayments 2001-2006 in the LSA, RSA, MSA and Queensland 36
Figure 8 Median Weekly rents quarterly for Moranbah, 2004 – 2009 37
Figure 9 Workforce required for the proposed MEP operations 47
Figure 10 Mining Workforce 48

TABLES

Table 9-1 Resident population in the LSA, RSA, MSA and Queensland by gender, 2006 8
Table 9-2 Resident population in the LSA 1996 - 2006 9
Table 9-3 Resident population in the RSA 1996 - 2006 9
Table 9-4 Population projections for the RSA, MSA and Queensland, 2006-2031 10
Table 9-5 Place of usual residence in 2006, compared to 2001, in the LSA, RSA, MSA and Queensland 11
Table 9-6 Place of usual residence in the LSA, RSA, MSA and Queensland, 2006 11
Table 9-7 Resident population in the LSA, RSA, MSA and Queensland by age, 2001 and 2006 13
Table 9-8 Indigenous population in the LSA, RSA, MSA and Queensland by age, 2006 14
Table 9-9 Indigenous status in the LSA, RSA, MSA and Queensland, 2006 14
Table 9-10 Marital status in the LSA, RSA, MSA and Queensland, 2001 15
Table 9-11 Marital status in the LSA, RSA, MSA and Queensland, 2006 15
Table 9-12 Family composition in the LSA, RSA, MSA and Queensland, 2006 16
Table 9-13 Dwelling structure in the LSA, RSA, MSA and Queensland, 2006 16
Table 9-14 Tenure and landlord type in the LSA, RSA, MSA and Queensland, 2006 17

Table 10-1 Index of Relative Socio-economic Advantage and Disadvantage compared to Queensland, 2006 18
Table 11-1 Method of travel to work in the LSA, RSA, MSA and Queensland, 2006 20
Table 11-2 Services and facilities, Moranbah and Coppabella 26
Table 12-1 Recreational, Cultural, Leisure and Sporting Activities in Moranbah 27
Table 13-1 Community health services and facilities, Moranbah 28
Table 13-2 Services provided by Moranbah Hospital 29
Table 14-1 Non-school qualification: level of education in the LSA, RSA, MSA and Queensland, 200634
Table 16-1 Rental payments in the LSA, RSA, MSA and Queensland, 2006 36
Table 16-2 Residential and non-residential Building Approvals in the RSA, MSA and Queensland, 12 months ending 30 September 2008 38
Table 16-3 Non-resident workers counted by survey of accommodation providers in the former Belyando, Broadsound and Nebo Shires, 2007 39
Table 16-4 SPQ total bed capacity in the former Belyando, Broadsound and Nebo Shires, 2006-200739
Table 17-1 Labour force status in the LSA, RSA, MSA and Queensland, 2006 41
Table 17-2 Unemployment rate by Age in the LSA, RSA, MSA and Queensland, 2006 42
Table 17-3 Industry of employment in the LSA, RSA, MSA and Queensland, 2006 43
Table 17-4 Employment by occupation in the LSA, RSA, MSA and Queensland, 2006 44
Table 17-5 Gross individual weekly income in the LSA, RSA, MSA and Queensland, 2006 45
Table 17-6 Selection of mining roles and salary range in Queensland 45
Table 17-7 Gross weekly individual income for Indigenous people in the RSA, MSA and Queensland, 2006* 46
Table 18-1 Estimated requirements for the proposed MEP construction works 47
Table 25-1 Breakdown of reported offences 56
Table 25-2 Number of offences reported for Moranbah from 2004 to 2008 56
Table 25-3 Number of offences reported for the LSA, RSA, MSA and Queensland in 2008 57
Table 25-4 Number of offences reported for the LSA, RSA, MSA and Queensland per 100,000 population for 2006 57
Table 31-1 Coal Expansion Projects in the Moranbah Area 62
Table 31-2 Coal Mining Projects Operating in the Isaac Region 63

1 INTRODUCTION

This social impact assessment (SIA) section of the Environmental Impact Statement (EIS) profiles the existing social values and characteristics of communities, groups and individuals likely to be impacted by the Millennium Expansion Project (MEP). It also includes appropriate mitigation and management measures required as a result of the MEP.

This SIA describes the social values of the affected communities and populations in terms of the: integrity of social conditions including amenity and liveability; harmony and wellbeing; sense of community; access to recreation; and access to social and community services and infrastructure. The social amenity and use of the MEP area and adjacent areas for rural, agricultural, forestry, fishing, recreational, industrial, educational or residential purposes is also covered.

Consideration will be given to:

- the population and demographics of the affected communities;
- local community values, vitality and lifestyles;
- community infrastructure and services, access and mobility;
- housing and accommodation;
- recreational, cultural, leisure and sporting facilities and activities in relation to the MEP area;
- health and educational facilities;
- on farm activities near the proposed expansion; and
- source communities for the proposed workforce.

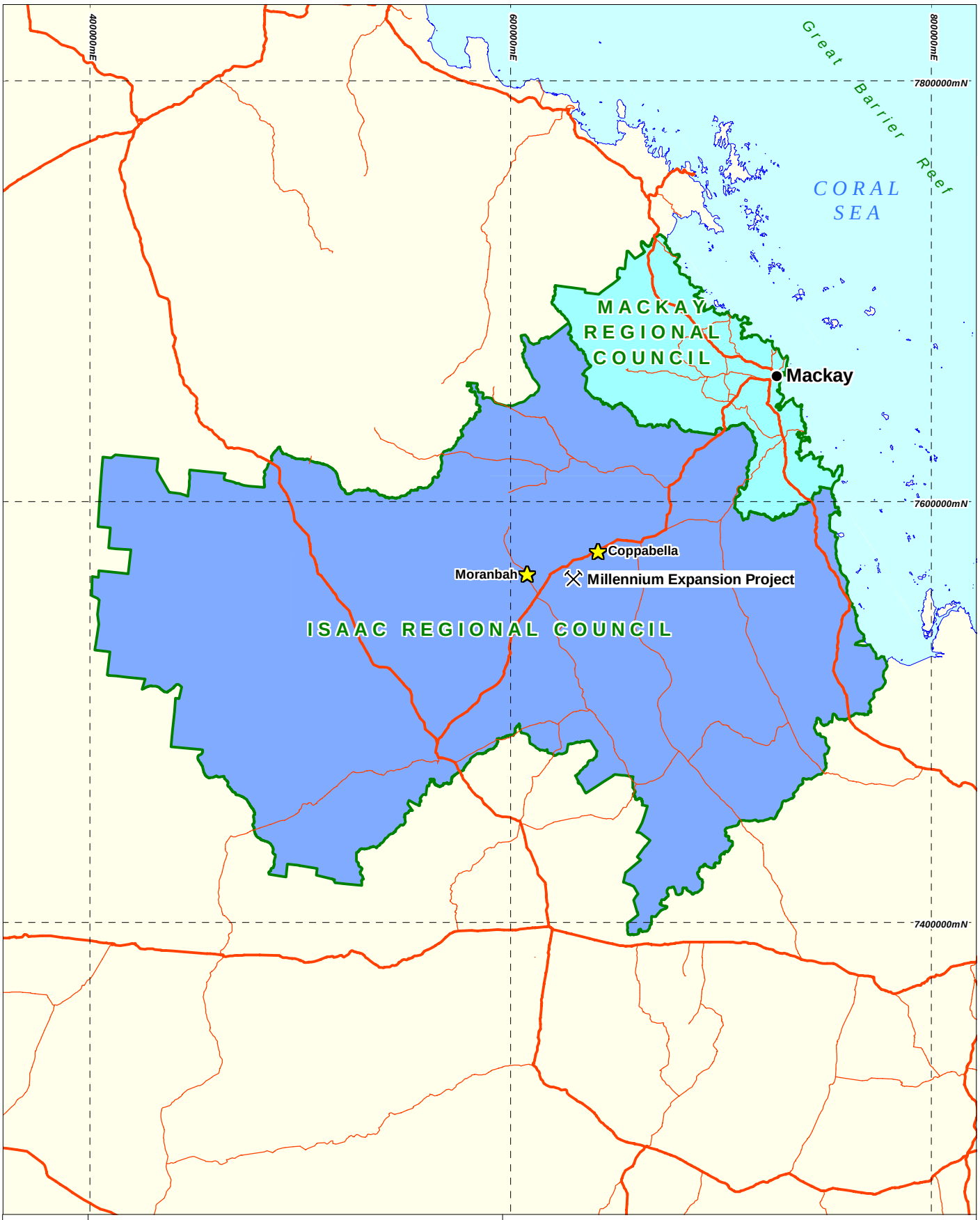
Social and economic values are not as easily separated as physical and ecological values. Therefore it is necessary for some material in this section to be cross-referenced with the Economic assessment of the MEP (refer to EIS Chapter 17 Economy).

The MEP is located within the Isaac Regional Council (IRC) Local Government Area (LGA). The existing Millennium Mine is located approximately 22 kilometres (km) east of Moranbah and 16 km southwest of Coppabella. The SIA identifies the local social and socio-economic environment in the area incorporating the townships of Moranbah and Coppabella, the closest population centres to the proposed project site, as well as identifying issues, impacts and benefits across the wider region. This stepped approach ensures that local impacts will be identified within the context of the wider region and the State of Queensland. **Section 19** onwards identifies potential impacts and mitigation measures.

For the purposes of the assessment, four study areas were defined as follows:

1. a 'Local Study Area (LSA)', comprising the Australian Bureau of Statistics (ABS) State suburb, Moranbah SSC 36793 and Collection District 3052004, Coppabella;
2. a 'Regional Study Area (RSA)', comprising the IRC area;
3. a 'Mackay Study Area (MSA)', comprising the Mackay Regional Council (MRC) area; and
4. the State of Queensland.

The LSA, RSA, MSA and Queensland study areas are illustrated in **Figure 1**.



LEGEND

- Principal road
- Road (sealed)
- Town
- Local study area
- Regional study area
- Mackay study area

MET SERVE

Peabody

Data Source:
Council - DERM. Topography - Geoscience Australia.

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Study Areas

0 50 100

Kilometres

Scale: 1:2,500,000 (A4)

12/10/2010

Datum: GDA94
Projection: MGA55

FIGURE 15-1

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M202A.wor

2 METHODOLOGY

The SIA has been undertaken in accordance with the requirements outlined in the Final Terms of Reference for the MEP EIS.

A desktop assessment of the demographic characteristics of the region has been undertaken. Statistical data from the ABS 2001 and 2006 Census of Population and Housing, Basic Community Profiles and Time Series Profiles (1991 to 2006) have been used to form the basis of the community profiles for all the study areas. This has been supplemented with information from other sets of government statistics and regional reports. Further sources were used to provide additional information on the community profiles of these study areas, of which the full list can be found in **Section 34**.

Due to the recent amalgamation of LGAs in Queensland and lack of consolidated statistics, information for the RSA and MSA has been collated from individual shire council records[1].

Consultation with residents of Moranbah, Coppabella and the wider community took place through a comprehensive Stakeholder and Community Engagement Program (SCEP), further details of which are summarised below and discussed in detail in Appendix E of the EIS.

A social survey was undertaken as part of the stakeholder and community engagement process with engagement focussed on gaining feedback from affected and interested stakeholders; informing the community of the project as well as the expected growth in the region.

3 STAKEHOLDER AND COMMUNITY ENGAGEMENT

The comprehensive SCEP undertaken for the MEP involved the compilation of a list of key stakeholders and engagement with these stakeholders through a variety of communication tools and methods.

Peabody representatives regularly discussed details of the MEP with the IRC and obtained council's input regarding the Project.

Community information days were held to engage with the broader community. This involved hosting public displays at venues attracting high numbers of the local community. The Clermont Show and Moranbah Lions Market were chosen for that purpose. To assist Peabody with this SIA, a community survey was also available at the display for people to complete. Staff members were also available to discuss the MEP and address any issues or concerns that visitors to the display may have raised. Details of the survey responses are included in Appendix E of the EIS, however no major areas of concern were raised during these information days.

A Community Reference Group (CRG), including representatives from IRC, neighbouring landholders, traditional owners, government agencies and local community and business groups was established. Key areas discussed included any issues or concerns relating to the MEP and the cumulative socio-economic impacts of mining in the region. The CRG will continue to function throughout the life of the MEP.

Other consultation activities involving stakeholders included providing project factsheets at significant stages of the Project and face-to-face meetings with directly affected stakeholders.

4 BACKGROUND

Moranbah is a relatively new town, established in 1968 by the Utah Development Company Ltd (now known as the BHP Billiton Mitsubishi Alliance (BMA)). The town was built to accommodate approximately 400 employees of the then newly constructed Goonyella Coal Mine. Since then, it has serviced employees and contractors from a number of surrounding mining operations.

[1] Refer to **Section 5** for amalgamation details.

Coppabella was established by Queensland Rail (QR) in the late 1960's to house employees working in rail operations associated with transporting coal from a number of Bowen Basin mines. Initially a 'closed' town, the former Nebo Shire took over responsibility for the town from QR. Coppabella is a small town with a limited range of services.

The Bowen Basin is an area of coal reserves and resource related communities occupying approximately 60,000 square kilometres (km^2) of Central Queensland from the town of Collinsville in the north to Theodore in the south. This is the largest coal reserve in Australia from which the 34 operational coal mines extract over 100 Million tons per year (Mt/y). This represents 83% of Queensland's coal production and is the State's most important export commodity.

5 REGIONAL COUNCIL REFORMS

In March 2008, an amalgamation of LGAs occurred in Queensland. As a result of this, the former Belyando, Broadsound and Nebo Shires became the IRC. The Mirani and Sarina Shires and Mackay City joined to become the MRC. The amalgamation of these councils does not affect the demographic statistics available from the 2006 Census.

6 STUDY AREAS

6.1.1.1 Local Study Area (LSA)

For the purpose of this assessment, statistics and information from Moranbah and Coppabella represents the LSA.

The MEP is located approximately 22 km east of Moranbah and 16 km southwest of Coppabella in Central Queensland and is comprised of the following tenements:

- Mining Lease (ML) 70312 'Red Mountain Joint Venture';
- ML 70313 'Millennium West';
- ML 70344 'Mountain Pit';
- ML Application 70401 'North Poitrel'; and
- Mineral Development Licence (MDL) 136 'Mavis Downs.

Peabody Pacific and BHP Mitsui Coal Pty Limited (BHPMC) are the joint holders of ML 70312. This arrangement is referred to as the 'Red Mountain Joint Venture'.

There are a number of coal mines operating in the vicinity of the MEP including Carborough Downs, approximately 2 km to the north and Poitrel Mine, which adjoins the existing Millennium Coal Mine's leases to the south.

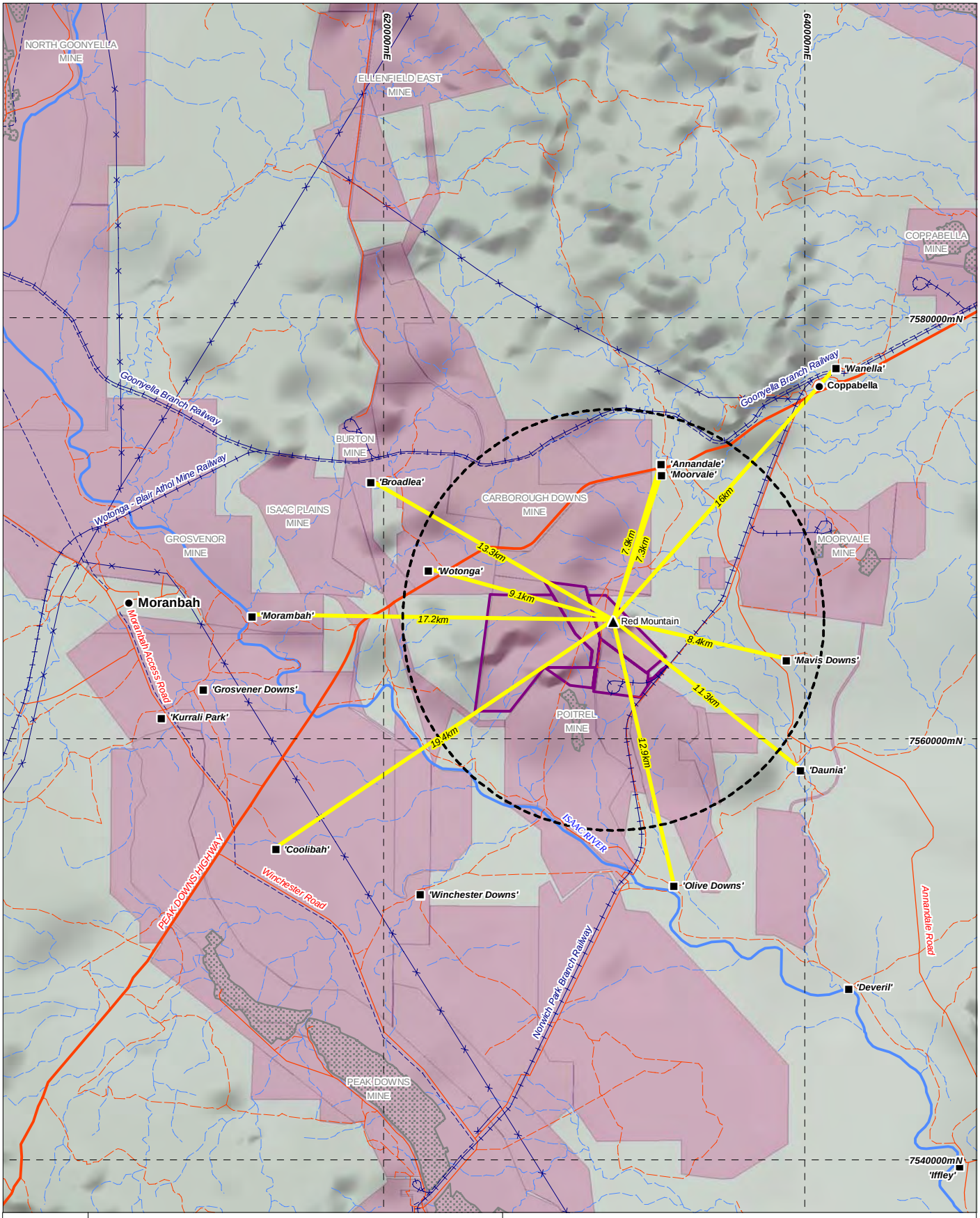
The nearest homesteads to the MEP are 'Tarkara', 'Mavis Downs', 'Poitrel', 'Olive Downs', 'Daunia', 'Broadlea', 'Moorvale' and 'Annandale' (**Figure 2**). 'Tarkari' is shown in **Figure 2** but is not a permanent residence as it is only periodically occupied.

There is one land user affected by the MEP within the operational land and 17 land users adjoining the operational land. The majority of land users potentially affected by the MEP are the owners of currently operational mines.

Moranbah has a population of 7,132 and is located 200 km south west of Mackay in Central Queensland and covers an area of approximately 3,065 km^2.

Situated 150 km south west of Mackay, Coppabella has a population of approximately 670 and covers an area of approximately 800 km^2. Both towns are situated in the northern part of the IRC and the Bowen Basin.

As described in **Section 4**, while Moranbah was established to service the local mines, Coppabella was established to service the associated rail network.



LEGEND

- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Powerline
- Pipeline
- River
- Watercourse
- Town
- Homestead
- Peabody tenement
- Other ML & MDL tenement
- Existing mine
- 10km radius from Red Mountain

Data Source:
Peabody tenement - Minserve. Other tenement - EEDI.
Topography (250k) - Geoscience Australia.

MET SERVE

Peabody

S:\Projects\PE001 Millennium Coal EIS_MapInfo\Workspaces\PE001_M203A.wor

Peabody Energy Australia Pty Ltd

Millennium Expansion Project

Location of Homesteads near the MEP

0 5 10

Kilometres

Scale: 1:250,000 (A4)

12/10/2010

Datum: GDA94
Projection: MGA55

FIGURE 15-2

6.1.1.2 Regional Study Area (RSA)

Statistics and information from the IRC have been included in this review of the RSA.

The RSA has a population of approximately 20,000 and covers an area of 58,586 km^2. The major towns in the region are Moranbah and Clermont. The area supports a mix of industries including coal production, cattle and cattle products, crop cultivation, sugar and tourism. Exports include mining and agricultural products which contribute significantly to Queensland's total exports. The economy continues to grow as more mineral deposits are developed and agricultural practices are modernised. Along the small coastal portion of the RSA there are a number of small commercial fishing enterprises and more recently aquaculture, crops and goat farming have been undertaken.

6.1.1.3 Mackay Study Area (MSA)

Statistics and information from the Mackay, Mirani and Sarina Shires have been used in reviewing the MSA.

The MSA has a population of approximately 166,000 and covers an area of 7,621 km^2. Mackay City is by far the largest residential area in the MSA. Mackay contains the largest coal exporting facility in the Southern Hemisphere, making the area a focal point for coal development. The MSA is also a major supplier of sugar cane and is home to seven sugar mills and one of Australia's four sugar refineries. The MSA also has the largest bulk sugar terminal in the world and Queensland's largest ethanol plant. Other rural activities include cattle grazing, dairy production, fruit processing, horticulture and fishing along the coastline and estuaries. The area also has a successful tourism industry, with approximately half a million visitors travelling to Mackay annually.

6.1.1.4 The State of Queensland Study Area

Queensland is Australia's second largest state, covering 1,722,000 km^2 and is Australia's fastest growing State with the resident population currently 4.09 million (M). It has boundaries with New South Wales, South Australia and the Northern Territory. It is also bounded by the Gulf of Carpentaria, Torres Strait and the Coral Sea in the north, and the South Pacific Ocean in the east.

The population of Queensland is concentrated in South East Queensland, which includes the capital city Brisbane as well as Logan City, Ipswich, Toowoomba, and the Gold and Sunshine Coasts. Other major regional centres include Cairns, Townsville, Mackay, Rockhampton, Bundaberg, Hervey Bay and Mount Isa.

Queensland has one of the strongest economies in Australia, with the State prospering through agriculture, mining and, more recently, tourism. However, from late 2008 to mid 2009 Australia and the majority of the world experienced a global financial crisis (GFC). At the time, the credit rating agency Standard and Poor's stated of the GFC that Queensland's 'projected deteriorating budgetary performance, which is a result of both declining revenues and structural operating expenditure', was a reason for downgrading the State's AAA rating to AA+ (Standard and Poor's, 2009). The current economic climate is discussed further in the following section.

7 ECONOMIC CLIMATE

At the beginning of 2007, Queensland was in the midst of an unprecedented economic growth period, mainly due to strong demand from China, India and Japan for the State's mineral resources. At the time, the boom translated into a boost for regional economies providing jobs, growth of local businesses and increasing populations. Between 2002 and 2007, Queensland experienced a 129% increase in the number of people employed in the mining industry (Department of Infrastructure and Planning, 2008a).

The global economic environment at the end of 2008 was shaped by slowing growth in developed countries alongside rising inflationary pressures throughout the developing world.

The growth in the mining sector would have had a major stimulatory impact on the Australian economy but for two factors. First, the Gregory effect saw the exchange rate appreciate, which caused a contraction in the rest of the economy. Secondly, the Reserve Bank of Australia increased interest rates in an attempt to offset the stimulatory effects of growth in the resource sector.

This cycle was also highly synchronised, with every significant country in the world affected. Household and business confidence collapsed simultaneously in every country by the start of 2009. Like all other economies, the Australian economy was very much affected.

The resulting economic downturn resulted in multiple job losses in Queensland in 2008 with the impact on the coal industry continuing throughout 2009. In addition to direct job losses, modelling current at the time suggested that in the Central Queensland region, for every job in mining, up to six jobs are created due to the high incomes associated with the mining industry and the propensity to spend (Rolfe, 2008). Therefore, losing 500 mining jobs from a regional economy means that in the longer term, the economy will contract by around 3,000 jobs.

The impact of these job losses were particularly felt in purpose-built mining towns like Glenden where even a small reduction in population has a range of short and long-term impacts, whereas regional hub towns such as Moranbah were more resilient because of their diversified economies.

Prior to the economic downturn, the resource sector in the Bowen Basin was responsible directly or indirectly for one in every four jobs (Queensland Resources Council, 2009).

The economic downturn also meant that the capital for investing in new projects or expanding existing operations has been more difficult to raise, resulting in some companies being forced to cut costs and postpone development plans (Heather, 2008).

At this time the Federal government enacted large fiscal stimulus packages, by borrowing and spending to offset the reduction in private sector demand caused by the crisis.

The economic conditions during the GFC presented an opportunity for the resources sector to strengthen and develop its infrastructure and its workforce for the future as prior to the economic downturn almost 4% of the Australian coal industry employees were nearing retirement.

A sustainable recovery appears to be underway in Australia with a favourable medium term outlook. The demand for resources from China and India could see mining investment remaining high for an extended period, possibly for decades.

The other driver of higher investment has been infrastructure. Total investment in infrastructure related industries (electricity, gas, water, transport and telecommunications) has risen by about 1.5 % of Australia's GDP over the past five years. Some of this infrastructure investment has been to service the resources sector, but faster population growth has also been a factor.

Since the decline in coal exports at the beginning of 2009, coal prices have returned to levels similar to the economic growth period of 2007. The economy continues to grow, in part reflecting the investment, export and population momentum set off by the China-fuelled resource expansion. Continued growth in China and India is expected to be the main driver of demand for the Australian economy over the next decade.

8 STATE GOVERNMENT INITIATIVES

In August 2008, the Queensland Government established the Sustainable Resource Communities Partnership Agreement in conjunction with the Local Government Association of Queensland and the Queensland Resources Council. The purpose of the agreement is to strengthen the partnerships between government, industry and local communities and improve the regulatory environment for SIA for new resource developments.

The agreement involves a $100 M funding program to be spent over three years for economic and social infrastructure in regional and rural communities in key mining areas.

In December 2008, a further $27 M of funding for key mining project areas was fast-tracked by Premier Anna Bligh to secure and create new jobs for Queensland communities.

Within the LSA, Moranbah benefited through the following initiatives:

- a $3.6 M expansion of Childcare Capacity in Bowen Basin areas including Moranbah (28 FTE jobs in total);
- a $3.5 M contribution for the Moranbah Affordable Accommodation Project which will deliver 45 new units (10 x one bed, 27 x two bed and eight x three bed);
- an emergency services upgrade;
- $1.6 M to the Moranbah Health Staff Accommodation for clinical staff with four units to be built in Moranbah and the surrounding areas. The provision of accommodation is anticipated to improve recruitment and retention rates for health industry staff; and
- $26.875 million, announced 22 January 2009, for fast tracked projects in the Bowen Basin to create new jobs.

In addition to the above, the Queensland Government hosted three Resource Community Summits to examine the current and future impacts of the growth in mining and gas utilisation in the Bowen Basin. Representatives from relevant government agencies, Queensland Resources Council, AgForce, industry representatives and key community stakeholders participated in the summits.

Key issues discussed at the summits were housing affordability, maintenance and funding for roads and the environmental and social impacts of mining. It was noted that the challenge facing communities in the Bowen Basin is to manage the short-term economic downturn whilst preparing strategies to reap potential financial benefits and to manage the social and economic impacts of the resource industry during the projected future growth (DIP, 2008b).

The first meeting of the Bowen Basin Local Leadership Group was held in August 2009 and is discussed further in **Section 9**.

9 POPULATION AND DEMOGRAPHIC PROFILE

The MEP is located within the existing IRC in the northern part of the Bowen Basin approximately 200 km south west of Mackay and 1,000 km north west of Brisbane. The existing Millennium Mine is located approximately 22 km east of Moranbah and 16 km south west of Coppabella.

9.1.1 Population

At the time of the Census in 2006, the population of the LSA was 7,931, the RSA was 19,882 and the MSA was 166,303 as detailed in **Table 1-1**.

Although Queensland has a higher proportion of females (50.5%), the LSA, RSA and MSA all have a higher ratio of males to females. This is likely due the large number of operational mines in the area, which have historically employed more males than females for their construction and operational workforce.

Table 9-1 Resident population in the LSA, RSA, MSA and Queensland by gender, 2006

Population by Gender	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Male	4,416	55.7	10,962	55.3	86,331	51.9	1,935,381	49.5
Female	3,515	44.3	8,860	44.7	79,972	48.1	1,969,153	50.5
TOTAL	**7,931**	**100**	**19,822**	**100**	**166,303**	**100**	**3,904,534**	**100**

Source: ABS, 2006

The differences in the male and female population of the LSA and RSA for the Census years 1996, 2001 and 2006 are detailed in **Table 1-2** and **Table 1-3** respectively. Historically, the male population has been higher than females, although over time the total percentage of males has decreased, possibly due to an increased female representation in the mining workforce.

Table 9-2 Resident population in the LSA 1996 - 2006

Population by Sex	1996*		2001		2006	
	Number	%	Number	%	Number	%
Male	4,571	57.9	4,225	56.8	4,416	55.7
Female	3,329	42.1	3,041	43.2	3,515	44.3
TOTAL	**7,900**	**100**	**7,266**	**100**	**7,931**	**100**

Source: ABS, 2006
*Data for Coppabella was not available

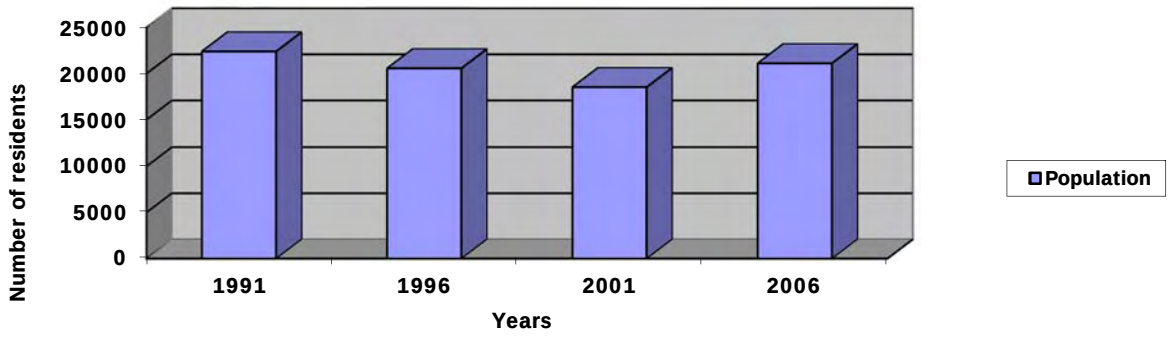
Table 9-3 Resident population in the RSA 1996 - 2006

Population by Sex	1996		2001		2006	
	Number	%	Number	%	Number	%
Male	11,559	55.9	10,976	57.7	10,962	55.3
Female	9,136	44.1	8,041	42.3	8,860	44.7
TOTAL	**20,695**	**100**	**19,017**	**100**	**19,822**	**100**

Source: ABS, 2006

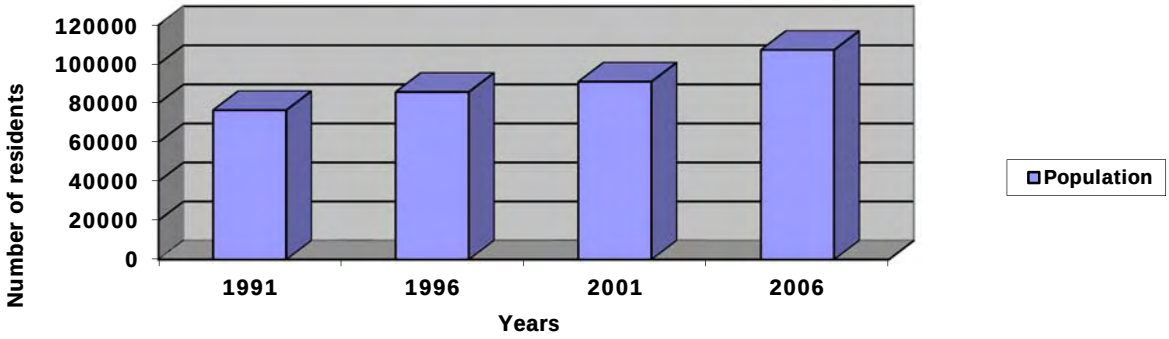
The following figures illustrate the resident populations in the RSA, MSA and Queensland from 1991-2006. Statistical data was not available for the LSA over this period. The data displayed in **Figure 3** shows that there was a significant decline in population from 1991 to 2001 in the RSA, after which time the RSA experienced a population boom, increasing by 4.2% in 2006.

Figure 4 shows that the MSA has experienced a constant increase in population from 1991 to 2006, with the rate of increase peaking in 2006. **Figure 5** indicates that this trend was similar for Queensland, which experienced an overall slower population growth rate from 1991 to 2001 followed by a significant rise by 2006.



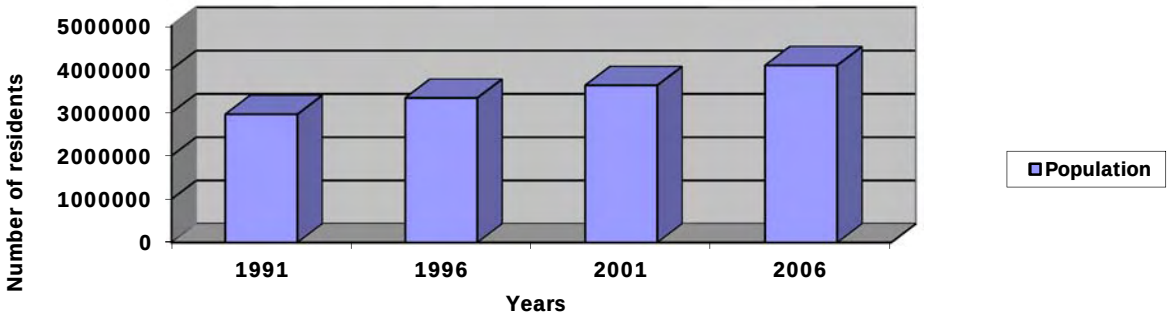
Source: DIP, PIFU, 2008

Figure 3 Resident population in the RSA from 1991-2006



Source: DIP, PIFU, 2008

Figure 4 Resident population in the MSA from 1991-2006



Source: DIP, PIFU, 2008

Figure 5 Resident population in Queensland from 1991-2006

Population projections released by the Department of Infrastructure and Planning (DIP), Planning Information and Forecasting Unit (PIFU) predict that between 2006 and 2031, the population of the RSA could increase from 21,113 people to 34,580, an increase of 63.8% (**Table 1-4**) although the rate of population change is predicted to slow after 2011. This trend is the same for the MSA and Queensland. There was no data available for the LSA.

Table 9-4 Population projections for the RSA, MSA and Queensland, 2006-2031

Population projections	RSA		MSA		Queensland	
	Total	Difference %	Total	Difference %	Total	Difference %
2006	21,113	-	107,332	-	4,090,908	-
2011	24,131	14.3	125,669	17.1	4,567,713	11.7
2016	27,436	13.7	144,463	15.0	5,040,325	10.3
2021	30,289	10.4	158,529	9.7	5,478,715	8.7
2026	32,432	7.1	166,958	5.3	5,884,439	7.4
2031	34,580	6.6	172,993	3.6	6,273,885	6.6

Source: DIP, PIFU, 2007

9.1.2 Demography

In contrast to the MSA and Queensland figures, **Table 1-5** shows that the resident population of the LSA in 2006 was highly mobile, with 51.3% of the population residing at a different address than in 2001. The majority of these residents moved to a different statistical local area (SLA) within Queensland. The RSA shows similar movements with 47.6% of the population residing at an alternate address in 2001.

Table 9-5 Place of usual residence in 2006, compared to 2001, in the LSA, RSA, MSA and Queensland

Place of usual residence	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Same usual address	2,534	35.3	6,826	38.0	43,098	45.8	1,644,415	45.1
Different address same SLA	1,004	14.0	2,126	11.9	15,963	17.0	334,258	9.2
Different SLA	2,679	37.3	6,396	35.7	24,220	25.7	1,217,767	33.4
Overseas	193	2.7	443	2.5	2,104	2.3	159,540	4.4
Not stated (a)	48	0.7	101	0.6	584	0.6	23,663	0.6
Not stated (b)	715	10.0	2,042	11.3	8,132	8.6	267,812	7.3
TOTAL	**7,173**	**100**	**17,934**	**100**	**94,101**	**100**	**3,647,455**	**100**

Source: ABS, 2006
a. Includes persons who stated that they lived at a different address five years ago but did not state that address.
b. Includes persons who did not state whether they were usually resident at a different address five years ago.

Many workers engaged in mining and associated infrastructure projects are non-resident workers who fly-in/fly-out (FIFO) or drive-in/drive-out (DIDO) from their permanent place of residence and only live within the LSA while working. These workers are part of the non-resident population of the area, which may also include day trippers, tourists and other short-term visitors.

A 2007 study by the PIFU found that non-resident workers currently account for a sizeable proportion of the working population. One in eight persons living in the Bowen Basin is a non-resident with non-resident workers occupying one in four jobs.

A survey of accommodation providers in July 2007 found that the IRC had a non-resident population of 7,197 persons. This non-resident population represented approximately 33.4% of the total resident population for the IRC (DIP PIFU, 2007).

The place of usual residence on census night in 2006 is provided in **Table 1-6**. There were an additional 2,138 people who spent extended periods of time in the LSA but whose usual place of residence was elsewhere. The RSA also has a large non-resident population with 5,524 people visiting the area. The LSA and RSA have significantly larger numbers of visitors from different SLAs compared to the MSA (6.0%) and Queensland (6.1%).

Table 9-6 Place of usual residence in the LSA, RSA, MSA and Queensland, 2006

Place of usual residence	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
At home	7,284	76.5	18,264	75.9	93,673	93.0	3,709,393	93.3
Visitor from same SLA	105	1.1	285	1.2	1,033	1.0	22,200	0.6
Visitor from different SLA	2,138	22.4	5,524	22.9	6,042	6.0	242,366	6.1
TOTAL	**9,527**	**100**	**24,073**	**100**	**100,748**	**100**	**3,973,959**	**100**

Source: ABS, 2006

Current demographic data, based on information from the 2006 Census and from the annual Estimated Resident Population data (both released by the ABS), provides an estimate of the number of usual residents within SLAs and LGAs. This data does not reflect non-resident population peaks, part-time residents or other visitors (which include workers in the area who live elsewhere, other temporary residents and holidaymakers).

The absence of accurate data on non-resident workers means that demand for infrastructure and services in these communities are consistently understated. While non-residents inject revenue into the local commercial economy and help to generate employment opportunities, they do not contribute to the cost of public infrastructure to meet the needs of visitors, such as roads, water, sewerage treatment, collection of waste and recreation facilities.

This inevitably impacts on the capacity of towns to finance the shortfalls in infrastructure and services and does not enable planners and decision-makers to better match resources with demand associated with population growth. However, the accommodation camps in the RSA do pay rates and should be included in the council planning process.

9.1.3 Age

Table 1-7 illustrates the proportion of the population in each age group at the time of the 2001 and 2006 Censuses. The 2006 Census indicates that the largest age group in the LSA is the 0-14 year old age group, followed by the 25-34 year old age group. The smallest group comprised people aged over 75 years.

In 2006, the median age in the LSA was 29 years, seven years less than the national median of 36 years, reflecting the working nature of the mining towns. Furthermore, 4,155 persons in the LSA were aged between 15 and 44 years. This is representative of a population that are employed in labour intensive industries such as mining, agriculture and their related support services.

Since the 2001 Census, the largest population increase in the LSA to 2006 was in the 55-74 year old age group (30.2%), followed by the 15-24 year old age group (29.2%). All age groups in the LSA experienced a growth in population except the 45-54 year old age group which declined 7.7% and the 75+ age group which experienced a 179.3% decrease. This decrease may reflect the lack of aged care facilities in the region. In contrast, from 2001 to 2006, the RSA experienced a decline in population in all age groups except 0-14 years which had a small increase of 1.5%. Similarly to the LSA, the RSA experienced a large population decline for persons aged 75+ years, again reflecting the lack of retirement accommodation in the region.

Table 9-7 Resident population in the LSA, RSA, MSA and Queensland by age, 2001 and 2006

Population by Age		LSA		RSA		MSA		Queensland	
		Number	% change	Number	% change	Number	% change	Number	% change
0-14 years	2001	1,754	+19.7	4,525	+1.5	20,874	+7.1	762,542	+5.8
	2006	2,099		4,591		22,347		806,536	
15-24 years	2001	855	+29.2	2,344	-2.9	11,783	+13.1	495,235	+8.9
	2006	1,105		2,279		13,324		539,201	
25-34 years	2001	1,261	+26.9	3,226	-4.4	12,176	+8.5	510,462	+2.6
	2006	1,600		3,089		13,205		523,597	
35-44 years	2001	1,265	+14.6	3,467	-13.9	13,901	+13.9	535,560	+7.5
	2006	1,450		3,045		15,827		575,568	
45-54 years	2001	1,111	-7.7	3,021	-22.7	12,195	+23.2	490,238	+10.0
	2006	1,032		2,461		15,019		539,184	
55-74 years	2001	473	+30.2	2,018	-8.1	14,422	+14.9	594,049	+17.3
	2006	616		1,867		16,566		696,979	
75 years +	2001	81	-179.3	358	-43.2	4,007	+21.2	197,553	+13.1
	2006	29		250		4,855		223,466	
Overseas Visitors	2001	8	--	55	--	516	--	69,500	--
	2006	n/a		n/a		n/a		n/a	

Source: ABS, 2006

9.1.4 Ethnicity

In general, Aboriginal and Torres Straight Islander groups differ from the general community as a whole in terms of their demographic, economic, social and cultural characteristics. Compared with the total population, they face a number of challenges relating to early childhood health and development, schooling achievement, substance abuse, economic development, and remoteness. These challenges have major implications for the Commonwealth and State Government who have responsibility for providing facilities and services to Indigenous communities.

In 2006, Queensland was home to over one-quarter of the Australian Aboriginal population, and almost two-thirds of all people who identified as being of Torres Strait Islander descent.

With a median age of 20 years, the Queensland Indigenous population is much younger than the median age of the non-Indigenous population of 36 years. The much younger age structure of the Indigenous population is largely a product of high rates of fertility and mortality compared with the non-Indigenous population.

Indigenous life tables for Australia (ABS, 2009) show that at the national level, life expectancy at birth for the period 1996–2001 was estimated to be 59.4 years for Indigenous males and 64.8 years for Indigenous females. The life expectancy of the Indigenous population is thus approximately 18 years less than that of the total Australian population.

The LSA holds a relatively small Indigenous population at 0.2% of the Queensland population. Indigenous people comprise 0.4% of the RSA's population and 6.3% of the MSA population (**Table 1-8**). The largest Indigenous population age group for all areas is the 0-14 year olds followed by the 15-24 year olds. In all the study areas the Indigenous population decreased with an increase in age.

Table 9-8 Indigenous population in the LSA, RSA, MSA and Queensland by age, 2006

Indigenous Population by Age	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
0-14 years	48	30.2	150	35.5	2,427	39.7	37,675	39.0
15-24 years	40	25.2	90	21.4	1,102	18.0	17,513	18.2
25-34 years	31	19.5	58	13.7	791	12.9	13,141	13.6
35-44 years	21	13.2	66	15.7	736	12.0	12,142	12.6
45-54 years	14	8.8	32	7.6	574	9.4	8,286	8.6
55-64 years	5	3.1	17	4.0	297	4.9	4,657	4.8
65 years and over	0	0.0	9	2.1	189	3.1	3,083	3.2
TOTAL	**159**	**100**	**422**	**100**	**6,116**	**100**	**96,497**	**100**

Source: ABS, 2006

Of the LSAs resident population in 2006, only 159 persons (2.0%) identified themselves as Indigenous. This percentage, although similar to the percentage of Indigenous people in the RSA, is lower than those recorded for the MSA (3.9%) and Queensland (3.3%) (**Table 1-9**).

The difference between the 1996 and 2001 census counts of Indigenous persons, as recorded on census forms, was significantly larger than would be expected based on demographic factors, i.e. the increase cannot be fully accounted for by natural increase (births minus deaths) and net migration over the inter-census period. The reasons for these unexpected increases in Indigenous census counts are varied and include changes in who completed the form, changes in attitudes toward Indigenous identification in the census, and improvements in census procedures (ABS, 2009).

Table 9-9 Indigenous status in the LSA, RSA, MSA and Queensland, 2006

Population	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Indigenous	159	2.0	422	2.1	3,935	3.9	127,580	3.3
Non-Indigenous	7,065	89.1	17,329	87.4	89,467	88.6	3,552,041	91.0
Not stated	708	8.9	2,071	10.5	7,615	7.5	224,910	5.7
TOTAL	**7,932**	**100**	**19,822**	**100**	**101,017**	**100**	**3,904,531**	**100**

Source: ABS, 2006

9.1.5 Marital Status

The number and proportion of people in each marital status group in the LSA, RSA, MSA and Queensland for 2001 and 2006 are outlined in **Table 1-10** and **Table 1-11** respectively. The statistical data for 2001 and 2006 is categorised slightly differently with persons classified as being in a de facto marriage having a separate category in the data for 2006. The percentage of married persons in the LSA in 2001 (60.1%) was higher than the Queensland percentage at 51.1% in 2001. This trend continued in 2006, but the margin was smaller.

Between 2001 and 2006 in the LSA, the percentage of people who had never been married increased from 29.5% to 31.7%. This trend was replicated in the other study areas.

Between 2001 and 2006, the percentage of persons who had separated remained almost the same in the LSA and decreased in all other areas. The percentage of persons who have never married increased from 2001 to 2006 across all study areas, but most significantly in the RSA. This may be a reflection of the increased numbers of single persons moving into the area to pursue a career in mining and its related industries.

Table 9-10 Marital status in the LSA, RSA, MSA and Queensland, 2001

Marital Status	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Married	3,023	60.1	8,678	59.9	37,320	54.1	1,472,893	51.1
Separated	135	2.7	429	3.0	2,451	3.6	107,077	3.7
Divorced	287	5.7	866	6.0	5,230	7.6	227,234	7.9
Widowed	99	2.0	408	2.8	3,815	5.5	167,104	5.8
Never married	1,483	29.5	4,106	28.3	20,139	29.2	909,873	31.5
TOTAL	**5,027**	**100**	**14,487**	**100**	**68,955**	**100**	**2,884,181**	**100**

Source: ABS, 2006

Table 9-11 Marital status in the LSA, RSA, MSA and Queensland, 2006

Marital Status	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Married in a registered marriage	3,137	47.9	6,584	44.2	35,600	44.1	1,369,700	42.4
Married in a de facto marriage*	715	10.9	1,633	11.0	7,661	9.5	283,557	8.8
Separated	189	2.9	453	3.0	2,344	2.9	102,903	3.2
Divorced	379	5.8	1,086	7.3	6,512	8.1	278,849	8.6
Widowed	68	1.0	304	2.0	3,997	5.0	167,311	5.2
Never married	2,055	31.5	4,825	32.4	24,561	30.4	1,029,323	31.8
TOTAL	**6,543**	**100**	**14,885**	**100**	**80,675**	**100**	**3,231,643**	**100**

Source: ABS, 2006
*Includes same sex couples

9.1.6 Family and Household Structure

A breakdown of family structure for the LSA, RSA, MSA and Queensland in 2006 is provided in **Table 1-12**. The most prevalent family type in the LSA is 'Couple with children under 15' while within the RSA and the MSA it is 'Couple with no children under 15'.

The proportion of 'Couple with no children under 15' in the RSA and MSA is significantly greater than the LSA and Queensland average for this family type.

In comparison, the proportion of 'One parent family with children under 15' within the LSA, RSA and MSA are all lower than the Queensland average.

Table 9-12 Family composition in the LSA, RSA, MSA and Queensland, 2006

Family composition*	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Couple with no children	605	32.0	1,660	24.2	10,223	28.4	403,854	39.1
Couple with children under 15	929	49.1	2,161	31.5	9,243	25.8	321,584	31.2
Couple with no children under 15	194	10.3	2,627	38.2	12,631	35.2	125,156	12.1
One parent family with children under 15	85	4.5	234	3.4	2,137	5.9	98,071	9.5
One parent family with no children under 15	61	3.2	141	2.1	1,408	3.9	66,148	6.4
Other family	17	0.9	46	0.6	298	0.8	17,221	1.7
TOTAL	**1,891**	**100**	**6,869**	**100**	**35,940**	**100**	**1,032,034**	**100**

Source: ABS, 2006
*Persons usually resident

9.1.7 Dwelling Structure

In 2006, 'Separate house' accounted for 88.7% of all dwellings in the LSA. This number was slightly higher for the RSA where separate houses accounted for 90.4% of all dwelling types. These figures were higher than the MSA and Queensland where separate houses accounted for 84.2% and 85.7% of all dwelling types, respectively (**Table 1-13**).

The next most prevalent dwelling type in the LSA and RSA was 'Other dwelling' (including caravans, cabins, improvised homes, tents and houses/flats attached to shops or offices). The second most common dwelling type in the MSA and Queensland was 'Flat, unit or apartment'.

Table 9-13 Dwelling structure in the LSA, RSA, MSA and Queensland, 2006

Dwelling Structure	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Separate house	2,058	88.7	5,402	90.4	28,623	84.2	3,093,535	85.7
Semi-detached, row or terrace house, townhouse	60	2.6	70	1.2	1,415	4.2	210,963	5.8
Flat, unit or apartment	88	3.8	208	3.5	3,109	9.2	267,233	7.4
Other dwelling *	113	4.9	292	4.8	805	2.3	37,606	1.0
Dwelling structure not stated	0	0.0	5	0.1	18	0.1	2,440	0.1
TOTAL	**2,319**	**100**	**5,977**	**100**	**33,970**	**100**	**3,611,777**	**100**

Source: ABS, 2006
* Caravan, cabin, improvised home, tent and house or flat attached to shop or office

Table 1-14 indicates that of the dwellings in the LSA and RSA in 2006, more than half were being rented (50.4% and 50.3% respectively). This is higher than the average for Queensland at 31.1%. In addition, 67.8% of these rentals in the LSA and 67.8% in the RSA were through 'Other landlord type' comprising dwellings being rented through a residential park (including caravan parks), and employer (government) or employers (private). By comparison, only 6.6% of all rentals in Queensland were through this type of rental. In the LSA, 24.4% dwellings were fully owned and 21.7% were in the process of being purchased compared to 31.6% and 33.8% respectively for Queensland.

The RSA had the lowest percentage of dwellings being purchased at 16.2%. This may be a direct reflection on the number of dwellings available on the market for purchase and the low number of building approvals (**Table 1-14**).

The higher level of rentals and lower level of home ownership within the LSA and RSA, compared with Queensland, is also reflective of the more transient nature of the population in the local community.

Table 9-14 Tenure and landlord type in the LSA, RSA, MSA and Queensland, 2006

Tenure and Landlord Type	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Fully owned	**565**	**24.4**	**1,741**	**29.1**	**11,206**	**33.0**	**439,677**	**31.6**
Being purchased including rent/buy scheme	**502**	**21.7**	**966**	**16.2**	**12,029**	**35.4**	**470,114**	**33.8**
Rented:								
Real estate agent	*145*	*12.3*	*282*	*9.4*	*4,299*	*45.0*	*220,041*	*50.9*
State or territory housing authority	*95*	*8.0*	*172*	*5.7*	*1,259*	*13.2*	*47,878*	*11.1*
Person not in same household (a)	*79*	*6.7*	*256*	*8.5*	*2,753*	*28.8*	*113,065*	*26.2*
Housing co-operative/ community/ church group	*10*	*0.9*	*29*	*1.0*	*242*	*2.5*	*9,997*	*2.3*
Other landlord type (b)	*792*	*67.8*	*2,066*	*68.7*	*654*	*6.8*	*28,595*	*6.6*
Landlord type not stated	*51*	*4.3*	*204*	*6.7*	*352*	*3.7*	*12,720*	*2.9*
TOTAL RENTED	**1,166**	**50.4**	**3,009**	**50.3**	**9,559**	**28.1**	**432,296**	**31.1**
Other tenure type	24	1.0	99	1.7	253	0.7	11,723	0.8
Tenure type not stated	57	2.5	164	2.7	924	2.8	37,822	2.7
TOTAL	**2,314**	**100**	**5,979**	**100**	**33,971**	**100**	**1,391,632**	**100**

Source: ABS, 2006
(a) Comprises dwellings being rented from a parent/other relative or other person
(b) Comprises dwellings being rented through residential parks, employer-government and employer-other

10 LOCAL COMMUNITY VALUES, VITALITY AND LIFESTYLE

Community identity is about how a community is perceived by others. A great deal of community identity is based on the beliefs people have regarding what they are known for outside their own locale or group. Communities often attempt to develop and project identities that they believe will stimulate positive social and economic development by attracting tourists, residents and investment in a manner consistent with existing lifestyles and aspirations (Rolfe *et al.*, 2003).

The Socio-Economic Index for Areas (SEIFA), developed by the ABS, has four indexes that explore different aspects of socio-economic conditions for every geographic area in Australia. Each area is given a SEIFA score which shows how advantaged/disadvantaged that area is compared with other areas in Australia.

The index used for the purpose of this report is the Index of Relative Socio-economic Advantage and Disadvantage which considers different aspects of the socio-economic conditions of people living in an area and is derived from Census variables relating to areas such as income, education and employment.

The score shown on a SEIFA index is for the area, not an individual. High scores on the SEIFA occur when there are low levels of disadvantage and low scores when high levels of advantage occur.

Moranbah is ranked 1,576 out of 1,897 suburbs in Queensland (**Table 1-15**) indicating a lack of disadvantage in this area.

Table 10-1 Index of Relative Socio-economic Advantage and Disadvantage compared to Queensland, 2006

Local Government Authority 2006	Score	Ranking in Queensland		
		Rank	Deciles/Ranking	Percentile
Belyando	1,025	152	10	97
Broadsound	1,001	143	10	91
Nebo	991	137	9	87
State Suburb 2006*				
Moranbah	1,047	1,576	9	84

Source: ABS, SEIFA Index, 2006
*There was no data available for Coppabella

Throughout the stakeholder and community engagement process for the MEP, local residents and organisations were encouraged to provide comments regarding community values and any issues or concerns they may have regarding the MEP (Appendix E of the EIS).

To ascertain important community values and how local residents perceive their lifestyle, a small sample community survey was undertaken at Community Information Days in Clermont (Clermont Show) and Moranbah (Lions Market). Comprehensive details of the survey are provided in Appendix E of the EIS. The following provides a summary of the findings.

The majority of respondents felt that their quality of life in the area in which they lived was either 'very good' or 'good'. Overall, they enjoyed living in a small town environment and the sense of community lifestyle. They also liked the relaxed and quiet way of life and felt that the areas were a great place for families and raising children.

Areas where respondents felt some improvement was needed were the variety of shops available, entertainment and, in general, facilities and services.

The high number of respondents who had been living in the area for more than one year but less than five years were more likely to be involved with the mining industry and associated support services. This is reflective in the number of respondents who said that they were attracted to the region for employment reasons.

The vast majority of the respondents who had lived in the area for more than 20 years were born and raised locally and have chosen to remain in the area. These respondents are more likely to be involved in the agricultural industries of the region with strong, often multi-generational ties to the land.

Although the largest group of respondents, 24%, stated they would remain in the area for more than five years but less than 10 years, 19% of respondents did not know how long they would remain living in the area. The main reason given was the uncertainty of employment.

There were no areas of major concern regarding the implementation of the MEP, however, people did feel that there may be increased traffic levels on local roads. They also felt that the cumulative effects of other mining projects in the area would put increased pressure on local services, such as emergency support and health care and also have an affect on housing and accommodation, which is already a major concern due to the lack of land available for residential development.

It was felt that the MEP would have a positive effect on training and employment and would benefit the local economy.

The first meeting of the Bowen Basin Local Leadership Group was held in Blackwater during July 2009. This group was established under the Queensland Government's Sustainable Resource

Communities Partnership Agreement and included representatives from local councils, mining companies and community members.

In parallel to the community survey results, the two areas that were raised at this meeting that were of most concern were the availability of health care services and affordable housing. Other issues identified at the meeting included the impacts of population growth, availability of land for residential development, regional planning, key transport infrastructure including road and rail, and land access concerns

As Moranbah and Coppabella are situated only two hours from Mackay, the communities have the benefit of a rural lifestyle, whilst having access to a major coastal town.

The question of whether residents have plans to remain in their community provides a good indication of how satisfied they are with life in that location. Only one third of all respondents in the Bowen Basin's Community Residents Survey (University of Queensland Social Research Centre, 2003) stated that they intended to remain in their community for more than five years.

Furthermore, respondents claimed that reasons they would consider moving out of the region included such things as being close to work, close to schools, good value housing, availability of recreational and shopping facilities, size of community, appearance of community and housing and closeness to family and friends. These findings demonstrate that older residents showed much stronger attachment to their community. The importance of good schools also effects people's decisions about where to live and also appears to influence the length of residence.

11 COMMUNITY INFRASTRUCTURE, SERVICES, ACCESS AND MOBILITY

Infrastructure can be defined as the basic physical and organisational structures needed for the operation of a society or enterprise. The term typically refers to the technical structures that support a society, such as roads, water supply, sewers, power grids and telecommunications (Oxford Dictionary, undated). Infrastructure is the base upon which economic growth is built and a community builds its future.

11.1.1 Transport

Table 1-16 demonstrates that in all areas the most popular method of travel to work is by car, as the driver. The lack of use of public transport services is apparent in the LSA, RSA and MSA with a very small percentage of the population using this method of transport. This is probably due to the remote location, lack of a passenger rail service from Mackay into the IRC area and a limited bus service. A larger amount of people walked to work in the LSA (6.1%) and the RSA (7.0%) compared with Queensland generally (4.0%). This may be due to a large number of local residents being employed in the LSA and living close to their place of employment.

Table 11-1 Method of travel to work in the LSA, RSA, MSA and Queensland, 2006

Method of travel to work	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Bicycle	41	1.0	107	1.1	664	1.4	20,580	1.1
Bus	89	2.1	229	2.3	860	1.8	52,275	2.9
Car, as driver	2,328	54.4	5,251	51.6	30,657	65.7	1,102,483	61.0
Car, as passenger	634	14.8	1,253	12.3	3,814	8.2	129,048	7.2
Motorbike/Scooter	21	0.5	56	0.5	511	1.1	20,071	1.1
Taxi	3	0.1	10	0.1	130	0.3	4,531	0.3
Train	0	0.0	8	0.1	16	0.1	36,044	2.0
Truck	44	1.0	124	1.2	723	1.6	29,283	1.6
Walked	261	6.1	714	7.0	360	0.8	72,981	4.0
Worked at home	123	2.9	651	6.4	2,304	4.9	93,580	5.2
Not worked	615	14.4	1,385	13.6	5,373	11.5	197,359	10.9
Method of travel other/not stated	116	2.7	387	3.8	1,217	2.6	47,948	2.7
TOTAL	**4,275**	**100**	**10,175**	**100**	**46,629**	**100**	**1,806,183**	**100**

Source: ABS, 2006

In a University of Queensland Social Research Centre report on the Bowen Basin Communities Residents Survey (2003), 70% of respondents claimed that the service with which they were least satisfied was public transport.

11.1.1.1 Vehicles

The existing traffic volumes for the Peak Downs Highway for 2008 have been provided by the Department of Transport and Main Roads (DTMR) (EIS Chapter 8, Transport). The Average Annual Daily Traffic Volumes (AADT) and the percentage of heavy vehicles are also provided in this chapter for the relevant sections of Peak Downs Highway.

There are limited road-based public transport facilities in the LSA. There are two bus routes using the Peak Downs Highway that service the three schools in Moranbah. Route P1348 uses the Peak Downs Highway between Moranbah and Wuthung Road in Clermont and Route S359 uses the Peak Downs Highway between Coppabella and Moranbah.

A bus service owned by Emerald Coaches with a long-term contract to Queensland Transport, runs between Mackay and Emerald daily and stops at both Clermont and Moranbah.

11.1.1.2 Road

The Peak Downs Highway is the predominant road infrastructure in the vicinity of the MEP. The highway is a State controlled road (SCR) and is part of Queensland's Strategic Road Network, connecting Mackay, Nebo, Moranbah and Clermont. It is a sealed, two-lane, two-way carriageway with occasional passing lanes. The maximum speed limit is 100 kilometres per hour (km/hr). It allows all multi-combination vehicles including Type 1 Road Trains, 23 metre (m) and 25 m B-Doubles from Clermont to the top of the Eton Range. From the Eton Range to Mackay, B Doubles are the only multi-combination vehicle allowed on the Peak Downs Highway.

Local roads in the vicinity of the MEP are controlled by the IRC.

The access road to the MEP is a private, sealed, 3.5 m wide, single-lane carriageway built to the appropriate standards at the time of construction. The maximum speed limit is 80 km/hr. Coal would be hauled to the Coal Handling and Preparation Plant (CHPP) via an internal network of haul roads and would therefore not impact any SCR or the access road.

As part of the Sustainable Resource Communities Partnership Agreement, a funding boost provides an extra $5 M for passing lane works on the Peak Downs Highway. This amount significantly bolstered the 4.8 km $6.75 M upgrade already announced by the Minister for Main Roads in November 2008. These upgrades will result in safer stretches of highway, especially for workers moving between the mines and the coast, as well as associated support industries that utilise heavy vehicles and wide loads.

Further information and an assessment of traffic impacts can be found in EIS Chapter 8, Transport.

11.1.1.3 Rail

There is no direct passenger train service to the LSA.

The North Coast Main Line, serviced by QR, runs from Brisbane to Cairns with a station in Mackay. Rail access to the Mackay hinterland is provided by a connection at Yukan, around 40 km south of Mackay to the Goonyella Coal System. This forms part of QR's integrated system serving the coal terminals at Hay Point and Dalrymple Bay. Materials and equipment are transported to and from Mackay and the coalfields. The rail line is also used to transport grain and agricultural produce from the Clermont area (Department of Transport, 2002).

QR is proposing to construct and operate a 69 km rail link between the North Goonyella and Newlands rail systems in the northern Bowen Basin coalfields. The rail link, commonly referred to as the Northern Missing Link, will give mining companies an alternate coal transport route by allowing coal trains originating in Central Queensland to ship coal to the port of Abbot Point, near Bowen.

In June 2007, the Queensland Government announced that it had reached an agreement with property owners to acquire the land for the proposed Northern Missing Link rail corridor. Construction will begin in May 2010 with completion targeted for January 2012 (QR Network, 2010).

11.1.1.4 Port

The Port of Hay Point is situated 40 km south of Mackay and is one of the largest coal exporters in the world. The port has two separate coal export terminals, Dalrymple Bay Coal Terminal (DBCT), leased from the Queensland Government by Babcock & Brown Infrastructure (BBI) and the Hay Point Coal Terminal (HPCT), owned and operated by BMA. Both terminals serve the coal mines of Central Queensland and are linked through an integrated rail-port network using the Goonyella System.

Completion of the Northern Missing Link rail line would provide mining companies in Central Queensland with the flexibility to ship coal to the Port of Abbot Point. Abbot Point is Australia's most northerly coal port and is situated around 25 km north of Bowen. The port is operated by Abbot Point Bulk Coal Pty Ltd, a subsidiary of Xstrata Coal Queensland Pty Ltd.

On 1 July 2009, Mackay Ports Limited (MPL) and Ports Corporation of Queensland Limited (PCQ) merged to become North Queensland Bulk Ports Corporation Limited (NQBP). NQBP is a State Government-owned corporation and is the Port Authority for the Ports of Abbot Point, Hay Point, Mackay, Weipa and Maryborough.

The Abbot Point Coal Terminal X110 Expansion Infrastructure Development Project Draft Voluntary Environmental Assessment (GHD, 2009) sought approval for expansion of the Port of Abbot Point to accommodate 110 MT/y of coal by mid-2015.

There are no passenger ports servicing the region.

11.1.1.5 Air

A private airport is located at Moranbah. From February 2009, Moranbah did not have a regular air service, with Qantaslink starting commercial flights to Moranbah in September 2009.

A daily flight service is also available from Brisbane to Mackay Airport and vice versa. On arrival in Mackay there is a two hour drive into Moranbah and its surrounds.

11.1.2 Water

SunWater constructed a pipeline from the Burdekin River to Moranbah to supplement existing water supplies. This extension enabled the Queensland coal mining industry to better plan for future expansions. The 218 km pipeline, costing $280 M, was fully commissioned in August 2007 and can transport around 17,000 megalitres (ML) of water per annum (SunWater, 2009). It includes a 50 km eastern pipeline from Moranbah to Coppabella and a 70 km southern pipeline from Moranbah to Dysart (DIP, 2010), providing sufficient water supplies for communities in the LSA and RSA for the foreseeable future.

11.1.3 Telecommunications

Reliable, accessible and affordable telecommunication infrastructure and services are essential to maintaining family, social, and professional links. They reduce perceptions of isolation and remoteness and can have a significant impact on individual and family decisions to live and work in regional areas.

The Australian Government has recently announced the establishment of a company that will invest up to $43 billion over the next eight years to build and operate a wholesale-only, open access National Broadband Network (NBN) providing ultra high-speed broadband via optic fibre to home, schools and workplaces, supplemented by next generation wireless and satellite technologies in regional and rural areas. As part of the NBN process, a submission was prepared in 2009 on behalf of the Mackay Whitsunday Isaac Region of Central Queensland that strongly supported the initiative (Stapleton, 2009).

Moranbah and Coppabella have a range of wireless and Asymmetric Digital Subscriber Line (ADSL) telecommunication connections. At present, Telstra has in place a fibre optic backbone running up through the Isaac Region, however due to cost constraints, Clermont is the only town currently connected.

11.1.4 Sewerage

A sustainable community has a functioning and well managed sewerage infrastructure. Sewage waste and wastewater in Moranbah and Coppabella are disposed of through a sewerage reticulation system which involves transport of wastewater off-site through pipes (sewers) and treatment in a sewage treatment plant. The wastewater is then discharged to local waterways.

In anticipation of latent demand for accommodation associated with coal development, the Queensland Government approved funding for a substantial upgrade of water and sewerage services in Coppabella in 2002 with no further major upgrades to towns within the LSA since this time. The MEP would not increase demand on sewerage infrastructure.

11.1.5 Emergency Services

11.1.5.1 Police Service

The LSA is serviced by the Moranbah Police Station. Police officers carry out general policing duties including highway patrols and traffic enforcement.

The Moranbah Police Station currently has nine full-time and two part-time uniformed police officers and two plain clothes police officers. The service has three marked and one unmarked police vehicles.

The most common incidents for which the police are called out in the Moranbah area are public nuisance offences such as dangerous driving and drunk and disorderly conduct. In addition, there has been an increase in the need for emergency services to respond to road accidents in the area. It has been suggested that this increase in accidents is in part related to increasing numbers of mine shift workers using local roads, and the increase in the number of fuel carriers transporting fuel to the mines. Other policing activities are typically related to call-outs in response to criminal activities (Moranbah and Glenden Police Service pers. comms. 2009). Crime details are provided in **Section 25**.

11.1.5.2 Ambulance Service

Moranbah is serviced by an Ambulance Service which covers the area from Dysart, 70 km to the south-west, through to Coppabella. In addition to emergency services, the ambulance service also provides assistance for the Central Queensland Rescue Helicopter and assists with patient transport from the Moranbah Hospital to the Mackay Base Hospital. There is one ambulance station at Moranbah, whilst Coppabella has a volunteer service that is equipped to deal with minor cases only.

Moranbah Ambulance Service has four crew members on an eight day on, six day off roster with all members working together on a Thursday. Operating hours are from 8am to 6pm daily with emergency service available from 6pm to 8am. The service currently has three vehicles which are equipped with up to date technology, including defibrillators and global positioning system (GPS) devices. The Station's calls are answered centrally at the Rockhampton Communications Centre (Moranbah and Glenden Ambulance Service pers. comms. 2009).

11.1.5.3 Fire Service

The Queensland Fire and Rescue Service (QFRS) services Moranbah and the surrounding areas through 18 auxiliary fire-fighters and two QFRS vehicles. They are called via pager to attend to any emergency response situation. Currently the QFRS's main emergency response workload is to traffic accident situations.

The Area Director of QFRS has indicated that any increase in the population would inevitably increase the number of vehicles on the road with the potential to increase the officer's main workload (or response). At this point in time the QFRS does not intend to recruit more staff (Moranbah Fire and Rescue Service pers. comms. 2009).

As mining companies are bound by their own legislation with regard to emergency response, responses to mine sites for QFRS assistance is by request only.

In December 2008, $27 M of funding for key mining project areas was fast-tracked by the Queensland Premier to secure and create new jobs for Queensland communities. Part of this funding will be spent on the Moranbah Emergency Services Centre with an upgrade of existing facilities and accommodation.

11.1.5.4 State Emergency Service

The State Emergency Service (SES) based in Moranbah, is administered by eight volunteer members who are fully trained to assist with emergency situations that may occur, if required.

11.1.6 Community Services

11.1.6.1 Emergency and Long-term Accommodation in Moranbah

Emergency and Long-term Accommodation in Moranbah (ELAM) provides services to assist families and individuals in a housing crisis. The organisation provides short-term crisis supported accommodation and manages long-term community housing. ELAM has applied to the Department of Communities (DoC) for additional funding to upgrade two current staff positions from part-time to full-time.

Long-term community housing comes under the 'One Social Housing' banner of the DoC. The services provided by ELAM are primarily funded by the DoC. The Youth Development Officer position operates within this organisation and is funded by the DoC and the BMA through the Community Partnerships program. Other services provided by ELAM include:

- Centrelink;
- emergency relief;
- advocacy and liaison; and
- referral to other relevant services.

The properties that form the emergency accommodation service for persons in housing crisis and funding for wages and operating costs are provided by the DoC. ELAM provides assistance to a wide range of people in various circumstances including:

- people unable to find affordable housing;
- women and children escaping family violence; and
- separated parents remaining in the region voluntarily or by court order.

There are 19 dwellings available in Moranbah consisting of one bedroom units, two and three bedroom duplexes and three bedroom houses. The crisis program is available for three-month placements which can be extended under certain criteria. Long-term community housing is available for a maximum of one year.

ELAM indicated that if there was an influx of additional workers and families in the area the current services provided by ELAM may not be adequate to provide a full service to the community (ELAM pers. comms. 2009). It is highly unlikely that Peabody employees would require ELAM services.

As part of the government's commitment to providing funding for affordable accommodation, a $3.5 M contribution is being made to the Moranbah Affordable Accommodation Project which will deliver 45 new units (10 x one bed, 27 x two bed and eight x three bed). This project is targeted to be completed by the end of 2010.

11.1.6.2 Domestic Violence Resource Service (Mackay and Region)

The Domestic Violence Resource Service (Mackay and Region), a non-profit organisation funded solely by the DoC is based in Mackay and serves the region from the Whitsundays in the north, St Lawrence in the south and to Moranbah in the west.

The service provides domestic violence awareness, education and training, resourcing, and counselling across the region and targets women and children affected by domestic violence.

11.1.6.3 Moranbah and District Support Services

The Moranbah and District Support Services in Moranbah is a non-profit organisation fully funded by the DoC that employs two full-time staff members. A Rural and Family Support Worker's primary role is to offer counselling and other family type support to children and families aged 0-18 years. The Community and Individual Support Worker offers domestic violence support and emergency relief support including crisis intervention. The role also engages the community and offers 'Women in Business' breakfast events, 'Welcome to Moranbah' morning teas and information packs (Moranbah and District Support Services pers. comms. 2009).

11.1.6.4 Support Services

A number of additional support services are available in the LSA. These include, but are not limited to:

- the Moranbah Cancer Support Social Group;
- Centacare - a personal relationships and family counselling employee assistance program. Special workshops can be arranged as needed e.g. substance abuse, anger management;
- Rural Youth Information Service - a referral service for young people aged 12-25 years to provide assistance with health, mental health, welfare, education, drug and alcohol, unemployment and young women's issues;
- Gam-Anon Support group for family and friends of those with a gambling problem;
- Al Anon - a self supporting fellowship of relatives and friends of alcoholics or problem drinkers who meet regularly to give support to each other;
- Rural Family Support - provides a personal support service, information, referral service for individuals, families and communities to access services, counselling to youth aged 0-18 years and families;

- Compassionate Friends - a support group for individuals and families coping with grief, especially parents who have lost children; and
- the Glenden Community Support Group.

Although there are no churches in Coppabella, there are five churches located in Moranbah. These churches conduct regular services and provide assistance to elderly people in Moranbah and the surrounding areas, as well as limited counselling services.

No other religious places of worship are located in Moranbah or Coppabella.

11.1.7 Services and Facilities

Moranbah offers a number of services and facilities, in addition to those mentioned in **Section 12** to **Section 15**. In Coppabella, the General Store also serves as the newsagency and post office with no other services and facilities available. The additional services and facilities available in Moranbah and Coppabella are provided in **Table 1-17**.

Table 11-2 Services and facilities, Moranbah and Coppabella

Services and Facilities	Moranbah	Coppabella
Coles Supermarket	✓	×
General Store	×	✓
Newsagents	✓	✓
Post Office	✓	✓
Car Hire	✓	×
Airport	✓	×
Beauticians/Hairdressers	✓	×
Bakery	✓	×
Furniture and Electrical Store	✓	×
Restaurants	✓	×
Cafes/Take Aways	✓	×
Hotels/Motels	✓	×
Caravan Parks	✓	×
Shoe and Clothing Shops	✓	×
Entertainment – Cinema	✓	×
Industrial Services	✓	×
Pharmacy/Health Services	✓	×
RACQ	✓	×
Veterinarian	✓	×
Accountants	✓	×
Banks/Building Societies	✓	×
Butcher	✓	×
Computers/Internet Café	✓	×
Laundromat	✓	×
Real Estate	✓	×
Travel Agent	✓	×
Court House/Government Agents	✓	×
Gift Stores	✓	×
Music Store	✓	×
Plumbers	✓	×
Produce stores	✓	×
fForist	✓	×
Hardware	✓	×
Mechanical and Tyre Repairs	✓	×
Service Station	✓	×
Tourism Information Centre	✓	×

The IRC is considering the inclusion of a smaller shopping centre in the new Isaac Views Residential Development in Moranbah with 3,080m^2 of land being allocated. The IRC is also locating a skate park in the north east corner of the central business district and trying to attract Woolworths to purchase land beside the swimming pool.

The Queensland Industrial Relations Commission gave approval for Moranbah to introduce seven day trading from August 2009, making shopping more convenient for miners working shift work as well as the local community. Moranbah is now the second town in Central Queensland to have extended trading hours, the other town being Yeppoon. The National Retail Association also commented that extended trading will boost employment in Moranbah (Australian Broadcasting Corporation News, 2009).

12 RECREATIONAL, CULTURAL, LEISURE AND SPORTING FACILITIES AND ACTIVITIES

As Coppabella is a small town, it does not provide any recreational, cultural, leisure or sporting activities. Facilities and recreational activities available at Moranbah are described in **Table 1-18**.

Table 12-1 Recreational, Cultural, Leisure and Sporting Activities in Moranbah

Facilities		
Archery	Gymnastics	Recreation Centre
Arts Council	Hockey	Rodeo
Australian Rules Football	Horse Racing	Rotary club
Basketball	Horse/Pony Riding	RSL
BMX Club	Karate	Rugby League
Bowls	Karting	Rugby Union
Boxing	Library	Soccer
Bridge	Lions Club	Speedway
Buffalo Lodge	Masonic Lodge	Squash
Youth Centre	Motorcycle Riders Club	Swimming
Cinema (currently closed)	Netball	Tennis
Craft Club	Off-Road Driving	Touch Football
Cricket	Photography	Trefoil Guild
Darts	Pistol/Gun Club	Golf
Fishing	Pottery	Volleyball

In addition to the above, there are a number of social clubs and a community radio station operating in Moranbah.

Lake Elphinstone, located approximately 92 km west of Mackay, is a natural lake lying within the RSA. Facilities beside the lake allow camping and fishing. Water skiing is allowed in one section of the lake when water height allows. The lake attracts an abundance of birdlife, making bird watching a popular activity with visitors. The lake has been known to dry out in periods of drought and flood during periods of heavy rainfall.

Sport and recreation facility provision and participation opportunities vary across the RSA with an imbalance evident between the different townships, age groups and genders. Cross boundary facility use is common and is most evident with Mackay City having a 'shadow' effect on the surrounding region as the leading provider of major sport and recreation venues and events in the area.

13 HEALTH

Given the low population base of the LSA and the difficulties this generates in attracting both public and private services, the possibility that mining development may stimulate enhanced service provision represents opportunities for significant public health benefits.

In regards to past development of the Bowen Basin, many mining companies established townships to service the mines and these historically provided many of the associated services. In more recent times, companies have focused more on core business activities, relying on Local and State Governments to provide various community services and infrastructure, and the business sector to provide private goods and services. This brings the mining industry more in line with developments in any other industrial or agricultural setting, where the developer is not normally responsible for provision of social and human services.

Moranbah has a range of health care services (**Table 1-19**) and offers an Ambulance Service, as described in **Section 11.5**. A more comprehensive range of health services is located at Mackay.

Although there are a number of health services and facilities provided in the LSA, respondents from the Community Survey felt that this issue remained an area of concern. Respondents stated that they have difficulty obtaining appointments in a reasonable timescale and emergency care is insufficient.

A helicopter service is available to transport critical patients to the Moranbah or Mackay Hospitals.

There are no health services in Coppabella.

Table 13-1 Community health services and facilities, Moranbah

Service
Hospital
Private General Practitioner
Pharmacy
Community Health Centre
Dental Surgery
Physiotherapy
Optometry
Police Station
Fire Brigade*
Ambulance Station
SES
Crisis and Counselling Service

* Including Rural Fire Brigade

13.1.1 Hospitals

The closest hospital to the MEP is located at Moranbah. The Moranbah Hospital provides a range of inpatient, medical, surgical and respite care services as well as specialist maternity and psychiatric services as outlined in **Table 1-20**.

Table 13-2 Services provided by Moranbah Hospital

Moranbah Hospital	Services Provided
Hospital - General	Inpatient, medical, surgical, respite care
Specialist	Maternity, psychiatric
Clinics	Child health; general outpatients; pharmacy; antenatal clinic; dressing; physiotherapy; counselling; aged care; Well Women; diabetic education; wound management; Well Baby; immunisation; community nursing; health promotion; Triple P program
Allied Health	Support groups; health; education and screening; home visit and support; adult, child and youth mental health; speech pathology; counselling; radiographer/sonographer
Hinterland Community Care	Meals on Wheels, home medical aids, home help, day respite, in home respite
Other Aged Services	Hinterland Community Care Services
Visiting Services	Flying obstetrician, gynaecologist, flying surgeon, psychiatrist, drug and alcohol services, mobile breast screening van, occupational therapist, mobile oral health van, school based youth health nurse

Source: Queensland Health, 2010

The other main referral hospitals in the wider region include:

- Mackay Base Hospital - approximately 200 km from Moranbah;
- Townsville Hospital - approximately 600 km from Moranbah; and
- The Royal Brisbane and Women's Hospitals - approximately 1,050 km from Moranbah.

Moranbah Hospital has 16 beds and employs the following staff:

- 31 nursing positions (including community health);
- 11 operation positions;
- 10 allied health positions;
- one medical superintendent with right to private practice;
- one senior medical officer with right to private practice; and
- nine administration positions.

During 2008, 887 patients were admitted to the Moranbah Hospital. The most common injuries/emergencies dealt with at the Moranbah Hospital were:

- trauma – crush injuries, fractures, back strain/pain, eye injuries, musculoskeletal (e.g. ankle injuries), car/truck accidents, multi-vehicle accidents, general construction injuries; and
- medical emergencies – cardiac, acute abdominal pain (e.g. pancreatitis, appendicitis, gastroenteritis), acute oesophagitis, paediatric, obstetric, environmental (e.g. snake and spider bite), drug/toxin overdoses, depression, anxiety.

Patients with acute conditions requiring further medical intervention are transported to either the Townsville or Mackay Base Hospitals. The Moranbah Hospital is supported by the Royal Flying Doctors Service and the RACQ CareFlight in transporting patients to Townsville, Mackay and Rockhampton. On occasions it may be necessary for one or two staff members, along with associated equipment, to accompany patients during emergency transfers.

Moranbah Hospital offers a limited range of allied health services and will refer patients to Mackay Base Hospital for consultations when necessary (Moranbah Hospital pers. comms. 2009).

13.1.2 Allied Health Services and Specialists

Specialists visit Moranbah on a regular basis. A women's health clinic visits the hospital monthly for consultations and procedures. A part-time physiotherapist and a full-time counsellor treat local residents when required. An occupational therapist, a diabetic educator and a radiography service are also available. Other allied health services available in Moranbah include:

- health promotion;
- education and screening;
- home visits and support;
- adult, child and youth mental health;
- speech pathology; and
- radiographer/sonographer.

A chemist, optometrist, dentist, physiotherapist and massage therapist are also available in Moranbah. Clinics available in Moranbah include:

- child health;
- antenatal clinic;
- dressing clinics;
- physiotherapy;
- counselling;
- aged care services;
- well women's clinic;
- diabetic education group; and
- wound management (Moranbah Hospital pers. comms. 2009).

13.1.3 Aged Care Facilities

There are no aged care facilities available in Moranbah or Coppabella. The closest facilities are located in Clermont or Mackay. There are nine Council/Community Housing one-bedroom units available for elderly and low-income pensioners in Moranbah.

Hinterland Community Care (HCC) provides a range of community services that assist elderly people and people with disabilities to continue living in their community. Funding for HCC is through grants provided by various government agencies such as Community Aged Care, Disability Services Queensland and Home and Community Care.

HCC also offers a fee-for-service for people who are not eligible for the government based service funding.

Homecare nurses are employed to offer basic maintenance for 90 people, 54 of which are located in the Moranbah area.

Anecdotal evidence suggests that the lack of aged care facilities in the LSA could be preventing older members of families moving to the area to be close to relatives and could result in long-term residents, who require aged care, moving out of the area.

A representative for HCC indicated that funding is an ongoing issue with aged care and disability services currently running at capacity. The transient nature of the community was also of concern as the majority of HCC workers were partners of miners and HCC often loses staff due to downturns in the industry and high rental prices. This ultimately impacts on the services provided by HCC to the communities of Moranbah and Coppabella (Hinterland Home Care pers. comms. 2009).

As part of the government's Sustainable Communities initiative, $1.6 M has been allocated to the Moranbah Health Staff Accommodation for clinical staff with four units to be built in Moranbah and the surrounding areas. The provision of accommodation is anticipated to improve recruitment and retention rates for health industry staff.

14 EDUCATION

Education, skills and qualifications are increasingly considered to be central to regional productivity, employment opportunities, personal development and the resilience of communities. More specifically, the acquisition, production, distribution and use of knowledge are valued as a contributor to individual and social well–being and economic prosperity.

Skills and education are increasingly accepted as being central to employment opportunities, regional productivity and the durability of communities. At a regional level, issues of importance include relative educational attainment levels, availability of skilled workers and the retention and attraction of a range of skilled professionals.

Inner regional areas appear to be catching up with the higher education and skill outcomes of major cities. However, skill and qualification levels and growth rates decline with remoteness and are significantly lower in outer regional and remote areas of Australia. Results decline with remoteness, particularly for indigenous Australians (Department of Transport and Regional Services, 2004).

Respondents from the community survey commented that they felt children received a very good level of education in the area.

14.1.1 Day Care Centres

There are currently two day care centres in Moranbah; the Moranbah Neighbourhood Centre Association and the Altitude Day Care Centre.

The Moranbah Neighbourhood Centre Association caters for children from birth to 12 years of age and offers long day care, casual care, outside kindergarten care, pupil-free days and vocational care. The facility is licensed to take 74 children and currently employs 25 staff (including administration staff). The centre identified a need for before and after school care and set up this service in association with the Moranbah State School.

The Altitude Day Care Centre currently caters for children from birth to 12 years. The centre offers long day care, an early learning program and a before and after school care service. Approximately 20 families have shown an interest in the before and after school care service. At present there are 63 children enrolled at the centre and it employs 15 staff.

14.1.2 Kindergarten and Preparatory Schooling

The introduction of compulsory full-time preparatory schooling in Queensland in 2007 marked the end of services provided by pre-schools. In relation to the LSA, this included the Moranbah East State Pre-School and Moranbah State Pre-School.

The Moranbah Community Kindergarten now offers pre-preparatory services for children aged four years only. The centre is licensed for 132 children per week and currently has 126 enrolments. The centre employs 10 staff in total, including three teachers, four teacher's aides and one special needs teacher.

As part of the funding from the Sustainable Resource Communities Partnership Agreement, $3.6 M has been allocated to expanding childcare capacity in Bowen Basin areas including Moranbah. This involves the construction of a new facility in Moranbah, which will result in 28 full time equivalent (FTE) jobs in total.

14.1.3 Schools

The LSA area has four schools, including:

- Moranbah State School and Moranbah Special Education Unit;
- Moranbah East State School;
- Moranbah State High School; and
- Coppabella State School.

The Moranbah State School offers education from preparatory to year seven and also operates a Special Education Unit. As of May 2009, the school had 535 children enrolled. Forty-nine staff are employed at the school, including 25 teachers, eight teacher's aides and special needs teachers as well as six ancillary staff. A shortage of supply of teachers is commonly experienced by the school.

The Moranbah East State School, which caters for preparatory to year seven, has 526 children enrolled (May 2009) with 55 staff, including 24 teachers, seven teacher's aides and 14 non-teaching staff. The school is regularly visited by four itinerant staff who provide services such as speech pathology and special needs assistance.

Moranbah State High School caters for 500 students from grades eight to 12. The school has approximately 60 staff, 39 of which are teachers.

The Coppabella State School offers education from preparatory to year seven with 37 students currently enrolled. There are two teaching staff offering two classes with support staff visiting the school approximately once a week to offer services such as music, physical education and speech pathology. Education Queensland provides housing accommodation for the two permanent teachers. Students at Coppabella State School feed into Moranbah State High School although some parents elect to enrol their children at boarding schools for their secondary education.

Numbers at these schools have not significantly changed due to increased mining activity as there have been few families with school aged children taking up residence in the LSA.

Most of the schools reported that through previous experience, finding accommodation for new teachers in Moranbah is challenging. While teachers are entitled to subsidised housing through the DoC, there is a limited supply of housing through this scheme in Moranbah.

All schools confirmed that they were operating within capacity and could take on additional students but noted that this would stretch existing teaching resources and recruitment of additional staff would be necessary.

14.1.4 Tertiary Education

Other educational facilities in the LSA include the Central Queensland Institute of TAFE, which has a campus in Mackay and an annexe located at the Moranbah State High School for flexi learners. The following courses are offered:

- arts (visual and graphic);
- automotive, building and construction (available at Moranbah);
- business, finance and retail (available at Moranbah);
- child care, community services and health;
- apprentice training such as, engineering, process manufacturing, electricians, mechanics and utilities;
- fitness;
- general education and training;
- hairdressing, beauty and massage;
- horticulture and environmental studies;
- hospitality and cookery;

- Indigenous and South Sea Islander programs;
- information technology; and
- science.

The Mackay campus has 24,991 enrolments across 124 programs with 202 staff. The Moranbah annexe has 144 enrolments across five programs with one staff member. There is capacity to take on more students at both locations. Any future plans to employ more staff are dependant upon the training needs of the community in which they operate (Central Queensland Institute of TAFE pers. comms 2009).

The Mackay campus of the CQU is the closest university to the LSA. This campus offers courses in:

- information technology;
- business;
- humanities and social sciences;
- education;
- built environment and design;
- creative and performing arts;
- engineering and technology;
- health and recreation;
- primary industries and environmental sciences; and
- sciences (CQU pers. comms. 2009).

James Cook University (JCU) also has a small campus in Mackay that offers courses in community welfare and social work. The Mackay campus has 38 students enrolled with three staff providing tutorial and administration support as well as a computer laboratory for external students in the region. The school of Medicine and Dental Sciences also has a facility in the Mackay Base Hospital that coordinates placements for medicine and health sciences (JCU pers. comms. 2009).

The single largest provider of mining training in Queensland is the Central Queensland Institute of TAFE which delivers training and assessment services to meet the needs of mining and related industries in conjunction with the individual mines.

In an effort to maximise skilling opportunities arising in Queensland's mining industry and associated industries, TAFE Queensland integrated the operations of a number of its institutes into one central point, forming what is now known as TQ Mining Services in 2001. TQ Mining Services operates as the central focus for mine training in Queensland and is administered by the Central Queensland Institute of TAFE, based in Rockhampton. Areas of study include:

- coal mining;
- metalliferous mining;
- extractive industries;
- site safety; and
- explosives (Central Queensland Institute of TAFE, 2009).

Table 1-21 shows the educational qualifications of the residents of the LSA in comparison to the RSA, MSA and Queensland. In the 2006 census, 546 people (18.1%) in the LSA held bachelor or higher degree qualifications compared with 15.8% for the RSA, 14.9% for the MSA and 23.7% for Queensland.

Residents in the LSA have attained a high level of education and the numbers are slightly higher than that of the RSA and MSA but lower than the State. As there is a distinct lack of higher education facilities in the region, it could therefore be assumed that these higher level qualifications are more

likely to have come through residents relocating to the region to work in the more specialised fields of mining.

There are a significantly higher proportion of persons in the LSA who have obtained Certificate level qualifications (46.4%) compared to Queensland at 35.5%. Most of the people holding certificate level credentials in the LSA and RSA are likely to be associated with the mining industry in the region.

It is noted that for residents of the LSA, any higher level education would have to be taken on an external basis or through relocation.

Table 14-1 Non-school qualification: level of education in the LSA, RSA, MSA and Queensland, 2006

Non-school Qualification	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Postgraduate Degree	48	1.6	106	1.4	543	1.4	60,402	3.9
Bachelor Degree	498	16.5	1,054	14.4	5,040	13.5	309,326	19.8
Graduate Diploma/Certificate	44	1.5	100	1.4	583	1.6	36,176	2.3
Advanced Diploma and Diploma	225	7.5	546	7.5	3,610	9.6	204,039	13.1
Certificate	1,400	46.4	3,206	43.8	16,708	44.6	554,243	35.5
Level of education inadequately described	49	1.6	134	1.8	885	2.4	42,841	2.7
Level of education not stated	750	24.9	2,170	29.7	10,077	26.9	353,841	22.7
Total	**3,014**	**100**	**7,316**	**100**	**37,446**	**100**	**1,560,868**	**100**

Source: ABS, 2006

15 AGRICULTURAL/ON FARM ACTIVITIES

Whilst mining in Queensland occupies a land area totalling 173,000 hectares (ha), or 0.1% of Queensland's land mass, in 2006-2007, the total land area of Queensland that was under agricultural production was 144 M ha (83%) (Roche, 2008).

The agricultural industry has been central to Queensland's economic development since European colonisation. It is still an important contributor to the Queensland economy and has maintained its role as a major export earner. In 2007-2008, the gross value of agricultural production for Queensland was $9.1 billion (ABS, 2009).

The major land use activities surrounding the LSA are agriculture and coal mining. Additional information on these activities is provided in EIS Chapter 17, Economy.

As discussed in **Section 6, Study Areas**, activities in the RSA include mining, prime grazing land, crop cultivation and it is also a large producer of cattle and cattle products. There are some smaller commercial fishing enterprises operating in the area and more recently a number of other activities such as aquaculture, fruit and vegetable growing and goat farming are being established.

16 HOUSING AND ACCOMMODATION

Rapid population growth within the local area has meant that the LSA is currently facing a housing shortage where demand for housing has resulted in high rental prices and purchase prices which are proving too expensive for many people. This housing shortage has been further compounded by a shortage of land available for residential development. The community survey highlighted housing as an issue in the area with the cost of purchasing and high rents a major problem.

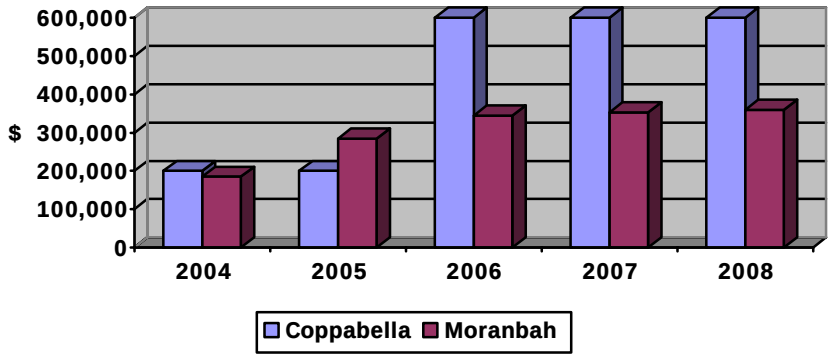
Average house prices in the township of Coppabella and Moranbah between 2004 and 2008 are presented in **Figure 6**. From this figure it can be seen that in 2004, the price of a house in Coppabella was $200,000 and in Moranbah was just less than $200,000. By 2008 however, the average price of housing in Coppabella had risen to $600,000. Moranbah's average house price increased to $360,000 over the same time period.

Recent figures from RPData show that the median property price in Moranbah at the end of 2009 was $450,000, an increase of 19% from $378,000 in 2008. Recent median rental price for Moranbah in February 2010 was $471,045. This increase may be due to the lack of available housing in the area and a surge in consumer confidence following the GFC.

House prices in Coppabella are higher than in Moranbah due to the size of land available on each property. Coppabella housing offers more acreage property whereas Moranbah is more residential housing.

The Real Estate Institute of Queensland (REIQ) also reported median vacant urban land prices for the IRC area were $85,690 for the September quarter 2008, a decrease of 5.0% from the previous year's price of $90,000.

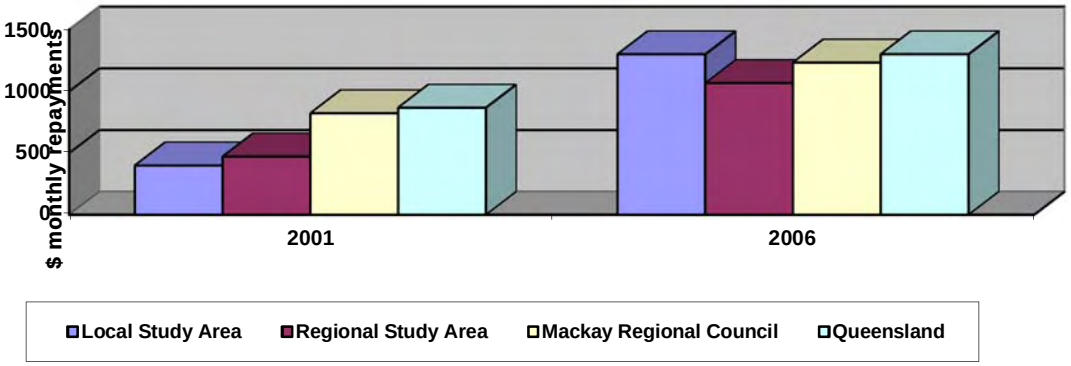
Although the cost of purchasing a house in the area is perceived to be expensive for people not working in mining, if mining workers chose to relocate to the area, the relatively high wages they are paid should make purchasing a home in the area affordable as house prices in the area are still low compared with other regional centres.



Source: RPData, 2009a; 2009b

Figure 6 Median House prices in Coppabella and Moranbah from 2004 to 2008

Figure 7 indicates that the LSA and RSA experienced a high rate of growth in median housing loan repayments from 2001 to 2006, a significant 225.8% and 126.5% increase respectively. This is well above the Queensland average of a 49.9% increase. The MSA experienced similar growth to Queensland at 50.0% over the same period.



Source: ABS, 2006

Figure 7 Median Housing Loan Repayments 2001-2006 in the LSA, RSA, MSA and Queensland

Rental payments in the LSA and RSA are represented in **Table 1-22**. The figures provided (sourced from the ABS) may not be a true representation of the rental market in the LSA and RSA as companies often provide housing subsidies to their employees. The high proportion of low rents may also be due to non-residents paying the bulk of the higher accommodation costs and this data is not recorded, by the ABS, for the non-resident population. As a result, the data represents a large proportion of persons paying low rents. However, **Table 1-22** does show that there is a higher representation of persons both in the LSA (10.7%) and the RSA (6%) who were paying $450 or more each week compared to persons in the MSA (2%) and Queensland (2.6%).

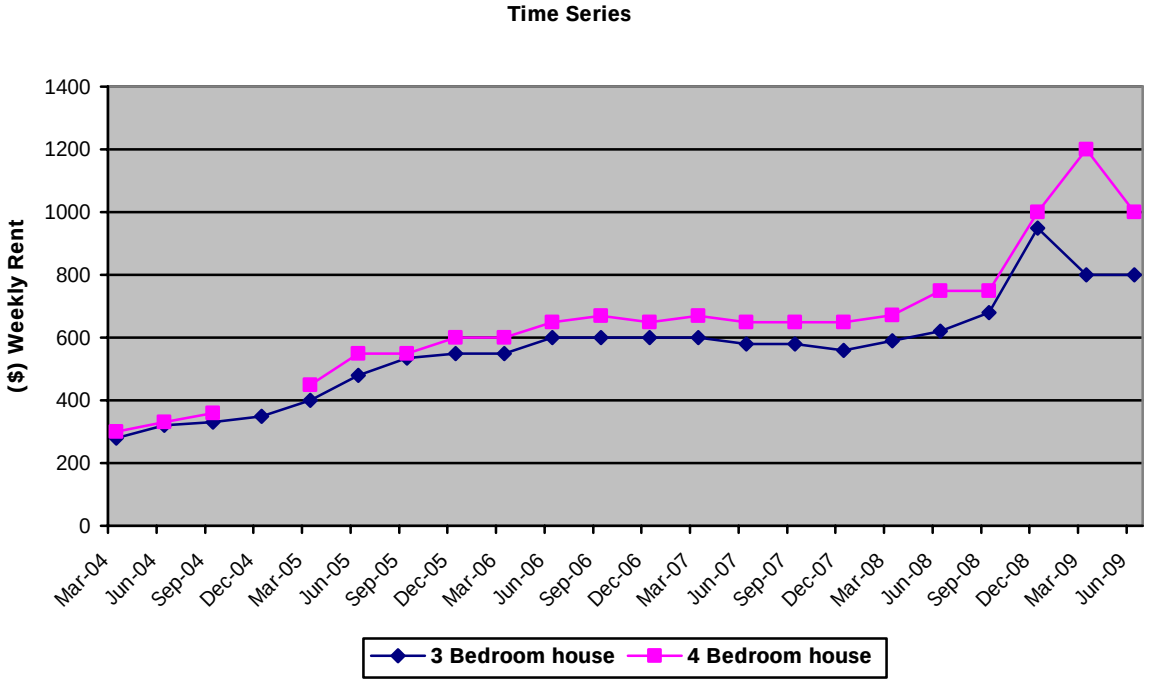
Table 16-1 Rental payments in the LSA, RSA, MSA and Queensland, 2006

Rental Payments (weekly)	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
$0-$49	262	22.5	1,216	40.4	603	6.3	23,496	5.4
$50-$99	516	44.1	868	28.8	904	9.5	35,877	8.3
$100-$139	88	7.5	251	8.3	1,150	12.0	43,565	10.1
$140-$179	39	3.3	117	3.9	1,537	16.1	60,270	13.9
$180-$224	35	3.0	95	3.2	1,610	16.8	79,282	18.3
$225-$274	13	1.0	25	0.8	1,357	14.2	82,447	19.1
$275-$349	19	1.6	46	1.6	1,295	13.5	61,342	14.2
$350-$449	8	0.7	14	0.5	613	6.4	22,414	5.2
$450-$549	35	3.0	45	1.5	120	1.3	5,481	1.3
$550 and over	90	7.7	136	4.5	69	0.7	5,406	1.3
Rent not stated	65	5.6	197	6.5	301	3.2	12,714	2.9
TOTAL	**1,170**	**100**	**3,010**	**100**	**9,559**	**100**	**432,294**	**100**

Source: ABS, 2006

Figure 8 presents data from the Residential Tenancies Authority and provides more accurate picture of the rental market in Moranbah. Since March 2004, rents have been steadily increasing for both three bedroom and four bedroom homes. In March 2004, three and four bedroom homes cost $280 and $300 per week, respectively, and in September 2008, rental prices had increased to $680 and $750, respectively. Rental payments for three bedroom homes increased significantly in the quarter from September 2008 to December 2008 from $680 to $950 (39.7%) and then decreased to $800 over the next two quarters to June 2009. This trend was the same for four bedroom homes which increased from $750 to $1,200 (62.5%) between September 2008 and March 2009, then decreased to $1,000 per week in June 2009.

Discussions with real estate agencies in the LSA and RSA in August 2009 confirm that rental prices in the area are on average $1,000 per month for a four bedroom home and that there is a shortage of accommodation available which accounts for the recent increase in renting and purchasing.



Source: Queensland Residential Tenancies Authority, 2009

Figure 8 Median Weekly rents quarterly for Moranbah, 2004 – 2009

High housing and rental prices normally stimulate the construction of more housing. However, there appears to be very limited evidence of this happening in the RSA (**Table 1-23**). The trend adopted by mining companies to deal with accommodation issues has typically focused on providing additional accommodation camps for a shifting population base.

The low affordability of housing for low income earners has meant that those unable to procure accommodation in the LSA are moving to the coastal towns such as Mackay. As a result of the mining boom, Mackay is also experiencing burgeoning rental prices, low vacancy rates in the private rental market and significant increases in property prices (Department of Housing, 2007).

Annual dwelling approvals is one of the key indicators used to measure the level of development activity in an area, as it is seen to reflect the activity that is occurring in one or a number of industry sectors such as construction and mining. Residential development also impacts development in other sectors including retail and education.

No figures on building approvals were available for the LSA. As detailed in **Table 1-23**, in the 12 months ending September 2008, there were 124 new residential building approvals in the RSA. These approvals were valued at $28,770,000 and accounted for 0.3% of the Queensland total. In comparison, the MSA had 1,018 new residential building approvals during the same period, valued at $280,535,000 (2.6% of Queensland's total). The proportion of the total value spent on building approvals that was residential, was relatively lower in the RSA at 36.3% compared with the RSA at 63.7% and Queensland at 57.7%.

Table 16-2 Residential and non-residential Building Approvals in the RSA, MSA and Queensland, 12 months ending 30 September 2008

Residential Building Approvals	No of dwelling units in new residential buildings	Residential building value ($000)	Total residential building value ($000)	Total non-residential building value ($000)	Total building value ($000)	Proportion of total value that is residential (%)
RSA	124	28,770	41,666	73,151	114,817	36.3
MSA	1,018	280,535	312,748	178,201	490,949	63.7
Queensland	41,608	10,855,364	12,121,879	8,881,409	21,003,288	57.7
RSA as % of Qld	0.3	0.3	0.3	0.8	0.5	-
MSA as % Qld	2.4	2.6	2.6	2.0	2.3	-

Source: ABS, 2006

The supply of land for residential development has been an ongoing issue in Moranbah, largely due to:

- the Queensland Government denying approval for urban development in areas adjacent to the existing Moranbah townships and within coal exploration leases;
- the capacity of existing infrastructure to accommodate further expansion in urban development; and
- the availability of water supply to new residential areas.

Moranbah is surrounded by a number of MDL and Mine Lease Applications (MLA). These have historically conflicted with planning provisions and affected the location and type of future growth in Moranbah. This was highlighted in 2005 when a development application for a 350 lot residential subdivision situated at the south-east edge of Moranbah by the former Belyando Shire Council was overturned by the Queensland Government following an appeal by the owner of the affected MDL.

The IRC has recently tendered 76 lots in stage two of the Isaac Views Residential Estate in Moranbah. It is understood that the IRC received well over 700 tenders for the 76 lots highlighting the size of the demand for residential land in Moranbah. A further 91 lots are currently being tendered by the Council in stage three of the Isaac Views Residential Estate.

The only land in Moranbah currently available for large scale residential development is the area to the west of Moranbah known as 'Potters Land'. The Council has recently acquired 100 ha of a 220 ha development site in this area. The Council's portion has been renamed 'Belyando Estate'. The total yield from the 220 ha site is estimated at 1,500 residential blocks, 1,400 medium density unit sites and 850 single person camp rooms.

Given the time it will take to prepare the land for residential construction and gain the necessary approvals, residential construction on 'Potters Land' is unlikely within the next five years (IRC, pers. comm., 2008). The MEP is not expected to increase demand for residential housing in Moranbah or Coppabella as they would be accommodated at the MAC Coppabella Accommodation Camp (see **Section 16.1, Short-Term/Temporary Accommodation**).

The DIP produce an annual population report for the Bowen Basin. The 2007 report undertook a survey of accommodation providers, therefore providing a count of non-resident workers living in the former Belyando, Broadsound and Nebo Shires (now IRC).

Table 1-24 shows that Single Person Quarters (SPQ) were the largest providers of accommodation for non-resident workers in 2007, catering for 88.3% of the population for the IRC. This high volume is understandable due to the predominance of mining activities employing transient workers within the areas.

Table 16-3 Non-resident workers counted by survey of accommodation providers in the former Belyando, Broadsound and Nebo Shires, 2007

Accommodation	Belyando		Broadsound		Nebo		Total	
	Number	%	Number	%	Number	%	Number	%
SPQ	1,351	71.8	2,286	93.4	2,718	94.8	6,355	88.3
Hotels/motels	158	8.4	15	0.6	101	3.5	274	3.8
Caravan Park	356	18.9	135	5.5	49	1.7	540	7.5
Other**	16	0.9	12	0.5	0	0	28	0.4
TOTAL	**1,881**	**100**	**2,448**	**100**	**2,868**	**100**	**7,197**	**100**

Source: PIFU, Survey of accommodation providers, 2007
*The category 'Other' includes houses and flats head-leased from the private market for company accommodation

The total number of beds available in SPQs increased from 7,255 in 2006 to 9,319 in 2007, an increase of 28.4% (**Table 1-25**). This was likely due to the increase in new mining projects and expansions to existing mining operations located in the region.

Table 16-4 SPQ total bed capacity in the former Belyando, Broadsound and Nebo Shires, 2006-2007

SPQ Capacity	Belyando	Broadsound	Nebo	Total
	Number	Number	Number	
SPQ – total bed capacity 30 June 2006	1,595	1,928	3,732	7,255
SPQ – total bed capacity 30 July 2007	2,431	2,737	4,151	9,319
Change in SPQ bed capacity 2006-2007	**836**	**809**	**419**	**2,064**

Source: PIFU Survey of accommodation providers, 2006 and 2007 collections

16.1.2 Short-Term/Temporary Accommodation

Moranbah has a number of short-term and temporary accommodation facilities that service the immediate and surrounding areas. These include:

- Black Nugget Hotel;
- Coal Country Caravan Park;
- Curtin House;
- Grosvenor Village Accommodation (backpackers included);
- Moranbah Accommodation Centre;
- Moranbah Caravan Village;
- Moranbah Drovers Rest Motel;
- Moranbah Motor Inn;
- Moranbah Outback Motel; and
- Western Heritage Motel.

In addition, an accommodation camp at Moranbah provides housing for the coal mining, construction, resources and tourism industries. The camp is owned and operated by The MAC Services Group Limited, one of Australia's leading accommodation village developers and operators. They currently have five facilities in Central Queensland at Coppabella, Dysart, Middlemount, Moranbah and Nebo.

The MAC Moranbah Accommodation Camp was established in August 1996 and currently has 60 staff members. There are approximately 900 single en-suited rooms at the camp that cater predominantly for mining employees and contractors and staff working at the camp. Mining employees staying at the camp use local facilities in Moranbah and its surrounds if they are not available at the camp.

The MAC Moranbah Accommodation Camp expects to cope with the potential increase in the need for accommodation resulting from the majority of mining growth projects in the area and will expand their site depending on demand.

The MAC Coppabella Accommodation Camp was established in March 2006 and currently employs 90 staff. There are approximately 1,700 single en-suites rooms at the camp, which are almost fully occupied. The camp caters for the same clientele as the Moranbah Camp. The MAC Coppabella Accommodation Camp recently expanded its facilities which required employing five additional staff members.

Apart from standard facilities, other services provided include laundry facilities, BBQ and gazebo and a recreation room. Facilities that were recently added include a running track, a tavern/coffee lounge and shopping facilities.

17 EMPLOYMENT AND INCOME

Employment trends in mining are cyclical, dependant amongst other factors on global economic growth, commodity prices, level of mineral reserves, intensity of exploration as well as employment needs at the various stages of operations.

The full impact of the economic downturn on the mineral industry in Queensland, although temporary, resulted in some loss of employment, however, the overall net loss of jobs was not as great as first expected.

Based on a surge of demand from China and emerging Asian markets, both production and exports are currently rising and there is now an increase in investments to develop a host of new coal projects in Queensland that would see the industry's importance to the local and national economy continue to strengthen. This is reflected in the industries increased levels of recruitment.

A recent report from the QRC expresses concern at the sector's ageing workforce coupled with slow growth in the availability of suitably skilled employees which has the potential to disrupt the state's ability to take full advantage of the current surge in the resources sector and its associated industries.

Skills shortage is an issue that has risen very sharply in importance since the announcement of multiple projects such as the coal seam gas and LNG industries in Queensland.

The levels of employment being proposed will need to be matched by the direct and indirect employment of more than 18,000 new employees over the next decade. Alongside this, there is a labour force demand for additional operational workers in the coal, bauxite, copper, lead, zinc and gold sectors in Queensland exceeding 23,000 by 2020 (Queensland Resources Council, 2010).

The Federal Government launched a 'National Resource Sector Employment Taskforce' in 2009 in recognition of the urgency to have appropriately skilled workers available to support resource and energy sector growth.

The minerals and energy sector in Queensland (directly, and indirectly using economic multipliers published by the Queensland Government) is responsible for more than 28% of Queensland's jobs reflecting the best pay rates of any industry. Queensland's minerals and energy sector companies supply more than 31% of the State's total wages and salaries (Roche, 2008).

The main economic driver for Moranbah and Coppabella is the coal industry and to a lesser extent the beef cattle industry. More recently, agricultural crops have expanded in the RSA.

The mining industry's dominant and generally rising share of employment in the IRC, in tandem with its payment of high wages, partly explains the comparatively large and mostly rising incomes of full-time workers in the LSA and RSA. The LSA has a greater number of employed people in the labour force (74%) compared to Queensland as a whole (58.9%). A majority of people in the LSA were in full-time employment (53.3%), an occurrence that is repeated for the other study areas (**Table 1-26**).

Between 2001 and 2006, Moranbah's labour force increased by 25.4%, from 3,182 to 4,395. In comparison, Queensland's labour force increased by 192,088 (12.2%) to 1,915,947. The significant increase in the labour force in Moranbah over this period is directly related to global demand for resources of the area and the available mining-related infrastructure that was previously under-utilised, allowing a rapid uptake of industry employees to the area (Department of Local Government, Planning, Sport and Recreation, 2007). Employment numbers are likely to increase alongside the current and future growth in the mining and resource industries.

The community survey respondents identified employment opportunities as a benefit of the MEP however, the lack of employment available for family members, who may decide to reside in the area, is a factor affecting some employees decision to move to the area on a more permanent basis.

Table 17-1 Labour force status in the LSA, RSA, MSA and Queensland, 2006

Labour force status	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Employed:								
Full-time*	3105	53.3	6,485	49.9	32,948	41.9	1,180,891	38.2
Part-time	905	15.5	1,930	14.9	11,961	15.2	530,504	17.1
Employed away from work**	187	3.2	384	3.0	1,667	2.1	63,507	2.0
Hrs work not stated	119	2.0	281	2.2	1,526	1.9	50,095	1.6
Unemployed, looking for work	**79**	**1.4**	**197**	**1.5**	**1,876**	**2.4**	**90,950**	**2.9**
Total Labour Force	**4,395**	**75.4**	**9,277**	**71.5**	**49,978**	**63.5**	**1,915,947**	**61.8**
Not in Labour Force	871	14.9	2,395	18.4	21,950	27.9	971,828	31.4
Not stated	562	9.7	1,316	10.1	6,743	8.6	210,200	6.8
TOTAL	**5,828**	**100**	**12,988**	**100**	**78,671**	**100**	**3,097,975**	**100**

Source: ABS, 2006
* 'Full-time' employment is defined as having worked 35 hours or more in all jobs during the week prior to the 2006 ABS Census
**Comprises employed persons who did not work any hours in the week prior to the 2006 ABS Census

In 2006, both the LSA and the RSA had a lower proportion of unemployed people (1.4% and 1.5% respectively) than Queensland as a whole (2.9%). This could be attributed to the significant employment opportunities in the region offered by the mining industry.

Unemployment figures by age group for the various study areas can be seen in **Table 1-27**. The highest unemployment for the LSA was from the 20-24 year old age group (26.7%). The RSA has similar findings with the 20-24 yr age group having the highest unemployment rate at 21.4%. Both the MSA and Queensland have the highest unemployment in the 25-34 year age group at 19.2% and 20.0% respectively. The age group 55-64 years was consistent across the study areas as having one of the lowest unemployment rates. This is likely to be due to people moving out of the area as they reach retirement age.

The LSA enjoys a low unemployment rate at 1.4%. While mining has opened up some opportunities for local employment both directly at the mines and some increases in local businesses, the low unemployment rate may also be a reflection of:

- movement away from the area by people in search of work;
- people dropping out of the labour market with a possible return if employment prospects for them improve; or
- unemployed or under-employed people leaving the area due to the shortage of rental accommodation.

Table 17-2 Unemployment rate by Age in the LSA, RSA, MSA and Queensland, 2006

Unemployment rate by Age	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
15-19 years	15	21.1	40	18.3	565	19.1	9,071	17.9
20-24 years	19	26.7	47	21.4	476	16.0	7,576	14.9
25-34 years	9	12.7	37	16.9	571	19.2	10,179	20.0
35-44 years	16	22.5	42	19.2	551	18.6	9,988	19.6
45-54 years	6	8.5	30	13.7	449	15.1	8,107	16.0
55-64 years	6	8.5	23	10.5	322	10.8	5,421	10.7
65 years and over	0	0.00	0	0.00	36	1.2	449	0.9
TOTAL	**71**	**100**	**219**	**100**	**2,970**	**100**	**50,791**	**100**

Source: ABS, 2006

Employment by industry categories for the areas of study in 2006 are shown in **Table 1-28**. The LSA and RSA have synergies in the percentage of people employed in similar industries in the labour force. Not surprisingly, 'Mining' is the most popular industry of employment for both areas at 43.6% and 39.7% respectively. Other industries in the LSA with a relatively large percentage of persons employed include 'Accommodation and Food Services' (7.1%), 'Retail Trade' (6.9%) and 'Construction' (6.5%). In the RSA, a relatively large percentage of persons are employed in 'Agriculture, Forestry and Fishing' (10.1%), 'Retail Trade' (7.4%) and 'Construction' (6.3%).

By comparison, only 8.3% of the working population of the MSA and 1.7% of the working population of Queensland were employed in 'Mining'. Significant industries in Queensland generally are 'Retail Trade', 'Health Care and Social Assistance', 'Manufacturing' and 'Construction'.

Table 17-3 Industry of employment in the LSA, RSA, MSA and Queensland, 2006

Industry of employment*	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Accommodation and food services	306	7.1	487	5.3	3,124	6.5	127,631	7.0
Administrative and support services	100	2.3	207	2.3	1,074	2.2	55,705	3.1
Agriculture, forestry and fishing	154	3.6	915	10.1	2,225	4.6	61,735	3.5
Arts and recreation services	15	0.3	20	0.2	281	0.6	24,625	1.3
Construction	280	6.5	575	6.3	4,859	10.2	164,936	9.0
Education and training	213	4.9	519	5.7	3,022	6.3	139,090	7.6
Electricity, gas and waste services	14	0.3	53	0.6	439	0.9	18,540	1.0
Financial and insurance services	27	0.6	48	0.5	866	1.7	52,035	2.9
Health care and social assistance	154	3.6	350	3.9	3,847	8.0	186,336	10.2
Information media and telecommunications	11	0.3	25	0.3	382	0.8	26,347	1.4
Manufacturing	80	1.9	181	2.0	4,764	9.9	180,212	9.9
Mining	1,884	43.6	3,605	39.7	3,990	8.3	30,721	1.7
Other services	121	2.8	265	2.9	2,266	4.7	68,361	3.7
Professional, scientific and technical services	79	1.8	120	1.3	2,120	4.4	102,412	5.6
Public administration and safety	89	2.1	268	2.9	1,930	4.0	122,416	6.7
Rental, hiring and real estate services	60	1.4	94	1.0	893	1.8	37,983	2.1
Retail trade	296	6.9	671	7.4	5,472	11.4	212,422	11.6
Transport, postal and warehousing	201	4.7	281	3.1	2,951	6.2	92,614	5.1
Wholesale trade	122	2.8	188	2.1	2,236	4.7	72,075	3.9
Inadequately described/not stated	108	2.5	215	2.4	1,363	2.8	48,800	2.7
TOTAL	**4,314**	**100**	**9,087**	**100**	**48,104**	**100**	**1,824,996**	**100**

Source: ABS, 2006
*Industry of employment was coded to the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC) edition. This has replaced the 1993 ANZSIC edition

The skill level of an occupation is defined as a function of the range and complexity of the set of tasks involved. The greater the range and complexity of the set of tasks, the greater the skill level of the occupation.

The determination of the skill level of each occupation requires some subjective judgment. As such, definitions should be interpreted as indicative only. It is also important to note that skill level is an attribute of occupations and not an attribute of the particular individuals who hold jobs in those occupations.

To be consistent with the definition used, the following was used:

- skilled - managers and administrators, professionals and associate professionals, advanced clerical and service workers;
- semi skilled – tradespersons and related workers, intermediate and elementary clerical, transport and service workers and labourers; and
- unskilled - no qualifications (ABS, 2009).

In 2006, the largest occupational category within the LSA was 'Machinery Operators and Drivers' at 25.8%, followed by 'Technicians and Tradespersons' represented by 23% of the workforce (**Table 1-29**).

The RSA has similar results with the majority of its labour force employed as 'Machinery Operators and Drivers' at 24.9%, followed by 'Technicians and Trade Workers' at 20.1%.

The labour force in the MSA and Queensland are more evenly distributed across the various occupations. The majority of workers in the MSA were employed as 'Technicians and Trade Workers' at 20.2% followed by 'Clerical and Administrative Workers' at 13.2%. Queensland had 17.1% of its labour force working as 'Professionals' and 15.4% as 'Technicians and Trade Workers'.

These results show that the highest portion of the labour force in the LSA and RSA are employed in unskilled or semi-skilled roles. The high percentage of 'Labourers' suggests higher demand for lower skilled workers to meet the requirements of the mining industry in this region.

The proportion of 'Managers' in the LSA is 8.4%, which is lower than the RSA, MSA and Queensland.

Table 17-4 Employment by occupation in the LSA, RSA, MSA and Queensland, 2006

Occupation*	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
Clerical and Administrative Workers	357	8.3	846	8.3	6,346	13.2	269,198	14.8
Community and Personal Service Workers	202	4.7	473	4.6	3,370	7.0	166,400	9.1
Labourers	490	11.3	1,255	12.4	5,887	12.2	217,251	11.9
Machinery Operators and Drivers	1,116	25.8	2,534	24.9	6,094	12.7	132,114	7.2
Managers	365	8.4	1,309	12.8	5,443	11.3	225,693	12.4
Professionals	479	11.1	1,005	9.9	5,877	12.3	312,865	17.1
Sales Workers	243	5.6	532	5.2	4,535	9.4	189,038	10.4
Technicians and Trade Workers	992	23.0	2,052	20.1	9,730	20.2	280,342	15.4
Inadequately Described/not Stated	77	1.8	183	1.8	816	1.7	32,095	1.7
TOTAL	**4,321**	**100**	**10,189**	**100**	**48,098**	**100**	**1,824,996**	**100**

Source: ABS 2006

* Occupation was coded to the 2006 Australian and New Zealand Standard Classification of Occupations (ANZSCO). This has replaced the 1996 Australian Standard Classification of Occupations (ASCO) Second Edition

In 2006, 17.6% of persons receiving an income in the LSA received over $2,000 each week, well above the Queensland average (2.9%) (**Table 1-30**). Therefore, purchasing a home in the LSA should be a realistic option for people choosing to do so. A large portion of employees in the RSA (13.7%) also received a weekly income of $2,000 or more.

The next most common category was people who received a weekly income of between $1,600 and $1,999. In the LSA, 9.8% fell into this bracket while in the RSA, 8.9% received this income.

The relatively high proportion of people receiving a weekly income in excess of $1,300 is largely due to the relatively high proportion of persons employed in the mining industry. The LSA is currently experiencing income polarisation, with persons employed in mining receiving substantially higher wages in comparison to other occupations in the area.

Individual low income earners are classified as those receiving approximately $450 or less per week gross (Centrelink, 2009). The LSA has the smallest proportion of persons earning $399 or less per week at 18.8%. This rate increases to 21.9% in the RSA, 30.5% in the MSA and 33.3% for Queensland. The smaller percentage of people earning low incomes in the LSA compared to Queensland is likely due to the flow-on effect of mining in the area.

Table 17-5 Gross individual weekly income in the LSA, RSA, MSA and Queensland, 2006

Gross individual income (weekly)	LSA		RSA		MSA		Queensland	
	Number	%	Number	%	Number	%	Number	%
$1-$399	1,095	18.8	3,203	21.9	23,971	30.5	1,033,722	33.3
$400-$599	549	9.4	1,417	9.6	10,738	13.7	461,288	14.9
$600-$799	324	5.6	949	6.4	8,128	10.3	353,111	11.4
$800-$999	291	5.0	739	5.0	5,807	7.4	249,072	8.0
$1,000-$1,299	419	7.2	998	6.8	6,209	7.9	242,608	7.8
$1,300-$1,599	397	6.8	886	6.0	3,806	4.8	120,183	3.9
$1,600-$1,999	571	9.8	1,317	8.9	3,071	3.9	68,920	2.2
$2,000 or more	1,025	17.6	2,013	13.7	3,178	4.0	88,509	2.9
Negative/Nil income	440	7.5	1,121	7.6	4,960	6.3	197,287	6.5
Individual income not stated	720	12.3	2,073	14.1	8,800	11.2	283,296	9.1
TOTAL	**5,831**	**100**	**14,716**	**100**	**78,668**	**100**	**3,097,996**	**100**

Source: ABS, 2006

In general, people in the LSA and RSA, directly employed in the mining sector, earn wages well above the national average.

The Queensland mining sector salary data shown in **Table 1-31** shows the typical salary range for a selection of different mining roles. Salaries range from $80,000 to $160,000.

Table 17-6 Selection of mining roles and salary range in Queensland

Mining Role	Salary Range ($)
Dump Truck Operator	80,000 – 110,000
Mechanical Fitter	80,000 – 95,000
Boiler Maker/Welder	90,000 – 110,000
Mechanical Engineer (Mid level – 3 to 7 years)	90,000 – 120,000
Electrician	90,000 – 120,000
Excavator Operator	90,000 – 120,000
Maintenance Supervisor	95,000 – 145,000
Leading Hand	100,000 – 130,000
Open Pit Supervisor	110,000 – 140,000
Maintenance Superintendent	120,000 – 160,000

Source: Hays (2009)

Although there is a higher percentage of non-Indigenous people than Indigenous people receiving an average income of approximately $400 to $999 for all the study areas (except for the LSA which did not have data available), the difference is highest in the RSA. Non-Indigenous people in the RSA as a whole received better pay than Indigenous peoples, however, 35.4% of the Indigenous working population in the RSA receive $1,000 or more per week which is a significantly greater percentage than in the MSA and Queensland (**Table 1-32**). This may be attributed to the large mining companies in the area providing employment to the local Indigenous people.

In the RSA, a substantial amount of Indigenous people (15.7%) received no work related income, compared with non-Indigenous people (7.6%). There are 5.0% more Indigenous people than non-Indigenous people in the RSA earning low incomes, $399 and under, and it is clear that this disparity is replicated in the MSA and Queensland (**Table 1-32**).

In Queensland, a much higher proportion of non-Indigenous people (16.8%) had an income over $1,000 gross per week compared to Indigenous people (7.0%). Although there are synergies for Indigenous and non-Indigenous people earning high incomes ($1,000 or more gross per week) in the MSA, the RSA has an equal percentage of high income earners of indigenous and non-Indigenous backgrounds.

Table 17-7 Gross weekly individual income for Indigenous people in the RSA, MSA and Queensland, 2006*

Gross individual income (weekly)	RSA		MSA		Queensland	
	Number	%	Number	%	Number	%
$1-$399	72	26.9	4,047	34.5	34,882	44.7
$400-$599	21	7.8	1,613	13.8	11,982	15.4
$600-$799	13	4.9	1,008	8.6	6,832	8.8
$800-$999	3	1.1	733	6.3	3,888	5.0
$1,000 or more	95	35.4	2,122	18.1	5,463	7.0
Negative/Nil income	42	15.7	982	8.4	6,568	8.4
Individual income not stated	22	8.2	1,203	10.3	8,338	10.7
TOTAL	**268**	**100**	**11,708**	**100**	**77,953**	**100**

Source: ABS, 2006
*Data was not available for the LSA

18 PROPOSED WORKFORCE

As the MEP is an expansion to the existing operations at the Millennium Mine, relatively minor construction works would be required to the existing Millennium Mine access road (e.g. signage), water storages and other ancillary infrastructure being utilised.

Approximately 60 employees would be required for the construction phase of the MEP. This number would be dependant on the type and number of construction infrastructure projects that are undertaken. **Table 1-33** provides the estimated requirements for the proposed construction works.

Upgrades to the CHPP to increase production would be undertaken if and when production rates necessitate. Any major modification to the CHPP would be the subject of a separate approval process as the CHPP is owned and operated by the Red Mountain Joint Venture (RMJV).

Table 18-1 Estimated requirements for the proposed MEP construction works

Construction Infrastructure	Timing	Estimated workforce	Mobile Equipment Used
66 kilovolt (kV) Transmission Line Relocation	2011 – 2012	12	Dozer, Excavator, Post hole digger, Semi-trailer Crane and Line installer
Millennium/Poitrel Access Road Relocation	2011 – 2012	20	Dozer, Grader and Bitumen spreader
Diversion of New Chum Creek	2011-2012	20	Dozer, Grader, Excavator and Dump truck
New Water Storages	To be determined	5	Dozer, Grader, Excavator and Dump truck

Electric shovel and truck will be the extraction method used for the MEP. An average of 340 people would be required at various stages of the MEP operational period as summarised in **Figure 9**. The numbers used in this table are averaged out over the life of mine. **Figure 10** provides a complete breakdown of the mining workforce, specifically the types of employment and workforce required over the life of mine.

A peak in workforce numbers will occur at various stages throughout the life of the MEP, specifically 2012, 2013 and 2018 with approximately 400 employees and contractors. The lowest workforce numbers, as expected, will be at project initiation and finalisation.

The operational workforce would be employed on a contractual basis and housed in the MAC Coppabella Accommodation Camp with additional accommodation being provided by MAC Moranbah Accommodation Camp. Services provided by these establishments are described in **Section 16.1, Short-Term/Temporary Accommodation**.

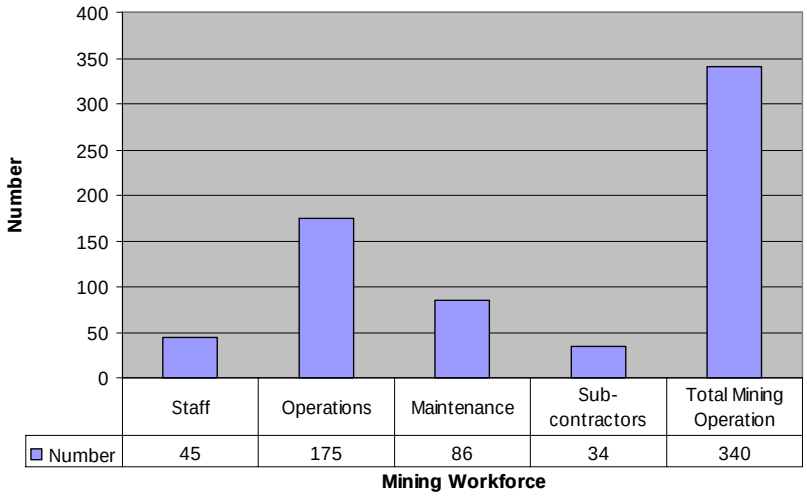
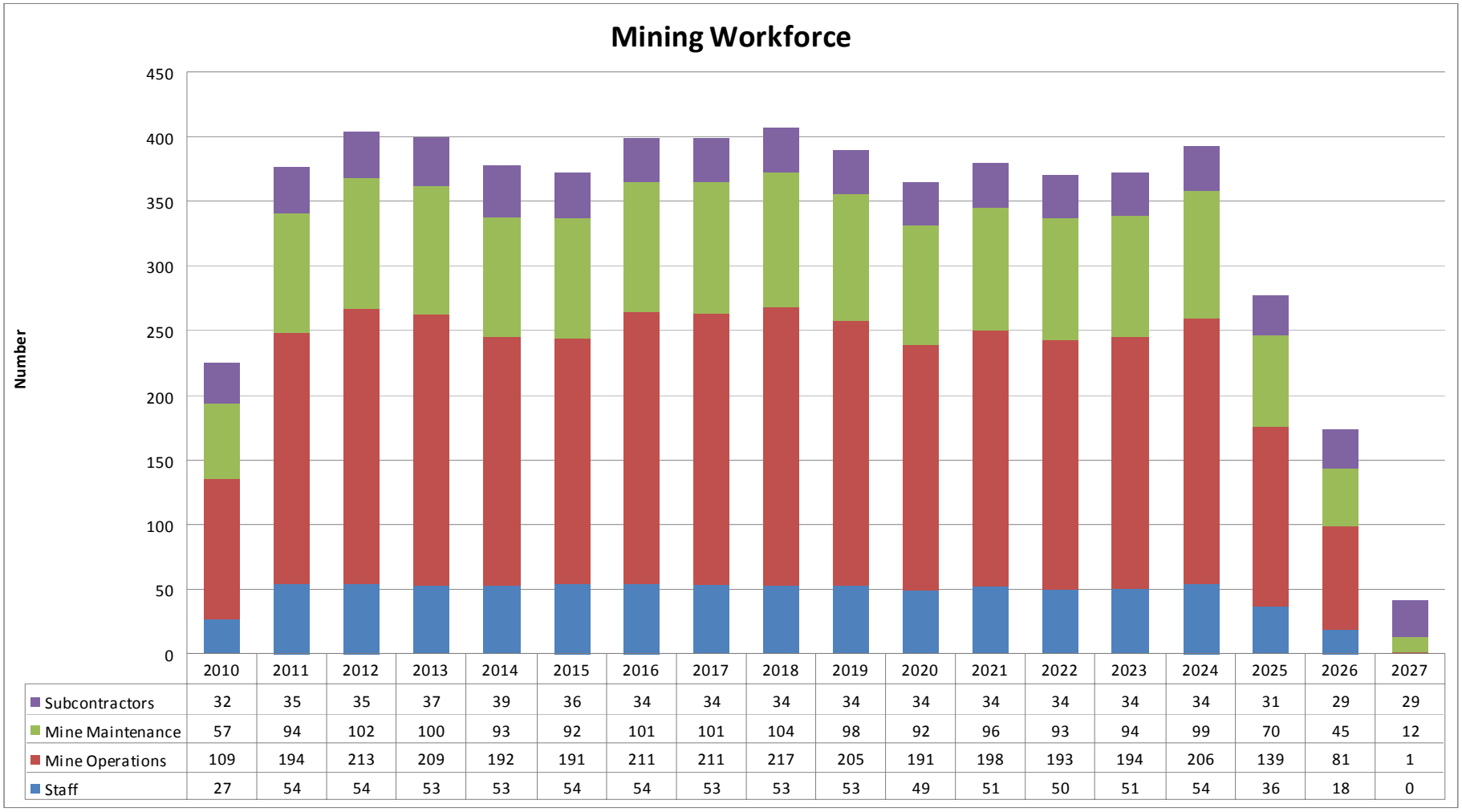


Figure 9 Workforce required for the proposed MEP operations

This choice of accommodation follows a recent trend in the mining industry for employees to be housed in single person's quarters during their shifts and afterwards travel to their residential base in larger regional centres, such as Mackay.

Due to the limited construction works, it is considered unlikely that any construction workers would relocate to the LSA. As with the existing Millennium Mine operational workforce, it is anticipated that approximately 95% of the workforce would be accommodated at the MAC Accommodation Camps with the remaining 5% seeking permanent accommodation in the LSA.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Subcontractors	32	35	35	37	39	36	34	34	34	34	34	34	34	34	34	31	29	29
Mine Maintenance	57	94	102	100	93	92	101	101	104	98	92	96	93	94	99	70	45	12
Mine Operations	109	194	213	209	192	191	211	211	217	205	191	198	193	194	206	139	81	1
Staff	27	54	54	53	53	54	54	53	53	53	49	51	50	51	54	36	18	0

Figure 10 Mining Workforce

The operational workforce would be employed on a four days on and four days off roster. The shift duration would be for 12 hours starting at 6am and finishing at 6pm. As the construction period is minimal, construction workers would work the above roster on an as-needs-basis.

It is not envisaged that any fly-in/fly-out arrangements for any additional employees would be necessary. Therefore, there would be negligible impacts of the MEP on accommodation and housing affordability in the LSA.

19 SUMMARY OF KEY FINDINGS

- The LSA and RSA experienced an increase in population since 2001 and this trend is predicted to continue.
- There is one landowner affected by the MEP within the operational land and 17 land users adjoining the operational land.
- Non-resident workers, those predominantly housed in accommodation camps, account for a significant proportion of the working population in the LSA and RSA.
- The majority of persons in the LSA and RSA were aged between 15 and 44, reflective of the working population.
- Compared to Queensland and the MSA, the LSA and RSA have a smaller Indigenous population.
- A large proportion of persons renting in the LSA and RSA do not rent through traditional methods.
- The Community Survey identified that a high percentage of the respondents believe the area in which they live is 'Very Good' or 'Good'. Comments received indicated that residents value the sense of community and quiet and relaxed lifestyles and believe that the region is a great place to raise children.
- There are a range of services available to people living in the LSA and RSA such as shops, emergency services, health facilities, support services, education, churches etc. Although people feel that there is not enough choice for grocery shopping and that access to major health services involved travelling to the MSA.
- The LSA has a number of recreational, cultural, leisure and sporting activities.
- There are no aged care facilities in the LSA reflecting the low proportion of persons aged 75+ years.
- Education facilities in the LSA and RSA range from pre-school to year 12. There are no Tertiary education centres provided in the LSA or RSA with the nearest centre established in the MSA.
- There is currently a housing shortage in the LSA and RSA.
- High rents and high house prices in the LSA and RSA are possibly a concern for attracting non-mine workers to live in the areas permanently.
- The accommodation camps, providing single person's quarters, are the major short-term and temporary accommodation facilities housing mining employees in the LSA.
- The LSA and RSA have a lower unemployment rate than Queensland.
- The majority of persons are in full-time employment in all study areas.
- The highest portion of the labour force in the LSA and RSA are employed in unskilled or semi-skilled occupations.
- A large proportion of persons working in the LSA and RSA received an income of over $2,000 per week, well above the Queensland average.

- Approximately 60 additional employees would be required during the construction phase of the MEP and, on average, 340 employees would be required during the operation period.
- Approximately 95% of the operational MEP workforce may be accommodated at the MAC Coppabella Accommodation Camp and, if required, at the MAC Moranbah Accommodation Camp. The remaining 5% may seek permanent accommodation in the surrounding areas. This is unlikely to affect housing availability or affordability in the region.

20 POTENTIAL IMPACTS AND MITIGATION MEASURES

The identification and assessment of the potential social impacts of the MEP has been undertaken by analysing the existing socio-economic environment in the LSA, RSA, MSA and Queensland and utilising the results of the stakeholder and community engagement process. The assessment considers the direct impacts on the local and regional communities as a result of the proposed expansion. Both beneficial and adverse impacts have been considered along with an evaluation of short-term, long-term and cumulative impacts.

Due to the relatively low numbers of employees being required for the operational phase of the MEP and the fact that 95% of those employees would be housed in existing camp accommodation, the potential impacts on the LSA and RSA would be minimal and therefore, impacts on the MSA and Queensland almost negligible. Thus, for the purposes of assessing the potential impacts and mitigation measures for the MEP, only the LSA and RSA are discussed in the sections below.

To assist in reducing potential impacts and to demonstrate that Peabody develops and maintains a positive and sustainable relationship with local and regional communities, mitigation strategies have been developed and are also outlined in the following sections.

21 POTENTIAL DEMOGRAPHIC CHANGES IN THE PROFILE OF THE REGION

The impact of the construction and operational workforce of the MEP on the demographic profile of the LSA and RSA is in most part dependant on the number of contractors and employees that decide to take up residence in the LSA and RSA and at the same time relocate their families.

It is envisaged that up to 60 employees may be required during construction and, on average, 340 employees during operation of the MEP. Therefore, minimal changes to the demographic profile of the region are anticipated as a result of the MEP. The current LSA and RSA populations are predominantly male and as the mining workforce is typically male-dominated, this trend is expected to continue.

Considering the current economic climate, a housing shortage, high rental prices in Moranbah and Coppabella and the comparatively short construction period for the MEP, it is considered that approximately 5% of construction workers may relocate to the area and this would most likely be on a temporary basis. It is expected only a minimal number of those members of the workforce would choose to relocate, as current trends in the mining industry indicate that the majority of people are choosing to base themselves and their families in larger regional centres for improved lifestyle, access to services and employment opportunities for family members.

Considering that the MEP life of mine is 16 years, it could be expected that approximately 5% of the operational workforce may consider moving to the area on a more permanent basis. Based on this assumption, it is more than likely that the types of workers that choose to move to the area would have families. The principal demographic change likely to occur in the LSA and/or RSA would be an increase in young families who would choose to relocate in order to maintain their family unit.

Population projections released by the PIFU (**Table 1-4** in **Section 9.1**) predicted that the region is set to experience steady growth. With an annual average growth rate of 2.1% for the RSA from 2006 to 2031, it appears that there is permanent growth forecast resulting from increased mining activities in the region. This rate for the region is marginally greater than the State's annual average growth

rate of 1.8% which indicates the region is likely to have an above average requirement for investment in community infrastructure and services.

Due to the predominant mining activity in the RSA, the projected growth rate is unlikely to have any significant effect on the overall age structure of the LSA and RSA resident population because there are proportionally more people in the 25-34 year old category and this is highly unlikely to change as the majority of the proposed workforce for the MEP would be expected to fall into this age category.

It can therefore be concluded that the MEP would have minimal impact on the demographic profile of the LSA and RSA.

22 SUFFICIENCY OF CURRENT INFRASTRUCTURE AND SERVICES

In the 2006 ABS census, a considerable number of people in mining towns reported that they lived elsewhere and as such are classified as visitors to the town. This gives an inaccurate assessment of the number of people that utilise the towns' infrastructure and services resulting in an underestimation of the number of people the town needs to service during any given period.

As the majority of the workforce for the MEP is more than likely to be permanently based in and around Mackay, it is envisaged that provision for increased community infrastructure would not be required as a result of the MEP. Mackay currently has sufficient community infrastructure to allow for the relatively small increase in population proposed as a result of the MEP.

The MEP would continue to provide a 'Bus In–Bus Out' service from Mackay for employees. Employees would be bussed in from Mackay on the day preceding their first roster day and bussed back to Mackay after the completion of their last rostered shift. Although this service is already in existence for the Millennium Mine, there would be a small increase in the number of bus movements on the Peak Downs Highway due to the MEP.

Access to the MEP site would primarily be from the Peak Downs Highway via the Millennium/Poitrel access road.

A detailed assessment of traffic movements related to the project is provided in EIS Chapter 8, Transport. Transport of the construction workforce to the project site would be managed by the successful contractor in line with Peabody policies.

While some disruptions to road users would occur as a result of the transportation of construction materials to the site, particularly with the movement of over-sized loads, any such movement would be coordinated with IRC, MRC and the local Police Service.

Two bus routes, servicing schools in Moranbah, use the Peak Downs Highway. Apart from a potential increase in travel times due to slow moving heavy vehicles, these bus routes are unlikely to be affected by delivery of construction equipment and material to the mine site. Where possible, delivery of such equipment would be scheduled to occur outside of school drop-off and pick-up times to minimise potential impacts on traffic levels.

Emergency service capacity and staffing is generally impacted by the number of emergencies generated within a catchment, with the majority likely to be associated with increased use of the Peak Downs Highway. It is not anticipated that the MEP would have any significant adverse affects on the provision of emergency services in the region. However, longer-term impacts may arise as a result of the cumulative impact of mine development and growth within the region and therefore the demand for emergency services could increase.

Barriers to participation in community activities by the MEP workforce exist largely due to the nature of shift patterns, the temporary nature of residence, and commitments to families, friends and activities elsewhere. The lack of community participation also affects community organisations including service organisations and sporting clubs. In small communities leadership of community organisations often falls to the same small group of people and without injection of new members, such organisations will struggle to maintain membership numbers and the services the organisation provides will be lost to the community.

As such, the MEP is unlikely to impact on local community infrastructure (e.g. support services and sporting facilities) or affect community members' access to such facilities. Any increase that may occur due to any part of the workforce and their families choosing to relocate to the area could be seen as a benefit. Some of the sporting and recreational facilities could see an increase in membership numbers, therefore enhancing the viability of associations.

The MEP would utilise the existing Millennium Mine telephone lines for both telephone and internet connections. There would be no physical impact on any existing telecommunication infrastructure.

23 IMPACTS ON TRAINING AND EMPLOYMENT

23.1.1 Construction Workforce

The appointed construction contractor(s) would be responsible for the recruitment of any additional construction workforce with labour being sourced from both within and outside the LSA. It is expected that employees for the construction phase would be sourced from:

- existing employees of contractors working on major construction projects;
- itinerant construction workers; and
- skilled and semi-skilled workers who reside in the LSA and RSA.

Historically, construction employment was direct through the mining company. That has now largely been replaced with a reliance on contracting and subcontracting. A consequence of this process is that contractors tend to take their employees with them from site to site while the employees maintain permanent residential bases elsewhere. A ready-made workforce may minimise potential job opportunities for local residents.

Considering the limited nature of construction works for the MEP, it is highly unlikely that this workforce would be sourced locally.

23.1.2 Operational Workforce

It is currently expected that each operating contractor would be required to manage the recruitment of their operating workforce. As discussed in **Section 18, Proposed Workforce,** it is envisaged that the mining contractor would employ, on average, 340 contractors.

Employees for the operational phase would be sourced from:

- existing Peabody employees;
- workers who reside in key Central Queensland regional centres;
- existing employees of contractors working on similar projects elsewhere; and
- residents from the LSA and RSA.

Peabody and the operating contractor(s) would recruit a mix of skilled and unskilled people. Recruitment of personnel would follow existing Peabody recruitment processes with contractors required to abide by Peabody's policies and standards.

As part of the recruitment strategy, residents from the LSA and RSA would be encouraged to apply for positions, assuming they have the necessary skills. However, the low unemployment rate and skills shortage within the LSA and RSA as a whole may require the workforce to be sourced from local or regional areas.

If employees are obtained locally, this is likely to be at the expense of other industries and mining operators in the LSA. Local businesses cannot generally afford to pay the same salaries as mining companies, consequently they may experience a loss in skilled labour during both the construction and operation phases of the MEP. Some local employers believe that a shortage of affordable accommodation and high wages paid by the mining industry has contributed to the difficulty they are experiencing in attracting employees to the area.

Peabody would engage in discussions with regional employment providers to encourage employment and training within the LSA. Peabody would also endeavour to work in partnership with government, industry and key stakeholders to address the skills shortage that exists within the region. Peabody would ensure pre-requisite training is provided to all employees.

Peabody is involved in a number of industry-wide and company-specific programs to:

- raise awareness of mining-related careers;
- ensure the accessibility of training and education; and
- improve skills retention within the company.

Such programs include:

- attendance at regional careers fairs to promote mining-related careers;
- sponsorship of Queensland Minerals and Energy Academy and its associated programs;
- participation in a number of industry skills development initiatives with the Mining Industry Skills Centre;
- support of trade programs in local schools and apprenticeship programs;
- an ongoing commitment to Graduate development through a two-year rotational program that has been designed to ensure Graduates receive varied and challenging development across a broad range of business functions and operations; and
- internal development through skills enhancement and leadership programs and education assistance for self-directed learning opportunities.

Peabody intends to recruit workers with a range of skills, including people with limited or no previous experience in the mining industry. Peabody hopes that this strategy will assist in reducing the potential for local businesses to experience possible skill shortages. Peabody proposes to work collaboratively with local training providers to develop and build on long-term training and up-skilling plans. Developing skills within the community would prove beneficial to the MEP.

Peabody recognises the need to attract a highly-skilled workforce and has introduced a broad recruiting effort that offers high-tech training and career development programs through its 'Next Generation Workforce' campaign (Peabody, 2008).

Peabody is committed to the principles and practices of equal opportunity employment and is seeking to increase the number of minority and female employees across all levels of the organisation (Peabody, 2008). For example, Peabody has recently developed the National Peabody Energy Australia Indigenous Employment, Training and Retention Strategy to recruit, train and retain a number of indigenous staff across the Peabody Energy Australia operations over an eighteen month period commencing July 2010. The Indigenous Employment Strategy will aim to create sustainable employment opportunities for indigenous Australians. Participants will be sourced from Job Services Australia providers, Community Development Employment Projects, TAFE, high schools, universities and relevant indigenous communities, organisations and agencies.

The difficulties faced by local residents in securing employment are exacerbated by the lack of locally-available training, lack of facilities (e.g. higher education) and infrastructure (e.g. housing). The lack of employment opportunities for partners may also prevent suitable candidates from taking up employment. Peabody would provide, where appropriate, employment opportunities for partners of workers.

A large proportion of the employment generated by mining operations is not in jobs at the mine site itself, but in ancillary activities such as transportation, processing, the manufacturing and supply of mining equipment and the supply of goods and services to mining communities. Many of these jobs, due to the nature and complexity of the work, are located outside the mining community and in the larger and major manufacturing centres of Queensland, Australia or overseas. Relatively few are located in the LSA (Maude and Hugo, 1992).

Local drivers for fluctuations in Moranbah and Coppabella's workforce may be associated with immediate causes such as:

- training - the number of people entering training;
- wastage - the number of people trained in a skill, but not working in that occupation;
- migration - the impacts of the global labour market; and
- workforce exits - the number of people permanently leaving the workforce.

A shortage of skilled workers existed in the Isaac Region prior to the economic downturn. It is not yet known how this would impact the employment opportunities for the MEP in the long-term. Staff for the MEP would be sourced locally where available however, as discussed in **Section 17**, there is already a shortage of skilled workers in the area.

A minor increase of higher income earners in the LSA is anticipated due to the MEP and can be expected to have some beneficial secondary impacts on spending, demand for services and job creation.

24 HOUSING AND ACCOMMODATION

Consultation with various stakeholders suggests that the demand for housing within the LSA outweighs supply. Aside from the quantity of housing available, issues such as quality and suitability of the dwellings available is not adequate.

Other housing issues include high private sector rents, lack of purchase opportunities, as well as a shortage of local builders and tradespeople for the construction of new properties. Where there are properties for sale, many newcomers are reluctant to purchase because of perceived difficulties and costs associated with selling the property if, and when, they relocate.

Approximately 95% of the MEP construction and operational workforce would be housed at the MAC Coppabella Accommodation Camp, and MAC Moranbah Accommodation Camp if required. The remaining 5% of the workforce is likely to seek permanent accommodation in the LSA.

Therefore, limited pressure on the LSA housing market is anticipated as a result of the MEP. Although a small proportion of the future workforce may take up permanent residency in the LSA, the impact of this proportion on the local housing market is anticipated to be minor.

The workers that choose to relocate may seek temporary accommodation in hotels, motels and caravan parks. They may also choose to purchase their own home, rent privately or reside outside of the LSA or RSA.

Given the relatively low number of new employees that would be required by the MEP, significant accommodation requirements resulting from the MEP in the LSA or RSA are not expected.

25 IMPACTS ON LOCAL COMMUNITY VALUES, VITALITY AND LIFESTYLE

Community identity is about how a community perceives itself and how it is perceived by others. It comprises the character, values and activities of a community that makes it unique.

The MEP is not expected to have and adverse effect on the values, vitality and lifestyle that exists in the region. The town of Moranbah was founded specifically to service mines in the area and the local community has been significantly shaped by the development of the mining industry for many years and still conforms to the identity of a town that is predominantly dependent on the mining industry. Conversely, Coppabella is a small community based around the rail network.

The increased visitor presence in Moranbah and Coppabella suggests that DIDO and FIFO arrangements have become an increasingly popular way of attracting workers to regional and remote mining towns. Both DIDO and FIFO working arrangements impact on community interaction and activities that are seen to build community spirit.

Barriers to participation in community activities exist due to the nature of workers shift patterns, the temporary nature of residence and commitments to families, friends and activities elsewhere. Therefore, MEP employees would have negligible impact on community activities or lifestyle.

The Community Survey undertaken for the MEP found that 91% of respondents living in the region believed their quality of life was either 'very good' or 'good' and the sense of community and family friendly atmosphere were highlighted as the main reasons for their satisfaction.

The majority of the construction and operational workforce would be housed in single person's quarters during their shifts. This approach can affect families as employees are away from home for extended periods of time. Employees who choose to move into the region with their families often go through a period of adjustment and may initially experience some isolation. Support is available for these families through Moranbah and District Support Services.

The MAC Accommodation Camps offer workers a range of recreational facilities and activities to mitigate against a drinking culture in the surrounding area.

Most of the facilities in the LSA are multi-purpose venues that serve a number of clubs and/or activities. Some offer spare capacity for future diversification in services. A number of facilities are under-utilised due to lack of community interest, participation numbers and/or funding to undertake necessary upgrades. In smaller communities such as the LSA, greater cooperation between individual clubs is required to improve facility management and use. There does not appear to be any evidence of increased demand for sport and recreation services as a consequence of the mining industry.

The MEP is unlikely to impact on recreational facilities or affect community members' access to such facilities. Slight increases in residential population as a result of the MEP could see an increase in the membership and hence viability of some recreational pursuits. However, the extent of this impact is likely to be minimal due to the small proportion of the workforce likely to choose to relocate to the LSA.

As discussed in **Section 16, Housing and Accommodation**, during the construction phase of the MEP it is unlikely that many workers would relocate to the area, thus the impacts of this workforce on the LSA would be minimal. Instead workers would be housed in self-contained village style accommodation in the MAC Coppabella Accommodation Camp. The self-contained facilities restrict the need for the workforce to access some of the services provided in the surrounding towns of Coppabella and Moranbah.

Although it is unlikely that the construction workforce would have a significant impact on the townships of Moranbah and Coppabella, some of the workforce may like to become part of the community on a social level.

Again slight increases in residential population as a result of the MEP could see the viability of some recreational, sporting and cultural pursuits increase.

Through the Community Survey undertaken as part of the MEP stakeholder and community engagement process, a number of local residents raised concerns over the shortage of affordable

housing and the trend towards the growing number of purpose-built accommodation camps housing proportionally high numbers of single males.

Respondents believed that left unmanaged, these issues could negatively affect the social values of the local townships. It was indicated by the respondents that there was a preference to have the workforce relocate to the area along with their families to preserve and enhance the community's social profile. However, considering the existing challenges over quantity and suitability of housing available, relocating a large proportion of the construction and operational workforce, as well as their families to the LSA, would not be viable because of a lack of suitable infrastructure.

The MEP would have no negative impacts on family wellbeing, community cohesion or demand for community services.

Research suggests that although residents were not aware of large numbers of specific incidents, they believed that the increased presence in the area of non-resident males employed to service mining development constituted an increased threat to both property and public safety.

Statistically, the number of reported crimes has increased in proportion to the population, however, the overall rates for the LSA have remained relatively low in comparison to the other study areas.

The subjective perception that the influx of single males will increase crime rates is a significant social impact. It is therefore important to consider the actual incidence of criminal offences and trends in the rate of crime over time in the LSA. **Tables 1-34** shows the breakdown of reported crimes.

Table 25-1 Breakdown of reported offences

Offences Against the Person	Offences Against Property	Other Offences
Homicide*	Unlawful entry	Drug offences
Other homicide**	Other theft (not including unlawful entry)	Prostitution
Assault (other than sexual)	Fraud	Weapons act offences
Sexual offences	Handling stolen goods	Traffic and related offences
Robbery		Good order offences
Other offences against another person		

Source: Queensland Police Service, 2009
*murder
**attempted murder, conspiracy to murder, manslaughter (excluding by driving), driving causing death

While cause and effect relationships are difficult to determine, there is some evidence that crime rates have increased since the commencement of mining in the LSA. **Table 1-34** describes the types of offences while **Table 1-35** details the number of offences reported in Moranbah from 2004 to 2008. There were no crime statistics available for Coppabella. 'Other Offences' in Moranbah recorded the highest numbers in 2008 at 313 and this has steadily increased from 2004.

Table 25-2 Number of offences reported for Moranbah from 2004 to 2008

Moranbah - reported for 2008					
	2004	2005	2006	2007	2008
Offences Against the Person	24	38	29	38	48
Offences Against Property	273	156	178	220	220
Other Offences	179	202	226	258	313
Total	**476**	**396**	**433**	**516**	**581**

Note: This is preliminary data and may be subject to change.
Source: Queensland Police Service, 2009

As shown in **Table 1-36**, in 2008, 'Other Offences' was the dominant crime category for the LSA, RSA and MSA with 'Offences Against Property' having the highest incidence in Queensland. The most common incidents the police are called out to in the LSA are public nuisance offences such as dangerous driving and drunk and disorderly conduct.

Table 25-3 Number of offences reported for the LSA, RSA, MSA and Queensland in 2008

Reported for 2008				
	LSA*	RSA	MSA	Queensland
Offences Against the Person	48	119	579	31,702
Offences Against Property	220	486	4,011	203,075
Other Offences	313	722	4,630	167,539
TOTAL	**581**	**1,327**	**9,220**	**402,316**

Note: This is preliminary data and may be subject to change
Source: Queensland Police Service, 2009
*Information for Coppabella was not available

As seen in **Table 1-37**, for each of the major crime categories, offence rates per 100,000 people were substantially higher at State level apart from 'Other Offence' which had a higher occurrence in the MSA. The LSA had the lowest occurrence of offences overall. This result clearly shows that an increase in the non-resident population does not inevitably result in an increase in crime rates. Peabody hopes that publishing these facts will help dispel the negative perceptions about mine workers.

Table 25-4 Number of offences reported for the LSA, RSA, MSA and Queensland per 100,000 population for 2006

Reported per 100,000 population for 2006				
	LSA*	RSA	MSA	Queensland
Offences Against the Person	365	677	573	812
Offences Against Property	2,239	2,764	3,971	5,201
Other Offences	2,842	4,107	4,583	4,291
TOTAL	**5,446**	**7,548**	**9,127**	**10,304**

Note: This is preliminary data and may be subject to change
Source: Queensland Police Service, 2009
*Information for Coppabella was not available

The LSA, in general, has a very low crime rate in relation to other regional and State figures.

It is impossible to determine the direct cause and effect relationship between implementation and operation of local mines and changes in crime rates in the surrounding LSA and RSA. This may be purely coincidental and does not take into account other activities occurring within the LSA and RSA at the time.

The construction and operational workforce of the MEP would adhere to Peabody's standards, procedures and codes of conduct which will be incorporated from Peabody's existing operations at the Millennium Mine. These procedures would be utilised to develop and enhance workers' behaviour both in and outside of the workplace to mitigate any possible negative impacts to the community in which they work and live.

Workplace policies in relation to drug and alcohol use are strictly enforced by Peabody. Company expectations including the need to maintain good relations with the local community will be communicated regularly to both the construction and operational workforce over the life of the mine.

26 IMPACTS ON HEALTH AND SOCIAL SERVICES

The difficulty in recruiting and retaining health care professionals in regional communities generates two primary issues. Firstly, there are fewer health care professionals to take care of the medical needs of communities. Secondly, members of the workforce, especially those with families, are not interested in living and working in small regional communities without easy access to health care.

Without a population catchment capable of supporting a medical practice, small communities find it difficult to attract doctors and other health care providers.

The MEP would have little or no effect on the supply or demand for medical services in the Isaac Region. Minor injuries on-site would be dealt with by first aid officers working for the MEP, and more serious injuries would be transported to Moranbah Hospital or Mackay Base Hospital for treatment.

It is envisaged that there would be a small increase in the amount of traffic utilising Peak Downs Highway associated with the operational workforce being transported via bus from their accommodation to the MEP. An assessment of road impacts, including management strategies, is discussed in detail in EIS Chapter 8, Transport.

The potential for serious traffic injuries to put pressure the local medical services is low and as such, no additional emergency service providers are required to meet the needs of the additional workforce.

Discussions with local service providers indicated that in many cases service delivery associated with health and community care is operating below capacity. It was indicated that this capacity may be negatively impacted upon if a large increase in the population occurred.

Community services provided by organisations such as ELAM, Domestic Violence Resource Service, Moranbah and District Support Services and various other support services for the LSA and RSA could be negatively impacted upon if a large change in the population occurred. Representatives from these organisations indicated that they were operating below capacity and thus the impact of the MEP on the delivery of their services would be nil to low.

While it is not anticipated that the MEP itself would have significant impacts on health and social services delivery, long-term issues associated with the potential increase in mining operations could result in cumulative impacts for the LSA and RSA.

27 LOCAL SERVICE REVENUE

Wealth created through the mineral exploration, mining, mineral processing and support industries (e.g. equipment supply and maintenance) flows throughout the community. This wealth creation can be achieved through processes such as:

- circulating money through the economy—the money that mining companies and mine workers spend in their local communities is important to maintaining strong regional economies;
- providing jobs in service and support industries—the mining industry purchases a wide range of services from within the State, nationally and internationally;
- providing jobs in infrastructure provision, such as road, rail and port facilities operation, expansion and maintenance;
- contributing to government incomes that fund social services—royalties as well as company and income taxes paid by mining companies that are returned to fund social services for the community in the form of hospitals, schools, police, roads and welfare support;
- directly contributing to social and environmental programs; and

- returning profits to shareholders—including direct investors and superannuation fund participants (Department of Mines and Energy, 2007).

Economic impacts of mining industry activity are closely linked to levels of employment in the LSA and spending in the local economy. While the economic impact of the MEP on local and regional economies is provided in EIS Chapter 17, Economy, a brief summary is provided below.

Local and regional businesses likely to benefit financially from the construction and operation of the MEP include:

- accommodation providers in the area who may see an increase in patronage for short-term accommodation during both the construction and operational phases. This impact is not expected to be significant as most short-term accommodation providers are already operating close to capacity;
- local businesses expanding when contracted to provide goods and services to the MEP, as well as people employed by those businesses. Where possible, Peabody would encourage contractors to utilise local suppliers and sub-contractors; and
- businesses supplying perishable goods such as dairy products, fruit and vegetables.

The local towns of Moranbah and Coppabella would experience some economic benefits from the net increase in the population due to the MEP. The long-term economic viability of the local communities would, however, be dependent on establishing and maintaining economic diversity. This subject is examined further in EIS Chapter 17, Economy.

Contractors tendering would be required to identify the component of their proposal to be sourced locally.

A comprehensive SCEP is being used to communicate with local and regional service providers and the general community during the approval phase of the MEP. This would continue through the construction and operational phase through to closure of the mine. A CRG was established and members of the local community were invited to participate. Consultation includes keeping the community informed of the MEP approvals process, timelines, key project milestones as well as all contract opportunities available to local service providers. Community expectations of the economic impacts of the MEP would be managed effectively through this ongoing communication strategy.

It has been recognised that mining in the Isaac Region has led to the expansion of other sectors to service the mining industry. It is not expected that the MEP would result in significant new business opportunities in the townships of Moranbah and Coppabella as the MEP (in the longer-term) would generate little additional demand for services beyond those already provided.

Peabody will assist, where appropriate, in promoting Indigenous business opportunities within the LSA and RSA. Peabody will also be involved in identifying business, employment and training opportunities with and for the local identified Traditional Owner group/s. As described in **Section 23.2**, Peabody has recently developed the National Peabody Energy Australia Indigenous Employment, Training and Retention Strategy to recruit, train and retain a number of indigenous staff across the Peabody Energy Australia operations.

28 LOCAL LAND USE

Mining leases are generally classified as Agricultural Land Class C (Pasture Land – suitable only for improved or native pastures, due to limitations which preclude continuous cultivation for crop production). The majority of the land that is being utilised by the MEP is categorised as Suitability Class Five (unsuitable) for dryland cropping, and Classes Two to Five (well–suited to unsuitable) for grazing. Details of a comprehensive land suitability survey conducted for the MEP to confirm the pre-disturbance land conditions can be found in EIS Chapter 7, Land Resources.

The entirety of the MEP area and surrounds has historically only been used for low intensity cattle grazing. Current land uses include grazing and coal mining. Compensation agreements are currently in place between Peabody and affected landowners.

Land disturbed by the MEP operation would be returned to low level grazing land where practical. Notable exceptions of disturbance categories that would not be returned to grazing land include voids, dams, tailings emplacements and remaining infrastructure such as the access road. The principal restoration objective is to reconstruct disturbed lands to a stable and self-sustaining state. Final landforms would be constructed to achieve two general post mining land uses described in EIS Chapter 5 (Areas Suitable for Grazing), and (Areas Not Suitable for Grazing).

The MEP is not expected to significantly diminish or discontinue the future use or development of surrounding areas for cropping, grazing, forestry, recreation, industry, education, aesthetics, or scientific or residential purposes beyond its existing capability.

Access to culturally important areas and landscapes outside of the MEP area would not be affected by the project.

29 EDUCATIONAL IMPACTS

Attraction and retention of skilled people and professionals in Queensland's rural and regional areas is often identified as a major issue. Skill shortages in certain professions can significantly affect standards of living, in particular health and quality of life and limit the capacity for regions to capitalise on their comparative advantages and socio-economic opportunities (Department of Transport and Regional Services, 2004).

Education and training levels are generally low in the region, suggesting that the population may be vulnerable to downturns in established economic sectors including mining and agriculture. It can also be a constraint on the ability of the community to initiate alternative economic opportunities.

Information provided by schools in the LSA suggests that most of the educational facilities in the area have capacity to take on additional students and that the provision of primary and secondary education would remain unchanged as a result of project construction or operation.

Recruiting and retaining teaching staff due to the lack of accommodation in the area was raised as an issue by education spokespeople. This is a long-term issue that needs to be addressed collaboratively by Local and State Governments and key stakeholders.

The level of impact that the MEP would have on educational services and the need for expansion of facilities and teaching staff would be determined by the number of workers who choose to move into the LSA and RSA with their families. As previously discussed in **Section 18, Proposed Workforce**, approximately 5% of the operational workforce may choose to relocate to the LSA and RSA. This may be either as a single person or as a family.

The small number of additional employees is expected to have little or no effect on the demand for educational services in the Isaac Region.

Ongoing identification and support of Indigenous business opportunities could be realised through the provision of education and training of local Indigenous groups.

Peabody provides environmental information and addresses concerns raised through its CRG. This is expected to continue throughout the life of the mining project.

30 MINE CLOSURE

Demographic and other changes in the LSA have seen Moranbah and Coppabella develop the characteristics of towns that are dependent on mining and therefore have increased vulnerability to mine closure.

Downsizing of operations among major mining employers would inevitably raise issues in relation to the desire of a number of residents to stay in these towns and the limited capacity of Local Government under these circumstances to maintain services. This may cause negative economic impacts sooner if the MEP is not approved.

A detailed mine closure plan that assesses the impacts on the LSA and identifies additional management strategies would be developed well in advance of closure and decommissioning of the Millennium Coal Mine. This plan will be developed in consultation with appropriate stakeholders and the Department of Environment and Resource Management (DERM). Further examination of this topic is provided in EIS **Chapter 5, Rehabilitation and Decommissioning**.

31 CUMULATIVE IMPACTS

Any major development in a community is accompanied by a degree of change and additional pressures for that community to adapt to these changes. This impacts on prevailing community values and identity as there are many competing influences which challenge community cohesion.

Historically, community studies and research are inclined to interpret the term 'cumulative impacts' as referring to negative more than positive outcomes. Although the positive economic contribution of coal mining is widely acknowledged, most residents that were consulted through the engagement process have tended to focus on the negatives.

The 2008 Coal Infrastructure Program of Actions report (DIP, 2008c) identified the need to take industry-wide strategic planning for future growth in coal demand and production. A Coal Infrastructure Taskforce was established to develop the Queensland Coal Infrastructure Strategic Plan which will give an overview of future transport infrastructure expansions and will provide a summary of committed and planned infrastructure expansions as well as indicative capacity expansions to 2020.

As plans for additional mines to open or expand in the area are realised, substantial cumulative impacts may be expected. This is of particular importance considering the number of already existing mines operating in the area as well as the proposed growth in mining operations predicted for the LSA and RSA. In this context, the potential additional impacts from the MEP also need to be considered.

The GFC had a significant effect on mining companies with resultant job cuts and retrenchment of employees across the industry. With the number of resource companies seeking approvals in the area, it is possible that the cumulative impacts of these projects will have a positive effect on the employment market now that an up turn in the resources market has occurred.

It is not expected that the MEP itself would have a significant impact on the LSA and RSA. However, if other mining developments proposed for the region are taken into consideration, some social impacts could result. The local community may potentially face a number of cumulative negative issues which include:

- housing shortages, affordability and lack of suitability;
- changes in participation rates in community groups and sporting clubs;
- disparity between mining incomes and other occupations;
- transient population - includes people moving into and out of the area in search of employment, as well as leaving due to lack of further education and aged care services;
- non-mining skill shortages; and
- increased traffic on the Peak Downs Highway.

Potential positive cumulative impacts from mining include:

- increased economic viability and wealth into the community;
- a buffer for the local economy from future economic downturns;
- increased number of skilled and semi-skilled positions available to the local community;
- promotion of Indigenous business opportunities and increased training/employment opportunities for Indigenous Australians; and
- increased population – increased participation rates in community groups and sporting clubs – leading to more viable ventures.

The townships of Moranbah and Coppabella as well as the Mackay area are currently experiencing a range of cumulative impacts from the growth in the mining industry in the Bowen Basin. While these negative and positive impacts may be marginally compounded by the MEP, none are likely to be significantly affected by the project alone or become unmanageable.

The Bowen Basin coalfield is one of Australia's primary coal mining areas. Sufficient known reserves exist in the Bowen Basin for over 200 years at current extraction rates (Department of Local Government, Planning, Sport and Recreation, 2007). The area directly surrounding the LSA has 15 operational mines, with a further 10 under consideration or in the early development stage.

Table 1-38 and **Table 1-39** detail the coal expansion projects and operating coal mines for the Moranbah and Coppabella area. As can be seen, future development activity over the next couple of years is likely to be concentrated in this area.

Table 31-1 Coal Expansion Projects in the Moranbah Area

Project	Company	Workforce		Expected Start Date	Life of Mine
		Construction	Operations		
Grosvenor	Anglo Coal	400		2013	30 years
Caval Ridge	BMA Coal	1200	495	2013	30+ years
Daunia	BMA Coal	450	300	2011	21 years
Goonyella Riverside mine expansion	BMA Coal	900	700	2013	INA
Peak Downs Mine Expansion	BMA Coal	INA	INA	2013	INA
Olive Downs	Macarthur Coal	INA	INA	2013	INA
Eaglefield Expansion Project	Peabody Energy	600	400	2011	21 years
MEP	Peabody Energy	160		2011	17 years
Eagle Downs	Vale/Aquila	60-360	420-570	2010	30+ years
Ellensfield	Vale	250-300	220-240	2011	20-30 years
Integrated Isaac Plains Project	Vale/Aquila	20-40	80	2010	15 years

Source: Matrix+ Consulting (2006); URS (2007); BMA (2008a); BMA (2008b); Hansen Bailey (2008); BMA (2009); DERM (2010); Department of Mines and Energy (2010); Hansen Bailey (2010); Queensland Government (2010)

*INA - Information Not Available

Table 31-2 Coal Mining Projects Operating in the Isaac Region

Project	Company	No of employees	Average Annual Production Million tonnes/annum
Moranbah North	Anglo Coal	303	4.5
Broadmeadow	BMA Coal	394	3
Goonyella Riverside	BMA Coal	1,420	4
Peak Downs	BMA Coal	1,215	9
Poitrel	BHP Mitsui Coal	159	3
South Walker Creek	BHP Mitsui Coal	295	3.2
Coppabella	Macarthur Coal	463	2.2
Moorvale	Macarthur Coal	175	1.9
Burton	Peabody Energy	311	5
Millennium	Peabody Energy	170	1.5
North Goonyella	Peabody Energy	475	3.5
Eaglefield	Peabody Energy	145	2
Broadlea North	Vale	45	INA*
Carborough Downs	Vale	194	3
Isaac Plains Coal Mine	Vale	79	2.8

*INA - Information Not Available

There is a need for collaboration between the local mining industry and other external agencies to improve the capacity to monitor and manage cumulative impacts of mining on communities. This would enable the establishment of a monitoring framework to track trends in social capital, community well-being and environmental conditions. This has recently begun through the QRC's Social Policy Working Group.

Establishing key social indicators for the local community and a common set of social performance measures for local mining companies would be beneficial to enable the tracking of community perceptions of mine-related impacts.

32 DRAFT SOCIAL IMPACT MANAGEMENT PLAN

Section 4.10.2 of the TOR states:

> *A draft social impact management plan should be presented that promotes an active and ongoing role for impacted communities, local authorities and government agencies through the project life cycle from planning, construction, operations and decommissioning. The draft plan should cover:*
>
> - *action plans for the implementation of mitigation strategies and measures;*
> - *assignment of accountability and resources;*
> - *reporting mechanism for activities and commitments;*
> - *mechanisms to respond to public enquiries and complaints;*
> - *mechanisms to resolve disputes with stakeholders;*
> - *periodic evaluation of the effectiveness of community engagement processes; and*
> - *practical mechanisms to monitor and adjust mitigation strategies and action plans to achieve best outcomes.*

The community consultation undertaken as part of the EIS process (described in detail in **Section 3** and Appendix E of the EIS) has encouraged an active and ongoing role for impacted communities, local authorities and government agencies during the project planning stage. The consultation undertaken to date has reinforced Peabody's commitment to involving the community in the development of mitigation and management strategies, both to increase the success of the techniques, and also to benefit the community.

A standalone Social Impact Management Plan (SIMP) which addresses the requirements of the TOR and the draft guideline *Social Impact Assessment: Preparing a social impact management plan* (draft SIMP Guideline) and builds upon the mitigation and management measures proposed in this EIS, will be developed following Project Approval.

The draft SIMP Guideline indicates that "a social impact management plan only covers the period from project approval onwards". The standalone SIMP would provide a framework for ongoing management of social impacts during the construction, operations and decommissioning stages of the MEP. The development of the SIMP will involve extensive consultation with relevant local, state and federal government departments, local community and industry, utilising a range of community techniques including community workshops, face-to-face meetings, partnership and surveys.

Specific details relating to the implementation of the SIMP (e.g. timing and personnel responsibilities) will be further refined during the SIMP consultation and development process.

The following subsections address the requirements of the TOR relating to the draft SIMP with reference to the draft SIMP Guideline.

32.1.1 Action Plans

Specific action plans for the implementation of mitigation strategies and measures will be detailed in the SIMP. As indicated above, these action plans will be developed in consultation with government, industry and the community and will build upon the mitigation measures proposed in the EIS (e.g. action plans will focus on infrastructure and services, training and employment, housing and accommodation, community values, vitality and lifestyle, health and social services, local service revenue, land use, education and indigenous participation).

The SIMP will outline the specific objectives, accountabilities and key activities relevant to each action plan.

32.1.2 Accountability and Resources

Once finalised, the SIMP will be submitted to the DIP and will be made publicly available.

The delivery and implementation of the SIMP will include:

- facilitating the necessary internal organisational change;
- integrating the social impact mitigation measures detailed in the SIMP into construction, operation and decommissioning management planning; and
- integrating the social impact mitigation measures detailed in the SIMP into contractors' delivery and performance.

Specific accountabilities for the implementation and monitoring of the SIMP will be negotiated as part of the development of the SIMP. Those accountable for delivery of the SIMP will include Peabody personnel at the management, operations and contractor levels. The success of social impact mitigation and management measures will be monitored and reported as described in **Section 32.3** and **Section 32.4**.

32.1.3 Monitoring

Peabody will implement a monitoring programme to achieve the following objectives:

- track the progress of implementation of mitigation measures and action plans;
- evaluate the effectiveness of social impact mitigation measures and action plans against a set of performance criteria;
- provide information on progress and achievements to be relayed to the local community and government;
- facilitate dialogue with stakeholders; and
- provide for adaptive management and continual improvement, with monitoring results used to inform mitigation measures and action plans.

Monitoring will commence following Project Approval with the details of the monitoring programme (e.g. targets, monitoring criteria, indicators, specific accountabilities, information sources and frequency) presented in the SIMP.

Peabody will undertake internal annual reviews of the SIMP. External review of the SIMP will be conducted at appropriate intervals.

32.1.4 Reporting Mechanisms

The results of the SIMP monitoring programme will be reported annually in the CRG meetings for dissemination to the relevant community groups and local authorities.

The results of the internal SIMP review will also be reported at this time, and will be forwarded separately to the Social Impact Assessment Unit of the DIP.

32.1.5 Evaluation of Community Engagement Processes

The SIMP will include a stakeholder engagement strategy which identifies the key stakeholders and their interests and describes actions to promote stakeholder engagement.

Peabody will evaluate/review the effectiveness of the stakeholder engagement strategy by conducting periodic community surveys at various stages of the MEP. The results of the community surveys will be analysed and used to refine the SIMP and implementation of mitigation measures.

32.1.6 Public Enquiries and Complaints

Peabody has established a range of mechanisms to enable the public to lodge enquiries and/or complaints in relation to the MEP. These mechanisms will remain in place during construction, operations and decommissioning of the MEP and include the following:

- Peabody website, which includes phone, mail and email contact details;
- Community Reference Group (CRG) meetings; and
- community surveys.

Peabody has also developed mechanisms to respond to enquires and/or complaints lodged by the public in relation to the MEP. These mechanisms will continue to be used during the construction, operations and decommissioning of the MEP and include the following:

- recording of all enquiries/complaints received using the 'Consultation Manager' stakeholder management software;
- considering and implementing appropriate follow-up action(s);
- providing a verbal and/or written response to all enquiries/complaints informing stakeholders how their concerns and queries will be addressed;

- recording of Peabody's responses using Consultation Manager;
- compliance with Peabody's 'Dispute Resolution Procedure' (**Section 32.7**);
- direct response to enquiries and/or complaints during CRG meetings and recording via meeting minutes; and
- annual reporting on enquiries, complaints and Peabody's responses.

32.1.7 Dispute Resolution Mechanism

Peabody will adopt a proactive approach to community enquiries and/or complaints. Appropriate dispute resolution mechanisms will enacted to handle grievances, through the CRG forum. Any grievance that cannot be addressed by Peabody or through the CRG may be forwarded to a mediator such as the Social Impact Assessment Unit of the DIP, for consideration and advice.

33 SUMMARY

In isolation, it is envisaged that the MEP is unlikely to have a significant impact on the social wellbeing of local and regional communities by creating new issues or significantly compounding existing issues.

Overall, stakeholders were either neutral or supportive of the MEP. In order to maintain active stakeholder and community engagement activities, impact mitigation methods would be reviewed and further developed where consultation identifies the requirement. Examples could include scheduled construction activities and a detailed construction communication program to notify potentially impacted stakeholders of upcoming works. The construction and operation of the MEP is not expected to significantly impact on the lifestyle, amenity or community cohesion of local communities in the LSA and RSA.

Monitoring programs are already in place for the existing Millennium Mine and these would be modified to incorporate the MEP. In addition, current mitigation measures for existing mining at the site will be extended to cover the expansion area. The main body of this EIS assesses all of the potential environmental impacts which may result from the MEP and mitigation measures are proposed in the Environmental Management Plan in **Chapter 20**.

The MEP offers scope for a net economic benefit to the LSA and RSA as well as Queensland without significant social or environmental costs.

In summary, comments raised throughout the engagement and consultation process focused on impacts during the operational phase of the MEP. The most commonly noted issues were impacts to the availability and affordability of housing, employment opportunities, potential skill shortages and increased number of non-resident population. Other less frequent issues included traffic impacts, dust and economic viability of the community.

The lack of housing is restricting the movement of new families into the area and is also putting additional financial pressure on lower and middle income earners, forcing many to move out of the area in the search for more affordable accommodation. This in turn has the capacity to reduce the quantity of available labour within the community. However, the IRC is releasing land for residential development.

The continuing trend of housing mining workers in camp-style accommodation will result in minor changes to the current community values and lifestyle of Moranbah and Coppabella. While Peabody is not in a position to address this housing crisis autonomously, they acknowledge their role as part of a collaborative approach alongside Local and State Governments, industry, key stakeholders and community members.

Peabody highly values the positive relationship it has developed and is continuing to develop with the local and regional communities in which it operates and will continue the CRG throughout the life of the MEP.

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Millennium Expansion Project

Environmental Impact Statement

APPENDIX F12:

ECONOMICS

Final Economic Impact Assessment Report Millennium Expansion Project

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MET Serve

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Contents

1.	**Introduction**	**1**
2.	**Project description**	**1**
3.	**Existing economic environment**	**2**
3.1	Scope	2
3.2	Study area	2
3.2.1	Mackay LGA	3
3.2.2	Isaac LGA	3
3.3	Population demographics	4
3.4	Housing	5
3.5	House prices	5
3.6	Labour	6
3.7	Industries	7
3.7.1	Jobs by industry of occupation	7
3.7.2	Types and numbers of businesses	9
3.7.3	Coal mining	10
3.7.4	Mining and support services	10
3.7.5	Construction	11
3.7.6	Agriculture and farming	12
3.7.7	Gas	12
4.	**Project Environment**	**12**
4.1.1	Purpose of project	12
4.2	Economic impacts of the MEP	13
4.3	Phase One (2011 to 2015)	13
4.4	Phase Two (2016 to 2027)	15
4.5	Decommissioning	16
4.6	Local significance	17
4.6.1	Employment	17
4.6.2	Local businesses	18
4.6.3	Housing	18
4.6.4	Local community infrastructure and services	19
4.7	Regional significance	19
4.7.1	Coal demand and exports	19
4.8	Costs to government	20
4.9	Government revenues	21
4.9.1	Coal royalties	21
4.10	Rail and port charges	21
4.10.1	State payroll tax	21
4.10.2	Local government revenue	22

4.10.3 Proposed Minerals Resource Rent Tax 22
4.11 Ecosystem impacts and alternative land use 23
4.11.1 Ecosystem impacts 23
4.11.2 Alternative land use 24
5. Conclusions 25
6. References 25

Appendix A

Input - Output methodology

1. Introduction

This assessment has been prepared to identify potential economic impacts, including direct and indirect impacts, of the Millennium Expansion Project (MEP). The economic environment considerations that have been addressed for this Environment Impact Statement (EIS) have been provided for in the final Terms of Reference (TOR). These considerations are as follows:

- Describe the existing economic environment that may be affected by the MEP
- The significance of the MEP on the local and regional economic context
- The long and short-term beneficial (eg job creation) and adverse (eg competition with local small business) impacts that are likely to result from the development
- The potential, if any, for direct equity investment in the MEP by local businesses or communities
- The cost to all levels of government of any additional infrastructure provision
- Implications for future development in the locality (including constraints on surrounding land uses and existing industry)
- The potential economic impact of any major hazard identified
- The distributional effects of the MEP including proposals to mitigate any negative impact on disadvantaged groups
- The value of lost opportunities or gained opportunities for other economic activities anticipated in the future
- Impacts on local property values.

The assessment has adopted an Input-Output (I-O) analysis to identify regional and state economic impacts relating to employment, income and output.

Material sources used in the assessment include economic data in the public domain and project specific information. The “Millennium Expansion Project – EIS Schedule Summary V5” (February 2010) has been used extensively. Appendix A contains a description of the I-0 method adopted in this assessment.

2. Project description

The Millennium Mine is located approximately 22 km east of Moranbah and 16 km southwest of Coppabella in Central Queensland. The MEP seeks to increase the existing the current mine extraction rate from approximately 2 million tonnes per annum (Mtpa) to 3.5 Mtpa product coal until 2015 when the existing operations are projected to cease. The MEP also proposes to extend the life of the mine by another 12 years to 2027, providing long-term economic sustainability.

The MEP would require an increase in staff at the Millennium Mine. It is expected that most workers will come from the Mackay region utilising drive in drive out living arrangements and be housed at the Mac Camp in Coppabella during their shifts. Some workers will reside locally in Moranbah. As such, the mine’s labour catchment area for the MEP includes both the Isaac Regional Council and the Mackay Regional Council.

The existing Coal Handling and Preparation Plan (CHPP) is expected to be used following suitable infrastructure upgrades necessary to facilitate the increased production resulting from the MEP. As the CHPP is owned by the Red Mountain Joint Venture, any major modification will need to be approved by the Peabody Energy Australia Pty Ltd (“Peabody”) and BHP Mitsui Coal JV.

It is planned that the MEP will utilise the existing site access road with new mine haulage roads to be provided to the expansion areas, as well as a crossing over the New Chum Creek. Also, changes to the water management infrastructure will be required and may involve the establishment of new water holding structures due to the location of the MEP pits.

The land surrounding the proposed MEP consists of large scale coal mines and low density cattle grazing stations. The majority of the land is categorised as “unsuitable for dry land cropping” or “marginal to unsuitable for grazing”. Land that is disturbed by the MEP will be returned to low level grazing land where possible. Compensation agreements have already been negotiated with landholders to the west and southwest of the MEP as part of other leases of the Millennium Coal Mine.

3. Existing economic environment

3.1 Scope

The existing economic environment is described in terms of the demographic structure, community infrastructure and services and housing for both the Isaac Regional Council and Mackay Regional Council. These two local government areas (LGAs) will be primarily impacted by the MEP.

Beneficial and adverse economic impacts are identified and discussed (Section 4), including changes to existing land use, impacts to local community and demographic profile, and impacts associated with construction and operation of the mine expansion. Specifically potential economic impacts on communities in the LGAs of Isaac and Mackay have been scoped to develop baseline information.

There will also be economic impacts further afield along the coal logistics chain that supports the export of coal. This involves the rail transporting of coal via the Goonyella Rail System to the Dalrymple Bay Coal Terminal (DBCT) at the Port of Hay Point, south of Mackay.

3.2 Study area

The local study area includes two major regions namely Mackay LGA and Isaac LGA. The following outlines the major towns within these regions that are expected to be impacted directly and indirectly by the MEP. The map below shows the locality of the Millennium mine in the geographic context of Mackay and Moranbah and other northern Bowen Basin coal mines.

Map 1 Northern Bowen Basin

The key characteristics of the local and regional demographic profiles are detailed below:

3.2.1 Mackay LGA

The Mackay Regional Council was formed in 2008 following the amalgamation of Mackay City Council, Sarina Shire and Mirani Shire. The Mackay region has a population of 116,123 (OESR 2010), projected to continue growing at an annual rate of 2.2% to 2026 (QDIP 2008). Major towns include Mackay and Sarina.

The Mackay region is well known as the gateway to Arlie Beach and the Whitsundays, whilst sugar cane production dominates the regional costal landscape. Although agriculture dominated (particularly sugar cane) the local economy for many decades, in recent times other sectors including mining and tourism have emerged providing significant economic growth opportunities. As a result of the mining boom in recent years, the Mackay region offers considerable employment opportunities in the mining, engineering and service industries.

Mackay

Mackay city had an estimated population of 76,500 persons at 30 June, 2009. It is the dominant urban centre within the broader Mackay and Isaac regions and is the major servicing centre for the northern Bowen Basin. As such it provides the largest range of public services, infrastructure and facilities. The Port of Mackay is Queensland's fourth busiest multi-commodity port and generated $14.1 million of operating revenue in 2007/08.

Sarina

Sarina is located approximately 40 km to the south of Mackay. Sarina's population is approximately 11,990 (2008 estimate) with a city of 3,448 persons. Key industries in Sarina include sugar cane, cattle grazing, agriculture and tourism. Sarina also benefits from its proximity to coal mining areas in North/Central Queensland. Sarina is a major supplier of ethanol as a by-product of sugar processing in the area. The coal terminal and port facilities include DBCT and Hay Point Coal Terminal at the Port of Hay Point.

3.2.2 Isaac LGA

The Isaac LGA comprises the former Belyando, Broadsound and Nebo shires which were amalgamated in March 2008. The Isaac region has an estimated population of 22,417 as at 30 June 2009 (OESR 2010). Coal mining is a significant industry accounting for 76.1% of Isaac's Gross Regional Product in 2007/08. Major towns include Moranbah and Clermont with smaller towns at Glenden, Coppabella and Dysart. The shire has one of the lowest unemployment rates in Queensland with only 1.3% persons unemployed. The most common occupations in Isaac are Machinery Operators and Drivers 24.9%, Technicians and Trades Workers 20.1%, Labourers 12.3%, Professionals 9.9%, and Clerical and Administrative Workers 8.3% (2006 Census). Most employment opportunities stem from the nearby mining activities with the mines employing 38.9% of the workforce directly (2006 Census).

Moranbah

Moranbah is a town of 8,326 residents (OESR 2010) in the northern Bowen Basin. The town was established in 1971 by the Utah Development Company Ltd, purposely as a mining town. It is located approximately 200km south-west of Mackay and is the major service town for Goonyella/Riverside, Peak Downs and Moranbah North Coal Mines. In addition, Moranbah has abundant facilities including but not limited to two primary schools, high school, TAFE, sporting and recreational facilities and health facilities.

Coppabella

Coppabella is a small town which lies 59 km northwest of Nebo, and 140 kilometres south-west of Mackay. It is a major railway hub, joining the Goonyella line and the Saraji line. In 2008, the Goonyella

coal rail network increased capacity with the commissioning of the Coppabella Yard Upgrade. In addition to the activity of Queensland Rail, the town is surrounded by large scale coal mines such as the Macarthur Coal's Coppabella Mine.

Clermont

Clermont is located in the southern part of the region and is home to approximately 1,940 residents (OESR 2010). It is located approximately 400 km north-west from Rockhampton and approximately and 280 km south-west of Mackay. Clermont is the major service town for the Blair Athol and Clermont coal mines and the surrounding rural properties. The majority of employment in the town is related to the mines located nearby. Land in Clermont is zoned suitable for industrial uses, and expansion of existing mining services have been identified as possible development opportunities for the area (REDC 2008, 14).

Glenden

Glenden is a small town of 1,313 residents with a median age of only 30 years (OESR 2010). The town is located approximately 165 km west of Mackay, less than a two hour drive. It was built in 1982 to service the Newlands Coal Mine.

Dysart

Dysart is located approximately 82km south-east of Moranbah and 260 km south-west of Mackay with a population of 3,444 (2010 OESR). Dysart was established in 1973, and is a service town for the Saraji and Norwich Park coalmines, as well as the surrounding farm properties.

3.3 Population demographics

The Isaac and Mackay Regional Councils are projected to grow at a higher rate than that of Queensland. The significance of Isaac LGA predominantly as a working region is highlighted by the higher proportion of males, and a lower median population age both of which are characteristic of mining regions across Australia.

Table 1 Population demographics

	Isaac LGA	Mackay LGA	Queensland
Population (2008)	21,933	112,607	4,293,915
Population (2026) *	32,432	166,958	5,884,390
Growth rate pa*	2.2%	2.2%	1.8%
Median Age	31	36	36
Male proportion	55.7%	51.3%	49.9%

(2006 Census; OESR 2010; REDC 2008))
** Medium series projection*

As indicated below in Figure 1, the Isaac region had a very high proportion of its population within the 25 – 44 year old age group. As at 30 June 2008, 36.3 % of persons were aged 25 - 44 years within Isaac, compared to the State's average of 28.4%.

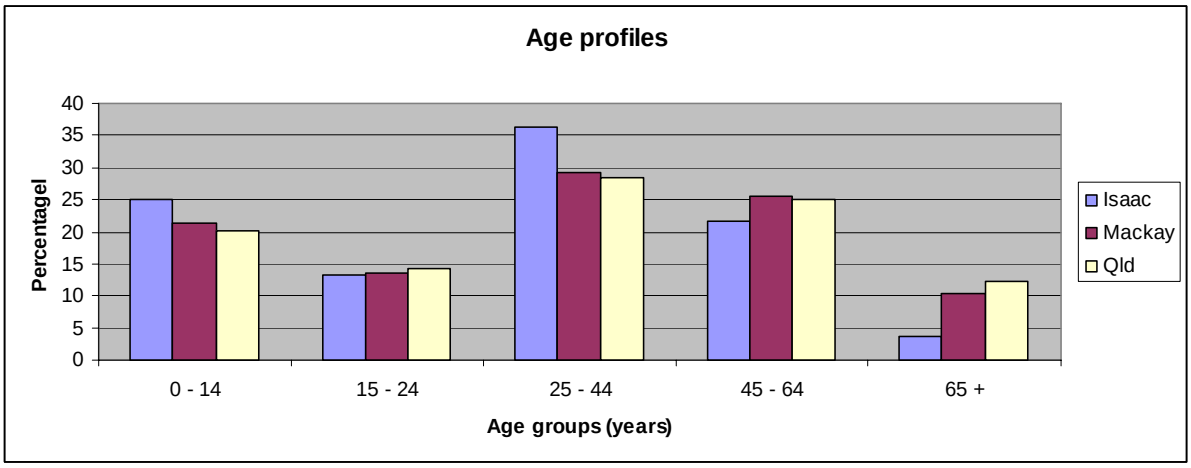

Figure 1 Age profiles: Isaac, Mackay, and Queensland (in percent of total population) 2006

Source: ABS 2006, Population by Age and Sex

3.4 Housing

The combined area of the Isaac and Mackay LGA has an estimated 39,947 occupied private dwellings with 33,970 dwellings within the dominant urban centre of Mackay. The following table provides details of the dwelling structure types by LGA:

Table 2 Occupied private dwellings (2006 Census)

Dwelling structure	Isaac	Mackay	Total	% of total
Separate house	5,403	28,624	34,027	85.2%
Semi detached	69	1,415	1,484	3.7%
Flat, unit & apartment	208	3,110	3,318	8.3%
Other	293	804	1,097	2.8%
Total	5,977	33,970	39,947	100%

Source: *QRSIS 2010*

The Separate House classification is the major type of dwelling structure with 34,027 or 85.2% of total occupied dwellings. Semi Detached housing, and Flats, Units and Apartments account for 4,802 dwellings or around 12%.

3.5 House prices

Median property prices have risen substantially within the Isaac region as indicated in the table below. The growth rate for median property prices have raised by over 700% in the past five years in Moranbah, well above the five year growth rate of 120% for Mackay region. This growth in house price over the past five years within Isaac was predominantly supported by the rapid growth by mining activities within this region. Note that house prices within Isaac would have started from a low base five years ago, in comparison to house prices within the Mackay region.

Now that median property prices within the Isaac region are comparable with those of Mackay region, future appreciation in house prices are likely to be more consistent between Isaac and those of neighbouring coastal areas of Mackay and Whitsunday.

Table 3 Median property prices (REDC)

Dwelling structure	Medium value March 2009	Change over last year	Change over 5 years
Isaac Regional Council	$380,000	11.80%	309.7%
- Clermont	$290,000	-0.9%	383.3%
- Moranbah	$389,500	19.8%	737.6%
- Dysart	$395,000	12.9%	216.0%
Mackay Regional Council	$383,000	0.30%	120.1%

Source: Real Estate Institute of Queensland

Median weekly rent prices were somewhat mixed within the Mackay region in 2009. Although strong rent increases were recorded for the region in December 2008, the Global Financial Crisis in 2009 dampened the local rental market. In 2009 weekly rents for flats were either lower, or comparable, with the rent prices recorded for 2008. Rent prices for 2 and 3 bedroom houses were actually higher in 2009, recording up to 10% growth in rent prices over 2008.

Table 4 Median weekly rent for the Mackay Region

Dwelling structure	Dec 2007	December 2008	December 2009
1 bed flat	$200	$230 (+15%)	$220 (-4.5%)
2 bed flat	$255	$280 (+10%)	$280 (0%)
3 bed flat	$330	$430 (+30%)	$420 (-2.5%)
2 bed house	$300	$300 (0%)	$310 (+2.5%)
3 bed house	$350	$380 (+8.5%)	$370 (+10%)
4 bed house	$450	$500 (+11%)	$450 (-9%)

Source: Residential Tenancies Authority

The ability of local businesses to attract new employees to the Isaac and Mackay LGAs is hindered by the lack of available and affordable non camp housing in Moranbah and other towns.

3.6 Labour

Labour profile

The labour profile for Isaac is characterised by a small population base with low unemployment levels (1.3%), well under that of Queensland (5.4%) (December 2009 Quarter). A summary of the labour force statistics is detailed below.

Table 5 Community profile data for December 2009 Quarter (OESR 2010)

	Isaac	Mackay	Queensland
Unemployed	171	2,740	127,400
Labour force	13,114	62,854	2,254,400
Unemployment rate	1.3%	4.4%	5.4%

Source: OESR 2010

Table 5 also highlights the labour market within the Mackay region. The Mackay region has a significantly larger workforce than that of Isaac, and also a higher rate of unemployment at 4.4%. Both

regions are below the State's average of 5.4%. Note that part of Mackay's registered labour force are mine staff employed within the Isaac region, residing permanently within Mackay for lifestyle reasons.

Occupations
Based on 2006 Census data, the most common occupations undertaken by employees in Isaac are:

- Machinery Operators and Drivers
- Technicians & Trades Workers
- Managers
- Labourers

Figure 2 below highlights the breakdown of occupation by type for Isaac and Mackay LGA. Clearly for Isaac, the significance of mining within Isaac is re-enforced by the relatively high proportion of employees recognised as *Machinery Operators & Drivers*.

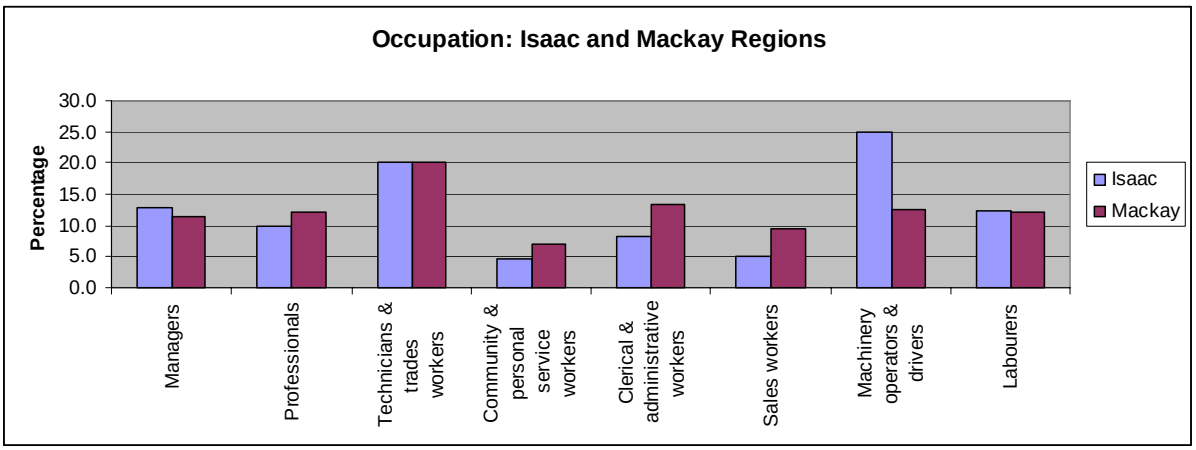

Figure 2 Occupation: Isaac and Mackay LGA[1]

Source: ABS 2006 Census Community Profile Series
[1] In percent of total employed persons aged 15 years and over (2006)

3.7 Industries

3.7.1 Jobs by industry of occupation

Isaac's economic base in terms of employment has traditionally centred upon agriculture and coal mining. In recent years the significance of mining as an employer has grown substantially, with mining now providing employment for 39% of Isaac's workforce. Together with agriculture (accounting for 11% of the workforce), these two industries dominate the local economy accounting for half of all jobs within Isaac LGA. Figures 3 and 4 graphically present the domination of mining as the key employer within Isaac.

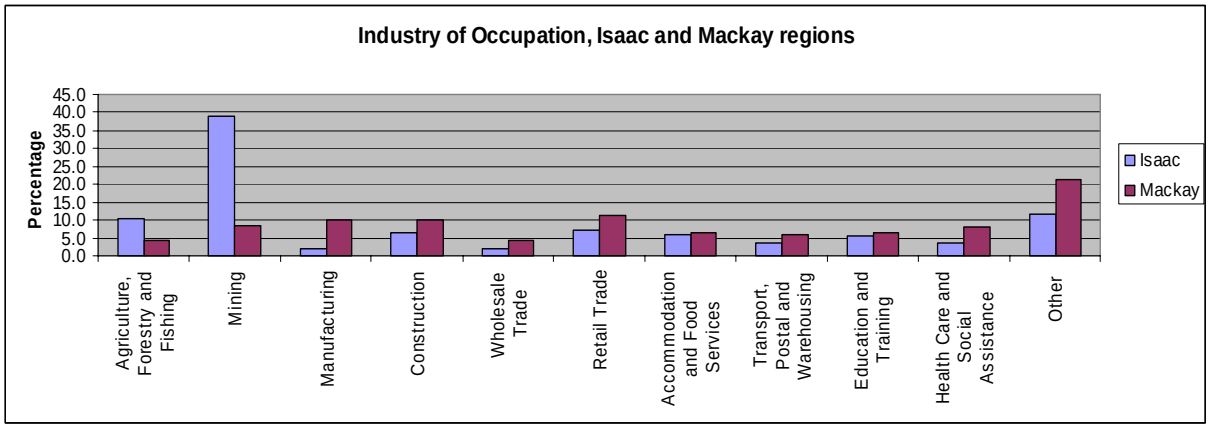

Figure 3 Industry of employment for Isaac and Mackay[1]

Source: ABS 2006 Census Community Profile Series
[1] In percent of total employed persons aged 15 years and over (2006)

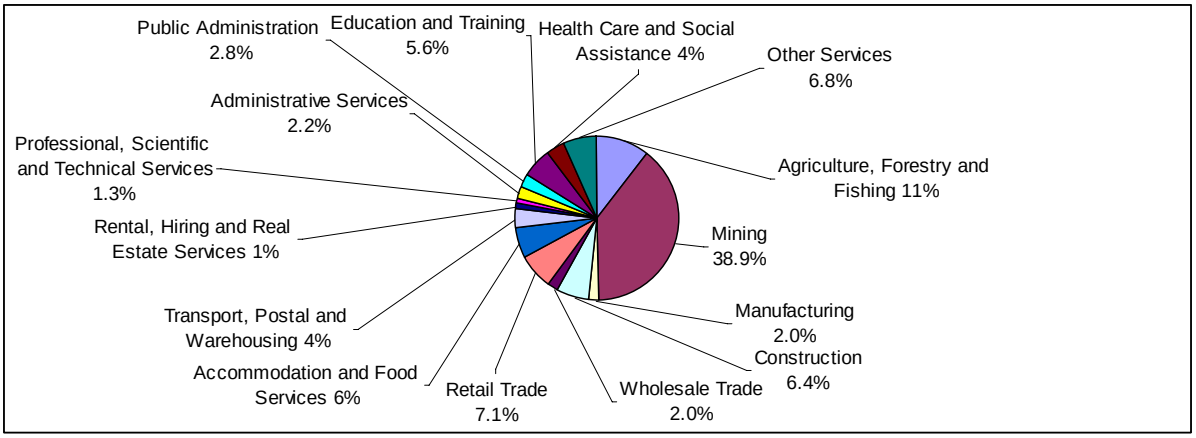

Figure 4 Industry of occupation for Isaac Region

Source: ABS 2006 Census Community Profile Series

On the other hand, Mackay's employment base is more diverse as highlighted below in Figures 3 and 5. The three largest employers (Retail 11.4%, Construction 10.1% and Manufacturing 9.9%) combined only accounted for 30% of all jobs. This highlights Mackay's significance as a diversified regional centre and township, providing a wide array of products and services to neighbouring regions. Note that a significant proportion of Mackay's registered mining employees (8.3%) are likely to work within the Isaac region, but may chose to reside within Mackay.

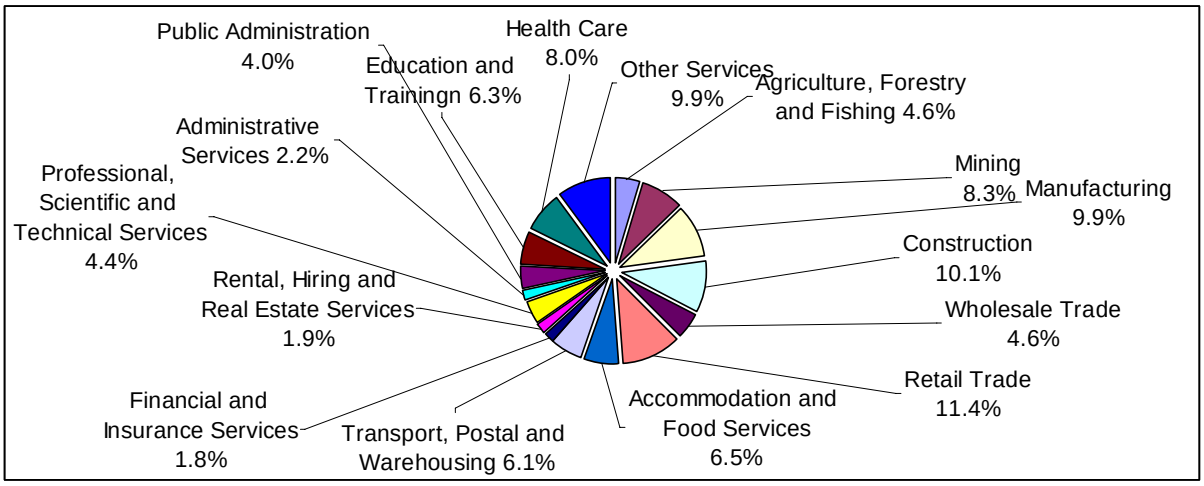

Figure 5 Industry of occupation for Mackay Region

Source: ABS 2006 Census Community Profile Series

3.7.2 Types and numbers of businesses

The distribution of businesses within Isaac and Mackay LGAs is presented below in Table 6. A summary of the key points for the LGA are as follows:

Isaac LGA

Within the Isaac LGA a total 1,635 businesses were recorded in 2007 of which approximately 729 or 45% were engaged in Agriculture. However, 348 of the businesses engaged in Agriculture had a gross turnover of less than $100,000 in 2006/07.

Other key sector groups were Property and Business Services (183 businesses), Construction (165 businesses) and Retail Trade (129 businesses).

Mackay LGA

The Mackay Region recorded 9,636 businesses in 2007, highlighting its status as a major regional business centre and provider of goods and services to neighbouring rural precincts including Isaac.

Similarly with the Isaac region, Agriculture accounted for the largest number of business registrations at 1,986 (21% of total), followed by Property and Business Services (1,803 businesses) and Construction (1,758 businesses).

Table 6 Business count by industry for the Isaac and Mackay regions

Industry	Isaac	Mackay
Agriculture	729	1,986
Mining	30	180
Manufacturing	87	417
Electricity and gas and water supply	0	3
Construction	165	1,758
Wholesale trade	30	288
Retail trade	129	1,017
Accommodation Cafes & restaurants	45	285

Industry	Isaac	Mackay
Transport and storage	96	561
Communication Services	21	72
Financial and insurance	45	480
Property And Business Services	183	1,803
Education	9	102
Health and Community Services	21	321
Cultural And Recreational Services	21	102
Personal and Other Services	24	261
Total Businesses	**1,635**	**9,636**

Source: ABS 2007, Counts of Australian Businesses

3.7.3 Coal mining

The MEP is located within the northern Bowen Basin that is Australia's largest coal reserve area providing approximately 83% of Queensland's coal production. Coal mining is the most significant contributor to the Isaac regional economy. In the 2007/08 financial year it directly contributed 85% of the Gross Regional Product (GRP) for Isaac (valued at Factor Cost).

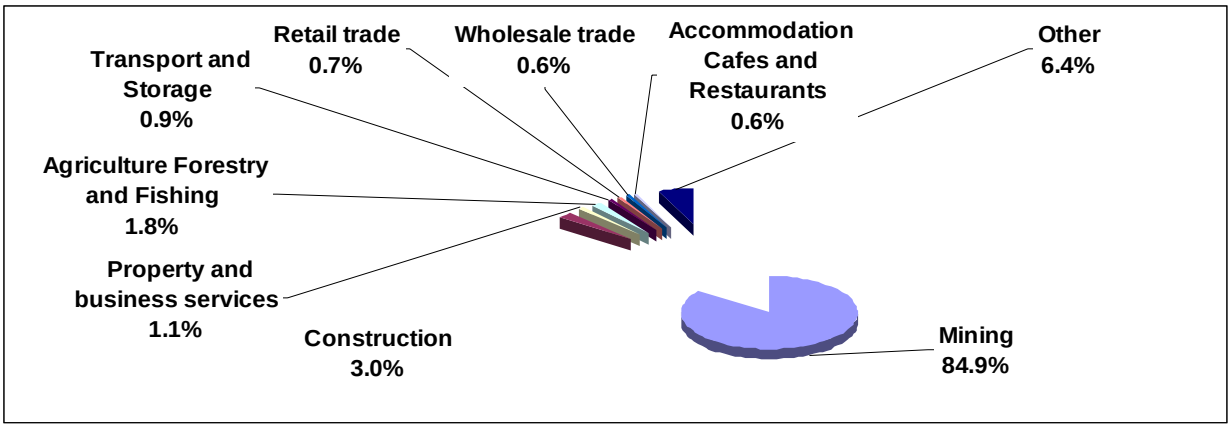

Figure 6 Breakdown of Isaac's gross regional product by sector

Source: Aurecon 2010, REDC 2008

Within the combined areas of Mackay, Whitsunday, and Isaac, mining is still the most dominant economic activity accounting for 58% of the GRP for the combined region (REDC 2008).

The contribution of mining to the region's GRP and employment has increased significantly. From 2001 to 2006, regional employment in mining grew by 89.9% to represent 12% of the Mackay, Whitsunday and Isaac region's employment (REDC 2008).

3.7.4 Mining and support services

As a highly mechanised sector handling bulk coal material, the sector invests heavily in heavy mining equipment and skilled labour. Servicing mining equipment, the mine site, on-site staff and supporting infrastructure, requires a wide array of products and services from other business sectors, many of which will be sourced from the Isaac region. Key sectors that rely on mining activity for income include Construction, Property and Business Services, Transport, Accommodation, and Food Service. Hence, mining's total contribution to the Isaac economy is above the 85% identified as direct contributions to the Isaac economy.

Specialised inputs such as mining engineering support services are more likely to be sourced from larger business centres such as Mackay. The REDC has identified the potential for a mining services industry within the Isaac LGA in either Moranbah or Clermont where industrial land is available. The MEP will add additional commercial merit for the development of a mining services industry within Isaac LGA, increasing the local skills set and job opportunities.

3.7.5 Construction

Construction (3%) is the next largest sector after Mining in terms of economic activity in Isaac based on contribution to total GRP. As indicated above, it is estimated that a large proportion of this construction activity is linked with mining activity either:

- Directly with on mine site construction of accommodation camps, amenities, offices, sheds, loading ramps, etc
- Indirectly with the construction of private dwellings in local townships housing mining employees and their families

As highlighted below in Figure 7 below, non-residential building ($17.5 million or 55%) dominated construction within Isaac while private residential ($14.3 million) accounted for the remaining 45% of building approvals in value terms.

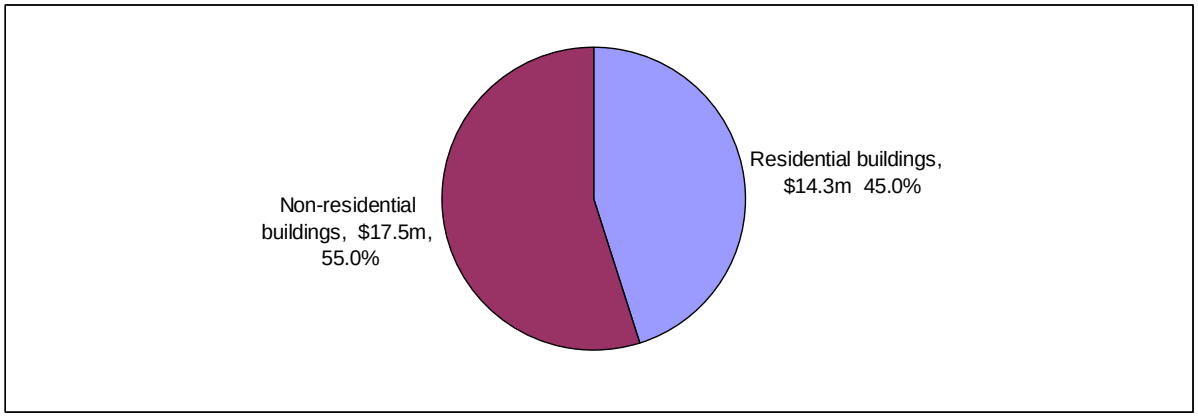

Figure 7 Breakdown of building approvals within Isaac LGA[1]

Source: ABS, Building Approvals, Queensland
[1]In the 12 months ending December 2009

Within the neighbouring Mackay region, Construction is the second largest economic contributor (10.1%), after Retail Trade (11.4%). As a major regional city and coastal region, Mackay's industry mix is more diverse than that of Isaac, and has a significant private dwelling construction sector servicing the rapidly growing residential population. As highlighted by Figure 8 below, most building approvals in value terms are for residential developments ($276 million or 53%), as opposed to non-residential development ($244.6 million or 47%).

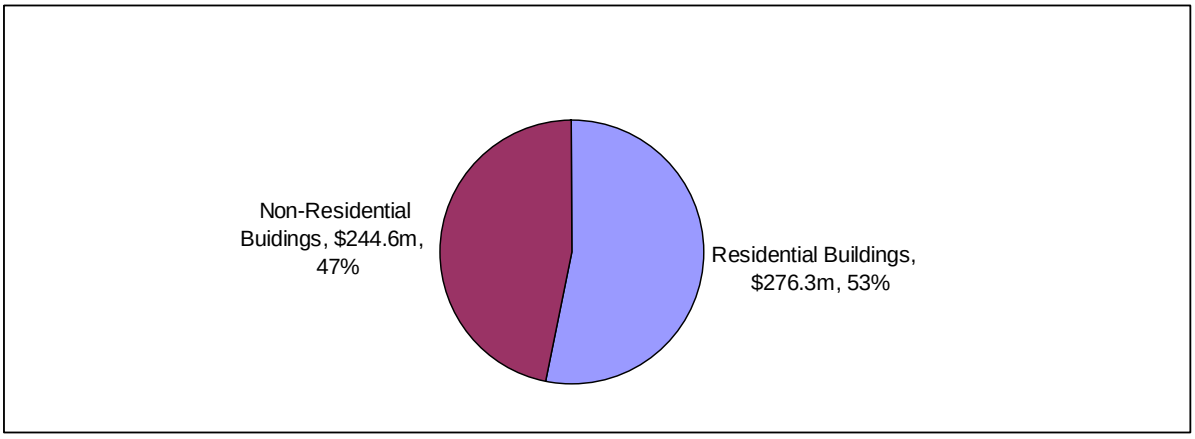

Figure 8 Breakdown of building approvals within Mackay LGA[1]

Source: ABS, Building Approvals, Queensland
[1]In the 12 months ending December 2009

3.7.6 Agriculture and farming

Agriculture is a significant industry sector within both Isaac and Mackay regions. In terms of business numbers, Agriculture supports the largest numbers of registered businesses within the Isaac regional community accounting for 45% of all businesses. However, a large proportion of these are sole trader/family partnership operations with relatively low gross turnovers.

In terms of employment, Agriculture employs 11% of Isaac's workforce, second only to mining which employs 39% of the local workforce.

Agriculture in Isaac is dominated by extensive livestock grazing systems, with minor areas cultivated for broad-acre cropping. Based on the latest Census, agriculture within the former LGA of Belyando was valued at $105.6 million in 2005/06, in which livestock production (beef) accounted for $91 million (86%) and broad-acre cropping (wheat, sorghum, maize) accounting for the remaining $14 million.

A total of 221 farms were engaged in grazing pasture production, covering a total area of 2.865 million ha. Based on recorded income from livestock production of $91 million in 2005/06, the income generated from grazing pastures was approximately $32 per ha.

3.7.7 Gas

The Moranbah Gas project has contributed significantly to the region's GRP. It is currently the sole provider of gas into the Townsville market. There is opportunity for the supply to expand to include Gladstone with the planned 440km high pressure coal seam gas line planned to run from Moranbah to Gladstone. The region has confirmed the Central Queensland Gas pipeline as one of the major projects to be developed in the region.

4. Project Environment

4.1.1 Purpose of project

The Millennium Coal Mine is an existing open-cut mine operated by Millennium Coal Pty Ltd (MCPL), a wholly owned subsidiary of Peabody, since 2005. The Millennium Coal Mine is located within the Isaac LGA area, approximately 22 km east of Moranbah and 16 km southwest of Coppabella in Central Queensland.

Currently the Millennium mine has approval to mine coal at a rate of 1.9 Mtpa until 2015. The MEP proposes to increase the extraction rate by 2.0Mtpa between 2011 and 2015, and extend the mine life by 12 years to 2027. Production for 2016 to 2027 is forecast at 3.5 Mtpa product coal.

It is likely that the DBCT will be utilised for the MEP, servicing the 3.5 Mtpa of product coal. Additionally, Peabody is negotiating with Abbot Point Coal Terminal (APCT) to secure allocation once the missing northern link from Goonyella rail line to Newlands rail line is completed. This will provide flexibility and capacity for transport from the mine. Additional port and rail contracts may be required depending upon the production profile from other mines in the area.

The MEP has the potential to impact the local, state and national economies. At the local level and within the Isaac region, there will be a direct increase in demand for employees, local services and supplies. Demand from the mine site for employees and services will also spill over into the wider Mackay-Whitsunday regional economy, along with increased demand for small and medium sized businesses supplying the mining industry.

On a state level there will be substantial increases in mining royalties, rail freight and port handling charges, and demand for medium and large sized businesses supplying products and services to the mining industry.

On a national level the increased coal production will lead to increases in Australia's coal exports, having a positive impact on the national trade balance.

4.2 Economic impacts of the MEP

The economic impact analysis of the MEP has been divided into the following mine expansion phases:

- Phase One: covering the period between 2011 and 2015 (inclusive). The current Millennium mine site is projected to be de-commissioned in 2015, and under the MEP proposal new mining activities are proposed to commence alongside the existing pit beginning in 2011.
- Phase Two: covering the period between 2016 and 2027 (inclusive). This covers the operational period of the MEP only with the existing Millennium mine site operations decommissioned. The MEP is projected to be decommissioned in 2027.

4.3 Phase One (2011 to 2015)

The analysis presented relates to new activities directly related to the MEP proposal. The operational costs and decommissioning costs in 2015 for the existing Millennium mine site operations are excluded from this analysis.

Projected total expenditure for the MEP is $880 million between 2011-2015 equalling $176m on a per annum basis. An additional 160 Full-Time Equivalent (FTE) persons on mine site positions will be required each year. The breakdown of net expenditure and jobs by region is highlighted in Table 7 below.

Table 7 Regional breakdown of net annual mine expenditure and jobs during Phase One

	Net expenditure ($ m) [1]	Income (salaries) [2] ($ m)	Mine employment [3] (FTE persons)
Isaac	$4.2 m	$1.6 m	16
Mackay/Whitsunday	$171.8 m	$14.4 m	144
Total	$176 m	$16 m	160

[1] Aurecon estimate 3.5% of total net expenditure (other than labour) to be spent within Isaac
[2] Aurecon conservatively estimate average mine salary at $100,000 per employee
[3] Aurecon estimate 10% of MEP employees to reside within Isaac
Source: Aurecon

While this expansion project relies predominantly upon existing transportation infrastructure, it will support the proposed second planned facility to rail coal to the APCT assuming the negotiations between Peabody and APCT are successfully concluded.

The following table summarises the Phase One impact of the MEP based upon annualised construction spend and forecasted employment.

Table 8 Annual economic impact of MEP Phase One on the Isaac LGA

	Output ($ m)	Income ($ m)	Employment (FTE persons)	Value added ($m)
Direct	$4.2 m	$1.6 m	16	$2.6 m
Indirect	$1.2 m	$0.2 m	11	$0.7 m
Total	$5.4 m	$1.8 m	27	$3.3 m

FTE = Full Time equivalent employment positions
Source: Aurecon

As indicated above, the annual economic impact on the Isaac region during Phase One of the MEP (2011-2015) is estimated as follows:

- An increase in direct mine output value of $4.2 million per annum, and additional flow on increases of $1.2 million through other industries
- An increase of $1.6 million in mining income (wages and salaries to mining staff) will result in an additional $200,000 in income through flow-on effects to other industries.
- An increase of 16 direct jobs at the mine will stimulate an additional 11 jobs through other industries.
- An estimated increase in GRP in Isaac of $3.3 million.

As indicated above in Table 7, the majority of mine expenditure and employment will be sourced from the Mackay and Whitsunday regions. The following table summaries the Phase One impact of the MEP based upon annualised construction spend and forecasted employment for the broader Mackay/Whitsunday region.

Table 9 Annual economic impact of MEP Phase One on the Mackay/Whitsunday region[1]

	Output ($ m)	Income ($ m)	Employment (FTE persons)	Value added ($m)
Direct	$171.8 m	$14.4 m	144	$106.2 m
Indirect	$66.3 m	$8.2 m	254	$32.8 m
Total	$238.1 m	$22.6 m	398	$139 m

Source: Aurecon

As indicated above, the annual economic impact on the neighbouring regions of Mackay and Whitsunday during Phase One of the project (2011-2015) is estimated as follows:

- An increase in direct mine output value of $171.8 million per annum, and additional flow on increases of $66.3 million through other industries
- An increase of $14.4 million in mining income (wages and salaries to mining staff) will result in an additional $8.2 million in income through flow-on effects to other industries.
- An increase of 144 direct jobs from the mine will stimulate an additional 254 jobs through other industries.
- An estimated increase in GRP of $139 million in the Mackay and Whitsunday regions.

The net impacts of MEP Phase One across the combined Isaac/Mackay/Whitsunday region are as follows:

- 160 new jobs at the mine site, and an additional 265 jobs in other industries
- $178 million in net mine expenditure resulting in additional $67 million in output from other industries
- Net value-adding from the mine of $108.8 million, leading to an additional $33 million in additional value-adding in other sectors.

4.4 Phase Two (2016 to 2027)

Phase Two of the MEP is projected to be 12 years (2016-2027) with annual operational costs projected at $225 million. Indicative resource planning has identified that an additional 380 staff will be required for this phase.

The majority of employees will live in the Mackay region and utilise camp facilities provided at the Village. Peabody will transport staff to and from the Village, though there will also be some local staff (10%) from neighbouring communities including Moranbah and Glenden.

The MEP would require upgrading the existing Coal Handling and Preparation Plan (CHPP) to improve its production rate. Additionally, the size of the current product and ROM stockpiles will be increased to manage the higher production rate. There is sufficient land adjacent to the mine to cater for these expansion requirements.

Once operations commence, the local Isaac region will experience ongoing annual economic impacts through the life of the expanded project, mainly due to direct employment in the local area and the level of spending in the region.

Table 10 Regional breakdown of net annual mine expenditure and jobs during Phase Two

	Net expenditure ($ m) [1]	Income (salaries) [2] ($ m)	Mine Employment[3] (FTE persons)
Isaac	$5.4 m	$3.8 m	38
Mackay/Whitsunday	$219.6 m	$34.2 m	342
Total	$225 m	$38 m	380

[1]Aurecon estimate 3.5% of total net expenditure (other than labour) to be spent within Isaac
[2]Aurecon conservatively estimate average mine salary at $100,000 per employee
[3]Aurecon estimate 10% of MEP employees to reside within Isaac

The following table summaries the Phase Two impact of the MEP based upon annualised construction spend and forecast employment.

Table 11 Annual economic impact of MEP Phase Two on the Isaac LGA

	Output ($ m)	Income ($ m)	Employment (FTE persons)	Value added ($m)
Direct	$5.4 m	$3.8 m	38	$3.3 m
Indirect	$2.1 m	$1.5 m	24	$0.9 m
Total	$7.5 m	$5.3 m	62	$4.2 m

FTE = Full Time equivalent employment positions
Source: Aurecon

As indicated above, the annual economic impact on the region during Phase Two of the project (2016-2027) is estimated as follows:

- An increase in direct mine output value of $5.2 million per annum within Isaac, and additional flow on increases of $2.1 million through other industries
- An increase of $3.3 million in mining income (wages and salaries to Isaac mining staff) will result in an additional $1.5 million in income through flow-on effects to other industries within Isaac
- An increase of 38 direct jobs at the mine will stimulate an additional 24 jobs through other industries
- An estimated increase in value adding of $4.2 million to Isaac

As indicated above in Table 10, the majority of mine expenditure and employment will be sourced from the greater Mackay/Whitsunday region (and beyond). The following table summaries the Phase Two impact of the MEP based upon annualised construction spend and forecasted employment for the Mackay/Whitsunday region.

Table 12 Annual economic impact of MEP Phase Two on the Mackay/Whitsunday region[1]

	Output ($ m)	Income ($ m)	Employment (FTE persons)	Value added ($m)
Direct	$219.6 m	$34.2 m	342	$135.9 m
Indirect	$84.7 m	$27.0 m	603	$41.9 m
Total	$304.3 m	$61.2 m	945	$177.8 m

Source: Aurecon

As indicated above, the annual economic impact on the neighbouring regions of Mackay and Whitsunday during MEP Phase Two (2016-2027) is estimated as follows:

- An increase in direct mine expenditure of $219.6 million per annum will result in additional flow on increases of $84.7 million through other industries
- An increase of $34.2 million in mining income (wages and salaries to mining staff) will result in an additional $27.0 million in income through flow-on effects to other industries
- An increase of 342 direct jobs from the mine will stimulate an additional 603 jobs through other industries
- An estimated increase in GRP of $177.8 million

The net impacts of MEP Phase Two across the combine Isaac/Mackay/Whitsunday region are as follows:

- 380 new jobs at the mine site, and an additional 627 jobs in other industries
- $225 million in net mine expenditure resulting in additional $87 million in output from other industries
- Net value-adding from the mine of $139 million, leading to an additional $43 million in additional value-adding in other sectors

The above figures represent an average annualised impact spread over the operational period.

4.5 Decommissioning

The current mining operation is forecast to cease in 2015. The MEP proposes to expand mining operations from the site until 2027. A detailed decommissioning plan will be developed well in advance of this time.

Cessation of mining activities at the Millennium mine will impact the local Isaac economy. However, the degree of economic impact will be influenced by a range of factors at that time including:

- The number of employees involved at the MEP mine site at time of decommissioning, and the possibility of staging decommissioning over a period of time

- The number of mine site employees and their families permanently residing within Isaac
- Continued expansion and development of other mining projects within the region
- Actual market demand and price of coal at time of decommissioning in 2027

Decommissioning MEP will also impact the neighbouring LGAs of Mackay and Whitsunday, but to a much lesser degree. Both Mackay and Whitsunday have a much more stable and diverse economic base with the majority of its available labour force employed in other industries including Retail, Construction, Tourism (Accommodation, Food Service, etc), Transport, Healthcare, and Agriculture.

4.6 Local significance

At the local level, a relationship can be drawn between the level of employment and spending in the area. The MEP would require both a substantial short term construction workforce and a long term operational workforce. This would have flow on effects to the local economy.

Due to the relatively tight local labour market, a proportion of the required workforce is likely to be sourced further afield including the Mackay and Whitsunday regions, elsewhere within Queensland and interstate.

For the staff that are sourced from other regions outside of Isaac, Mackay and Whitsunday LGAs, the impact at the local and regional level would depend on how many choose to relocate to the area permanently, rather than operate on a drive-in, drive out, or bus-in, bus-out basis. Permanent residents would spend more money in local businesses. Furthermore, this would have an impact on the housing and rental markets in the region.

4.6.1 Employment

It is difficult to estimate the full flow-on effects at the local level, without additional detailed information regarding place of residence and expenditure behaviour. However, the increased economic activity from the project employees spending in local businesses will generate additional full time and part time jobs within the local community.

The Isaac Regional Council area has been characterised by a constrained labour market, low unemployment and shortages in skilled labour over a number of years. Despite major job losses in the recent global financial crisis, the Queensland Resources Council continues to report that industry employment remains near record levels. High proportions of the workforce in Moranbah (45.6%) and the Isaac Regional Council LGA area (38.9%) are employed in the mining sector.

In addition, jobs in mining are generally high paying, evidenced by the wage levels for the Isaac region as well above that of the state. However, high wages within mining is having detrimental impacts for other local business sectors, particularly agribusiness which continues to lose skilled and unskilled labour resources to the mines.

While the construction phase of the MEP may require some imported labour from outside the region, this is typical of most Queensland construction projects in regional and remote areas. It is estimated that 90% of staff will come from the Mackay region and utilise facilities at the mining village. The other 10% are assumed to live in and commute locally around Moranbah and Coppabella.

Overall the project will have a positive impact on the local economy and workforce by attracting additional workers to the Isaac region. Over time, it is likely a proportion of project employees and their families would relocate to the local region on a permanent basis. An additional impact would arise from family members, who are not project employees, seeking and obtaining employment in the local area. An influx of working-age people associated with project employees would help ease some of the pressures that have been experienced on the local labour market.

4.6.2 Local businesses

Not only do the mines directly employ a significant proportion of the local labour market, but local businesses rely on the mines and mining staff for their market and expenditures arising from additional employment stimulated by the MEP. As such, the MEP would benefit local and regional areas through increased employment opportunities as well as through required services and support, with some of the project's budget being spent in the region. Furthermore, by spending in local businesses, flow on effects may include increased profitability for local businesses, and the potential for them to hire additional employees. This would certainly help support the recent introduction of seven day trading at Moranbah.

Impact of direct MEP- related employment

According to the ABS data from the most recent household income and expenditure survey, average household expenditure on goods and services was approximately 79% of gross household income. An estimated 80% of household expenditure was identified as likely to be incurred with or through local businesses.

Average earnings for mining industry personnel are around $100,000 per annum. The MEP expects to employ at least 160 additional staff in the first 5 years (2011-2015), and then an additional 380 staff between 2016 and 2027. It is estimated that approximately 10% of the additional workforce will reside locally within the Isaac area, as indicated in the table below.

Table 13 Additional wage income generation within the Isaac region

	Additional mining staff	Additional mining staff residing locally	Additional wage income in Isaac	Additional wage income in Mackay Whitsunday[1]
2011-2015	160	16	$1.6 m pa	$14.4 m pa
2016 - 2027	380	38	$3.8 m pa	$34.2 m pa

[1]*The remaining workforce that reside permanently outside the Isaac Region*

Impact of MEP-stimulated employment

According to the REDC, average weekly full-time adult earnings were around $1,138 or $59,176 per annum for the broader Mackay Whitsunday Isaac region in 2006.

Based on the impact analysis above, approximately 265 new jobs would be created indirectly from the economic stimulation resulting from the MEP in the first five years (Phase One 2011-2015). During Phase Two representing the mine life's extension (2016 to 2027), 627 jobs would be created indirectly. Assuming that these jobs do not offset employment creation that would have otherwise occurred, this is equivalent to expenditure through local and regional businesses of an additional $15.6 million during Phase One and $37.0 million during Phase Two of MEP. These estimates are in constant 2010 prices.

4.6.3 Housing

As a result of the low unemployment rate and skills shortage within the Isaac region, MEP staff requirements are more likely to be sourced from other regions such as Mackay/Whitsunday, or further afield including South East Queensland. It is expected that most staff will stay at the Mac Camp in Coppabella.

Some staff however may chose to reside in Moranbah. As a result, some pressure may be placed on the housing market by those requiring both temporary and permanent accommodation. However, if most workers stay at the camp as is anticipated, the impact on the value of properties is not likely to be significant. Incremental impacts on housing associated with specific mining projects may be small;

however given the heavy reliance of the region on the mining industry and the number of mining projects within the region, the cumulative impacts can be significant.

Peabody is unable to directly address this cumulative issue because housing demand and supply is dependent on a number of factors beyond its control. These factors include the development of other unrelated projects in the Isaac region which may impact on housing demand and supply. In addition the quantum and the timing of the release of residential land is a local government responsibility. However, Peabody will assist long term planning by providing accurate and timely planning updates to the existing stakeholders (local government authorities and others) engaged in accommodation planning.

4.6.4 Local community infrastructure and services

The impact of MEP on community infrastructure and services will be limited by the fact that the majority of the workforce will be accommodated on site camps, which provide full amenities on site. Currently, employees are free to leave the site between shifts, however many employees choose to remain on site because of the high level of amenities provided.

Any potential impact of MEP on the capacity of community infrastructure and services will be dependent on a range of influences on population and the relevant timing of these in relation to the timing of this project (and other mining expansion and development projects within the Isaac region). In order to assist with forward social infrastructure planning, Peabody will consult with Isaac Regional Council and other relevant community infrastructure providers to ensure that any impacts of the project are understood and considered in planning proposals.

4.7 Regional significance

4.7.1 Coal demand and exports

The MEP would result in a significant increase in coal exports from the region. The MEP proposes to increase coal production as follows:

- Increase the existing coal mining capacity by 2 Mtpa product coal for the current life (2011-2015)
- Increase the operational life of the mine beyond 2015 to 2027 for the MEP, at a production rate of 3.5 Mtpa.

The value of hard coking coal has increased significantly in recent years, as highlighted below.

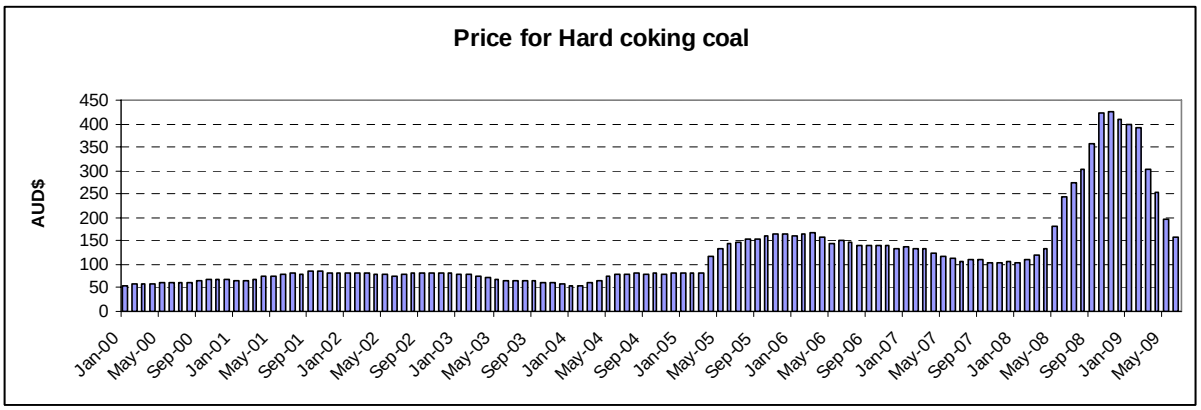

Figure 9 Monthly prices for hard coking coal[1]

Source: Queensland Treasury
[1]Note that over 90% of coal currently produced at Millennium mine is coking coal.

During 2008, the price of coking coal rose substantially from around $100/tonne at the start of the year, to historical highs of over $400 per tonne at the end of the year. Prices in 2009 eased

substantially back towards $150 per tonne, however in March/April 2010 a number of mines were signing contracts at $200 per tonne.

For the purposes of this analysis, future coking coal prices are estimated at $150 to $200 per tonne. Assuming the latest quoted market price of $180 per tonne, the added value of exports in 2010 constant prices is highlighted in the table below:

Table 14 Additional coal exports attributed to MEP[1]

	Additional coal tonnage	Additional coal export value[1]
2011 - 2015	2.0 Mtpa	$300 million to $400 million pa
2016 - 2027	3.5 Mtpa	$525 million to $700 million pa

Note that the coking coal price is held constant in this calculation at between $150 and $200 per tonne (constant 2010 prices

4.8 Costs to government

Potential costs to government are discussed in this section and mainly relate to general costs for the coal system as opposed to specific costs associated with this particular mine expansion project:

Rail

The Goonyella coal rail network increased capacity with the commissioning of the Coppabella Yard Upgrade in 2008. It is not expected that any additional upgrades to rail will be necessary for the MEP, and therefore no additional railway infrastructure costs are likely.

Port

Coal will be loaded at DBCT. No additional cost is expected to be incurred by government as a result of the use of these facilities as any costs incurred by the MEP are expected to be recovered through fees levied to the project for coal handling. Peabody is also negotiating with APCT to secure allocation on the basis that the missing northern link from Goonyella rail line to Newlands rail line is constructed.

Road

It is planned that the MEP will utilise the existing site access road, but that new mine haulage roads to the expansion areas will be required, as well as a crossing over the New Chum Creek.

Water

Management of water resources is based on sourcing water from the Burton Gorge Dam. The potential interconnection of three Peabody operations (Burton Coal Mine, Millennium Coal Mine and Eaglefield Coal Mine) would enable adequate supply and reuse options. No augmentation of existing government bulk water sources is considered.

Accommodation

The Mac Camp in Coppabella will provide sufficient accommodation for the additional workers required by the MEP. However, additional capacity at other camps may be required during peak times.

The project workforce and their families would use services provided by the state and local government (e.g. educational, medical, justice and municipal services). However, these costs would have been occurred if the workforce lived elsewhere in Queensland and therefore should not be considered an additional cost.

Increased costs to the Isaac Regional Council should be offset by rates charged to new residents. No significant increase in overall government costs is anticipated to result from the proposed MEP.

4.9 Government revenues

This section considers the possible impacts on government revenues arising from the MEP. These include coal royalties, state payroll tax and local government revenues.

4.9.1 Coal royalties

The MEP is expected to generate additional production of 2.0 Mtpa for 2011 to 2015, and 3.5 Mtpa of product coal for 2016 to 2027 The production of this coal would generate royalty payments to the Queensland Government. Under the current two-tiered coal royalty system, companies pay 7% of the value up to A$100 per tonne and 10% of the value thereafter. For example, a price of A$100 per tonne attracts a rate of 7% of coal value, A$150 per tonne attracts 8% and A$200 per tonne attracts 8.5%.

Subject to exchange rate variations and coal price fluctuations over the life of the mine, the estimated royalty payments that would be made to the Queensland Government are estimated at $24 million to $59.5 million per annum as indicated in the table below. It is anticipated that the Queensland Government will receive equivalent payments under the Australian Government's Minerals Resources Rent Tax if this tax replaces state royalties.

Table 15 Additional coal royalties to the Queensland Government[1]

	Additional coal tonnage	Royalties to the Queensland Government
2011 - 2015	2.0 Mtpa	$24 million to $34 million pa
2016 - 2027	3.5 Mtpa	$42 million to $59.5 million pa

[1]*Note that the coking coal price is held constant in this calculation at between $150 and $200 per tonne.*

4.10 Rail and port charges

The existing transport infrastructure is projected to support the MEP with coal transported by rail on the Goonyella rail network to most likely DBCT. As indicated earlier, the APCT may be utilised in future once the missing northern link from the Goonyella Rail system to the Newlands Rail system is completed.

Table 16 Additional income to rail and port authorities – based on 3.5Mtpa of product coal

	Additional coal tonnage	Approximate Rail charges[1]	Approximate port charges[2]
2011 – 2015	2.0 Mtpa	$19.5 million pa	$0.7 million pa
2016 - 2027	3.5 Mtpa	$34 million pa	$1.2 million pa

[1]*Based on 162 km rail track journey to port, at $0.06 t/km*
[2]*Based on Harbour Due of $0.067 per tonne for DBCT. In addition, there is a Tonnage Due of $0.258 and Port Security Charge of $0.002 per gross registered tonne of the ship (which have been added in this analysis on direct coal tonnage).*

4.10.1 State payroll tax

Companies or groups of companies that pay $1 million or more a year in Australian wages must pay payroll tax. There are deductions, concessions and exemptions available to eligible entities. The current payroll tax is 4.75% of Total Taxable Wages (Queensland Office of State Revenue).

The additional employment attributed to the MEP is assumed to comprise Peabody's personnel over and above any exemption or payroll tax deduction levels. Average earnings for mining industry personnel are estimated conservatively at $100,000 per annum. The MEP expects to employ a total workforce of 160 additional staff for Phase One (2011-2015) and an additional 380 staff thereafter (2016-2027). The table below highlights the MEP staffing levels and forecast State payroll taxes.

Table 17 Additional State payroll taxes to the Queensland Government

	Additional mining staff	Additional payroll taxes to the Queensland Government[1]
2011-2015	160	$760,000 pa
2016 - 2027	380	$1.8 million pa

[1] *In current dollars, assuming conservative average mine site wages of $100,000 per annum, and payroll tax of 4.75%.*

On an annualised basis this is equivalent to a wages bill of $16 million for the first five years, and then $38 million thereafter relating to the MEP. If the full value of these wages attracted payroll tax, it is estimated that the Queensland Government would receive tax revenues of $0.76 million per annum between 2011 and 2015, and then $1.8 million per annum thereafter up until 2027. While this might overstate the level of payroll tax generated, there is the possibility that employment additional to the anticipated staff could be generated as a result of the MEP.

4.10.2 Local government revenue

For both the Isaac and Mackay LGAs, a proportion of the new employment generated by the MEP would stimulate housing and commercial/ retail development. To the extent that new land is developed or converted into higher value use, local government revenues would benefit. However, an estimate of the likely revenue generated would depend critically on two factors namely the number of workers attracted to the MEP from outside the region; and the extent to which those workers build new houses or trigger additional commercial/retail development on greenfield sites. The latter factor is significantly influenced by Isaac and Mackay LGAs to provide appropriately zoned land to meet residential and commercial demand.

4.10.3 Proposed Minerals Resource Rent Tax

Following consultation with industry, the Australian Government has proposed a Minerals Resource Rent Tax (MRRT) regime for the mining of iron ore and coal in Australia. Subject to receiving the appropriate approvals, the MRRT will commence on 1 July 2012.

The Australian Government's rationale for the MRRT is to provide a more appropriate return to the Australian community from the exploitation of its non-renewable resources compared with the current arrangements.

Key features of the MRRT are:

- Limited to iron ore and coal companies whose resource profits exceed $50 million per annum
- The MRRT will apply a tax rate of 30 per cent to the value of the resource, rather than the value added by the miner
- New investment will be treated in the form of an immediate write off, rather than depreciated over a number of years
- It will broadly adopt the same category of non-deductible expenditure that currently applies to the Petroleum Resources Rent Tax.
- The MRRT will carry forward unutilised losses at the long term government bond rate plus 7 per cent
- It will provide transferability of deductions thereby supporting mine development because it means a company can use the deductions that flow from investments in the construction phase of a project to offset the MRRT liability from another of its projects that is in the production phase
- States and territories will keep existing royalties with the Australian Government providing companies with refundable credits for current state royalties paid
- Recognition of past investments will be provided through a credit that recognises the market value of the investment written down over a period of up to 25 years. Unlike other costs, this starting base will not be uplifted. However, those companies that wish to use their current written down values of the project's assets, excluding the value of the resource, will be

provided with an accelerated depreciation over five years. This starting base will be able to be uplifted at the government's long term bond rate plus 7 per cent.
- The MRRT will recognise the particular characteristics of different commodities, by applying a taxing point as close to the point of extraction as practicable, and using appropriate pricing arrangements to ensure only the value of resources extracted is taxed.
- The MRRT will provide a 25 per cent extraction allowance to further shield from tax the important know-how and capital that mining companies bring to mineral extraction.

The specific detail of the MRRT has still to be finalised and legislated and therefore it is considered too early to identify the financial impacts of the MRRT on the MEP.

4.11 Ecosystem impacts and alternative land use

4.11.1 Ecosystem impacts

The majority of the MEP area and surrounds has been modified through cattle grazing and mining, which has significantly altered the landscape. The presence of ten vegetation communities hosting remnant ecosystems has been identified for the MEP site. The distribution of these communities is complex, often occurring in small pockets or mixed communities that cannot be separated at a 1:25,000 scale.

Approximately 66 ha of remnant vegetation is likely to be cleared for the MEP, consisting mainly of Acacia woodland. The area of ecosystem to be cleared for MEP, will include revegetation with native species The ecosystem residing within this vegetation provides significant goods and services, many of which are both difficult to fully identify and value from an economic perspective.

However, a report by Millennium Ecosystem Assessment (2005) provides an insightful basis for identifying the potential benefits of an ecosystem as:
- Provisioning services such as food, water, timber and fibre
- Regulating services that affect climate, floods, disease, wastes and water quality
- Cultural services that provide recreational, aesthetic and spiritual benefits, and
- Supporting services such as soil formation, photosynthesis and nutrient cycling.

As many of these services and products fall outside the current market system, the full value of the ecosystem from an economic perspective is difficult to estimate (Skinner & Hall 2007)

In valuing the 66ha of remnant vegetation to be cleared as part of the MEP, Aurecon have estimated the economic value of this ecosystem utilising two approaches:
- Comparison to past studies; and
- As a carbon sink.

Comparison to past studies

The most useful study identified was by Curtis (2003) who undertook a study to place an economic value of the ecosystem of the Wet Tropics World Heritage Area of north-east Queensland. Curtis (2003) identifies a total of 10 ecosystem services, and valued each utilising various methodologies including surveys and Delphi panel studies. Curtis (2003) identifies the value of remnant ecosystems within the Wet Tropics at $210 to $236 per ha per annum.

In considering this ecosystem valuation, Aurecon acknowledges the following key points relating to the Wet Tropics (in comparison to the MEP site):
- the wet tropics region resides within a much higher rainfall region,
- contains a much broader spectrum of fauna and flora, and diversity of ecosystems
- likely to have a much more significant ecosystem value

Acknowledging the above points, and the date of Curtis' work (2003), it ascribes an ecosystem value for the remnant vegetation at MEP at $250 per ha/pa. At this estimate of $250 per ha/pa, the economic value of the 66ha of remnant vegetation to be cleared is estimated at $16,500 per annum in total.

A more controversial and international study is that by Costanza et al (1997). Examining Australian ecosystems in generic terms, Costanza estimate the economic value of Temperate/boreal forests at $543 per ha/pa. Note that this estimate is more than twice that of Curtis (2003). Utilising Costanza's (1997) estimate of approximately $550 per ha, then the projected economic value of the 66ha of remnant vegetation is $36,300 per annum.

As a carbon sink

A second economic valuation technique considered is to value the area of remnant vegetation to be cleared for MEP as a carbon sink (sequestration). In some ways, this methodology relies on partial market signals which are easier to validate from an economic perspective. As a carbon sink, the remnant vegetation has two carbon values: stored carbon in current state, and an annual sequestration value. Maraseni et al (2006) provide a useful indication of soil carbon within a spotted gum location in a low rainfall area of South East Queensland. A remnant forest was observed to contain approximately 300 tonne soil carbon per ha, and was able to sequester approximately 2 to 3 tonnes per annum.

Assuming a carbon value of $20 per tonne (which is a longer term value projected under a national trading scheme), then the potential value of the 66ha of remnant vegetation at MEP is calculated as:

- $396,000 in total carbon currently stored in the soil (300 tonne ha soil carbon, which is assumed to be totally lost upon clearing).
- $3,960 per annum, being the annual value of carbon sequestered by the remnant vegetation based on carbon sequestered into the soil at 3 tonne per annum.

4.11.2 Alternative land use

Alternative land use for the proposed MEP site is low intensity cattle grazing. To the extent that mining operations reflect a higher economic use of the land, there would be, prima facie, a net economic benefit from a change in land use.

Examining the 2005/06 Agricultural Census (see Section 3.4.6), it was identified that the average value of gross return from livestock grazing across the region was approximately $32 per ha. It is noted that this value would include a wide spectrum of grazing operations from irrigated improved pastures, through to low quality native pastures.

The Initial Advice Statement states that the MEP site is categorised as Suitability Class 5 (Unsuitable for dry land cropping), and Classes 4 to 5 (Marginal to Unsuitable) for grazing.

The foregone opportunity cost of the mine site (900 ha) for cattle grazing is estimate at $28,800 per annum, based on production and financial data from the 2005/06 census year. Note that production rates (stocking rates) and market prices vary from year to year, however the $28,800 gross annual grazing value is considered to be optimistic considering the land classification provided. Assuming that the MEP will lock out livestock grazing operations for the next 20 years (post 2030, allowing re-vegetation to establish), then the forgone grazing value of the site is approximately $580,000 for the entire 20 years.

Effective rehabilitation of the site after completion of mining operations would allow for restoration of native and improved vegetation, and subsequent re-introduction of cattle grazing where suitable and sustainable.

5. Conclusions

The following conclusions have been drawn from the preceding economic impact analysis for the MEP:

Significant economic stimulus to the economy
The MEP is estimated to provide significant on-going economic benefits approximately $2.9billion in value add to the local and regional economies during the construction and operational phases of the project.

Minor cost in terms of revenues forgone
In absence of the MEP, the economic contribution of the existing beef grazing system over the next 20 years (projected operating life of MEP) is estimated at approximately $600,000 in total. Incorporating the most optimistic value for ecosystems services for the remnant vegetation to be cleared for MEP of $40,000 per annum ($800,000 over the 20 years), then the net projected opportunity cost (revenue foregone as a result of the MEP) for the site is $1.2 million over the next 20 years.

New jobs
The MEP is projected to result in an additional 380 jobs directly on site post 2015 with a 5.5 Mtpa ROM coal. Purchases by MEP and expenditure by the mining staff will stimulate an additional flow on of over 620 jobs through other industries within local and state communities.

Boost for Federal government revenue
Although still under discussion and negotiation, the MRRT recently agreed in principle with sections of the mining industry will result in a substantial tax payment to the Australian Government at the expense of the project proponent. The MRRT may undergo other changes leading up to the being legislated and later introduced in 2012.

Substantial boast to balance of payments
The value of production in constant prices from the MEP is projected at $525 million to $700 million for the 12 years of the MEP post 2015. All of the production is assumed to be exported. Over the life of the project, the MEP will improve Australia's balance of payment by approximately $4.5 billion to $10.4 billion.

Boost for State government revenue
Subject to exchange rate variations and coal price fluctuations over the life of the mine, the estimated royalty payments alone that would be made to the Queensland Government are estimated at $42 million to $59.5 million per annum post 2015. It is expected that the quantum of this payment will remain the same whether collected under the existing Queensland Government royalty system or under the administrative arrangements of the proposed MRRT.

6. References

The following references have been used to compile this report:

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Appendix A
Input - Output methodology

The impacts on the regional economic environment can be assessed using input-output analysis. As it is an economic impact analysis, it does not address project evaluation matters that are better suited to cost benefit analysis which returns the net economic worth of a project.

The input-output approach is based on industry tables that model the structure of an economy by describing inter-industry relationships. It is a useful approach that can describe total impact on an economy from an initial increase in demand in a particular industry. Underlying data sets that supported this analysis were the Queensland 1996/97 input/output tables for the Mackay region (published in August 2004) and the 2001-02 System of National Accounts Input-Output Multipliers released by the Australian Bureau of Statistics.

Proportional impacts on relevant industry sectors were modelled on an earlier economic assessment of coal mining developing in the region, given that the assumed industrial structure and downstream impacts associated with coal development would be unchanged.

Economic impacts at a regional and national level can be traced through the economic system in a number of difference ways. In this assessment, the following impacts are considered:

- Direct multiplier effects – increases in economic activity (value added) and employment that are directly generated in the industry receiving the impact
- Indirect multiplier effects – flow-on impacts from industries that support the industry receiving the direct impact
- Induced multiplier effects – changes in consumption by the household sector in response to income changes from the direct and indirect impacts
- Total multiplier effects – the sum of the direct, indirect and induced effects outlined above

These impacts are measured in a number of different ways:

- Output
- Value-added
- Employment

While output measures consider the gross value of production, they include the value of raw materials generated in earlier stages of production. There is a potential tendency to double count the impact. Consequently, value added is used, as it only considers the value of incremental raw materials at each stage.

Employment measures the number of jobs required to meet additional production in the economy. It may occur through increased use of existing labour or creation of additional jobs, and typically expressed in terms of equivalent full-time employment (FTEs).

There are a number of limitations relating to the application of an input-output methodology which are discussed in the following points:

- This study relies on data prepared by the Queensland Government and the Australian Government in 2004 and 2002 respectively using, in some cases, older data sets. Care should be taken in terms of the reliability and accuracy of this data, as the assumption is that the industrial structure of the regional and national economies have not changed significantly since these tables were prepared. It is expensive, time consuming and complex to update the underlying data tables.
- Further, it should be noted that this method has a general bias to overstate impacts, as the ABS has noted that “the theoretical basis (of multiplier effects) produces estimates which somewhat overstate the actual impacts in terms of output and employment” (ABS 2002). This is mitigated by conservative estimates of the initial construction and operation impacts.

Inter-industry relationships are implicitly assumed to be linear across the scale of impacts and relative prices for inputs and outputs are assumed to remain in fixed proportion irrespective if supply conditions for inputs. This means that the results of input-output analysis do not take into account shortages in factors of production or changes in relative prices of inputs.

In effect, these tables do not take into account marginal effects or economies of scale or unused capacity.

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