

Addendum to the Wandoan Coal Project

Geology, mineral resources, overburden and soils impact assessment

September, 2009

Wandoan Joint Venture



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Attachment A Land suitability criteria	
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Glossary

A horizon	See topsoil.
Alluvium	Any stream laid sediment found in a stream channel and in low parts of a stream valley subject to flooding.
Anthropogenic	Caused or influenced by humans.
Australian Height Datum (AHD)	A level datum, uniform throughout Australia, based on an origin determined from observations of mean sea level at tide gauge stations, located at more than 30 points along the Australian coastline.
Borehole	A hole produced in the ground by drilling or driving.
Bushland	A functional, multi layered, semi-natural plant community including a permanent tree layer, natural or established (e. g. on spoil). The area would be capable of sustaining flora and fauna habitats.
CHPP	Coal handling and preparation plant
Chromosol	Soils with strong texture contrast between A horizons and B horizons, in which the B horizons are not strongly acid and are not sodic, as defined by Isbell (1998).
Clay	Particles with a diameter less than 0.002 mm (McDonald <i>et al.</i> 1998).
Competent spoil	Non acid, non dispersive durable spoil with potential characteristics to resist erosion.
Competent rock	Rock that is considered suitable for the intended use.
Cover material	Soil or other suitable plant growth medium placed on reshaped spoil surfaces; typically non crusting and low salinity.
Dermosol	Soil with a structured B2 horizon and lacking strong texture contrast between the A and B horizons, as defined by Isbell (1998).
Diversions/diversion channels	Structures for the controlled re-direction of drainage lines and watercourses around open cut pits and infrastructure areas.
EC	Electrical conductivity, an indirect measure of the dissolved salts in a substance.
Erosional stability	The ability of a rehabilitated area to resist the natural forces of soil erosion.
Externally drained	Rainfall runoff that reports to the external environment of a structure via local drainage systems.
Functional vegetation	Vegetation that consists of species able to survive and regenerate under specific conditions, providing soil erosion control and fauna habitat.
Geochemistry	The chemical characteristics of a soil or rock material.
Geomorphology	Study of the characteristics, origin and development of land forms and the processes that act on them.
Geotechnical stability	Resistance of a natural slope or earth structures to various forms of erosion.
Gilgai	The phenomena of an irregular land surface with mounds and depressions formed due to clay horizons shrinking and swelling with alternate drying and wetting cycles.
Graded banks	Cross slope earthen banks constructed on reshaped spoil areas, typically at horizontal intervals of approximately 50 m and 1 to 1.5% longitudinal gradient, to reduce the effective slope length and control the runoff flow rate.
Holocene	The most recent epoch of geological time covering the last 10,000 years.
Hostile spoil	Acid, sodic or saline spoil deleterious to seed emergence, geotechnical and geochemical stability of spoil.
Incident register	A database of environmental incidents, causes and remedial actions.

Internal drainage	Drainage of rainfall runoff from reshaped spoil areas confined and ponded within the spoil area.
Leaching profile	Vertical change in chemical concentrations down the soil profile due to leaching.
MLA	Mining Lease Application
NATA	National Association of Testing Authorities Australia
Overburden	The soil or other mineral matter which has to be removed to gain access to the underlying material.
PAWC	Plant available water capacity.
Plan	Set of actions required to ensure the achievement of a stated objective/program.
Plant growth medium	Material which is typically non crusting and has low salinity levels, in which plant seed will germinate and establish.
Policy	Stated commitment to achieving objectives.
Program	Management supported work commitment, budget and time frame to achieve a stated objective.
Quaternary	The geological period of time from the present to about two million years ago.
Refuse dump	Site to be used for the permanent placement of waste.
Rehabilitation	Reshaping of a disturbed area to a geotechnically and geochemically stable condition, followed by revegetation.
Regulated waste	Non-domestic waste as defined in Schedule 7 of the <i>Environment Protection (Waste) Regulation 1998</i> , (whether treated or immobilised) and includes: - for an element — any chemical compound containing the element - anything that has contained the waste.
Regional ecosystems	A vegetation community, within a bioregion, that is consistently associated with a particular combination of geology, landform and soil, as defined by Sattler & Williams (1999) in <i>The Conservation Status of Queensland's Bioregional Ecosystems</i> .
Revegetation	Establishment of suitable plant species to support the agreed post mining land use and control soil erosion to sustainable levels.
Rock mulch	Durable or competent rock, together with topsoil, purposely placed on an area under rehabilitation to provide additional resistance to erosion and growth media.
Sand	Natural mineral particles with a diameter between 0.02 mm to 2.0 mm (McDonald <i>et al.</i> 1998)
Saline	Presence of salts, in water or spoil, generally undrinkable or in sufficient concentration to impair plant growth.
Sediment dams	Large impoundment structures used to retain rainfall runoff to allow settlement of suspended particles, prior to discharge.
Silt	Mineral particles with a diameter between 0.002 mm to 0.02 mm (McDonald <i>et al.</i> 1998)
Silt traps	Small impoundment structures built within a drainage line, which retard water flow and allow suspended solids to settle out.
Sodic	A soil is considered sodic when the exchangeable sodium percent (ESP) is greater than six. Sodic conditions usually result in clay dispersion and surface crust formation.
Sodosol	Soils with a strong texture contrast between A horizons and sodic B horizons which are not strongly acid, as defined by Isbell (1998).

Soil	That part of the upper weathered layer of the earth's crust which can support plant growth
Soil horizons	Soil horizons as defined by McDonald <i>et al.</i> (1998) are: O — surface layer dominated by organic material in varying stages of decomposition A — one or more surface mineral horizons with some organic accumulation A1 — mineral horizon at or near the surface with some accumulation of humified organic matter. It is usually darker than underlying horizons A2 — mineral horizon having less organic matter, sesquioxides and/or silicate clay than immediately adjacent horizons. It is usually paler in colour than the A1 or B horizon. A3 — transition horizon between the A and B horizons, which is similar to the A horizon B — one or more mineral soil layers characterised by a concentration of silicate clay, iron, aluminium and/or organic material; and/or a differing structure, consistence or colour of the A horizon. B1 — transitional horizon between the A and B horizon which is similar to the B horizon B2 — horizon dominated by an illuvial, residual or other concentration of silicate clay, iron, aluminium and/or humus, and/or maximum development of pedological organisation. B3 — transitional horizon between the B and C horizon which is similar to the B horizon C — consolidated and unconsolidated material below the A and B horizon. Usually partially weathered and little affected by pedological processes.
Spoil area	Area where overburden has been dumped.
Sump	Temporary excavation for the storage of water.
Subsoil	The B horizon within the soil profile which lies immediately below the topsoil or A horizon. The subsoil is not enriched with organic material as is the topsoil. It may also be subject to clay and/or salt accumulation.
Suitably qualified person	A person whose professional training or experience is relevant to the matter being considered (EPA 2007).
t	Tonne
Tension cracks	Cracks at the ground surface, which occur due to tensional forces in the soil or rock mass.
Test pit	An excavation for examination of subsurface soil conditions
Topsoil	The uppermost horizon (or A horizon) of the soil profile which usually contains the organic matter, biota and a concentration of the nutrients.
Exploration track	Temporary vehicle traffic route used for exploration or infrequent access from which topsoil has not been removed.
Vertosol	Clay soil with shrink-swell properties as defined by Isbell (1998)
Waters	River, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, bed and bank of any waters, dams, non-tidal or tidal waters or any part-thereof.
Wetland	Area where natural flow has been permanently interrupted and will remain as a feature of the landform after mining.
WJV	Wandoan Joint Venture

Executive summary

This geology, mineral resources, overburden and soils report forms part of the Supplementary EIS for the Wandoan Coal Project (the Project) and is an addendum to the EIS, Volume 1, Technical Report TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment. Alterations to the mining schedule, the provision of a final landform, and amendments to the land suitability assessment in response to submissions on the EIS, have required further assessment to be undertaken.

As per the EIS, it is expected that the Project will reduce areas of Class 3 dry land cropping and Class 2 beef cattle grazing. Large portions of the disturbed areas, including overburden stockpiles are recommended to be rehabilitated to Class 2 beef cattle grazing, and the final land use is suggested as a combination of cattle grazing and nature conservation.

Compared to the EIS technical report, the impact to land suitability classification is much less, with a reduction of only 3,407 ha of Class 2 land for cattle grazing, and with 18,222 ha of Class 3 cropping land present in the final landform.

1. Introduction

1.1 Project background

The Wandoan Coal Project Environmental Impact Statement (EIS) was advertised for public comment during December 2008 to February 2009. This report is part of the Supplementary EIS for the Wandoan Coal Project (the Project) and is an addendum to the EIS, Volume 1, Technical Report TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment. Alterations to the mining schedule, the provision of a final landform, and amendments to the land suitability assessment in response to submissions on the EIS required further assessment.

1.2 Description of study area

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2. Methodology of assessment

2.1 Relevant legislation and guidelines

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2 How the study was conducted and information obtained

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment, with a revised assessment of land suitability, as discussed in Section 2.2.6, and a new assessment relating to land suitability during mine operations, as described in Section 2.2.7.

2.2.1 Review of existing information

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2.2 Field assessment

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2.3 Laboratory testing

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2.4 Soil mapping and classification

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2.5 Overburden assessment

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

2.2.6 Land suitability assessment

Further information from the Department of Environment and Resource Management (formerly NRW) indicated that some land suitability criteria in Appendix 2 of the Land Suitability Guidelines (DME 1991) require modification for use in Central Queensland (Surat Basin) for cropping. These criteria relate to nutrient availability and water erosion. In Central Queensland (Surat Basin) alkaline near-surface soils do not appear to impact crop nutrient availability (A Biggs, per comms, 27 February 2009).

As such, these parameters have been reassessed, and the 'nutrient deficiency' and 'water erosion' criteria presented in Table E-1 in Appendix E of EIS Volume 1, Technical Report 9-1-V1.5 Geology, Mineral Resources, Overburden and Soils should be replaced with the criteria presented in Attachment E of this addendum.

In amending the land suitability classification, it should be noted that Dalby Regional Council, the body responsible for GQAL classification in the Project area, did not comment of the land suitability class distribution as presented in the EIS in its submission.

2.2.7 Land suitability during mine operations

As a new assessment conducted for the Supplementary EIS, the land suitability classification of land potentially available for agricultural use was assessed. Land suitability, in essence, does not consider land use, only potential land uses. However, for the purpose of assessing the impacts to agriculture during mine operation, land in which agriculture will not be able to be conducted due to mine operations has been considered 'unavailable' for the land suitability assessment.

The land suitability classes were assessed for indicative 'snapshot' scenarios in Years 5, 10, 20 and 30. In preparing the assessment, buffer areas around mine infrastructure were assigned to represent areas in which agriculture would be excluded. These buffers have been selected to provide a conservative estimate of the amount of land potentially available for agriculture. These buffers are indicative estimates only, for this purpose of this assessment, and may not be the actual buffers implemented. The location of associated infrastructure may be subject to refinement during detailed design, and as such infrastructure locations should also only be considered indicative. The buffers and assumptions made in conducting this assessment are:

- areas not directly impacted by mine operations will retain their pre-mining land suitability class
- land will be unavailable in the vicinity of mine infrastructure area, including areas between the mine infrastructure area and Austinvale Pit, Austinvale North Pit, Woleebee Pit, Leichhardt Pit, and Frank West Pit, as these pits develop
- land will be unavailable for a 1 km buffer around active mining faces. This accounts for the 600 m exclusion zone for blasting, as well as an additional distance to allow for fencing relocations (i.e. stock fences will only be relocated periodically)
- land will be unavailable for a 100 m buffer around haul roads, mine access roads, the rail spur, conveyors, levees, in-pit dumps, creek diversions and other mine infrastructure. It should be noted that these distances have been assigned for operational purposes, not safety purposes
- land suitability classes for rehabilitated land will be assigned based on Section 5.5 of this report
- rehabilitated land will be considered in the land suitability assessment when rehabilitation areas reach 200 ha. Areas smaller than 200 ha are considered economically non-viable for cattle grazing (an area of 200 ha would run about 50–60 steers which would justify putting in watering points and fencing). Although not strictly land suitability related, this minimal area allowance provides for a conservative and realistic assessment of land potentially available for agricultural use.

2.3 Limitations

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3. Existing environment

3.1 Topography

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.2 Vegetation

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.3 Geology

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.4 Mineral resources

A new search of the Department of Employment, Economic Development and Innovation's Interactive Resource and Tenure online maps (http://www.dme.qld.gov.au/mines/tenure_maps.cfm, viewed on 19 June 2009) was conducted for the Project area, as shown in Figure 3-1. This search identified no changes to petroleum leases (PL), exploration permits for coal (EPC), mineral development licences (MDL) or mining leases relative to the EIS.

The following changes to exploration permits for petroleum (EPP) have occurred since the EIS:

- EPP867 (application) held by Paillard Energy Pty Ltd was deemed unsuccessful
- EPP869 (application) held by Bow Energy Resources Ltd was deemed unsuccessful
- EPP870 (application) held by Pure Energy Resources Limited was deemed unsuccessful.

3.5 Geomorphology

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.6 Overburden

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.7 Soils

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.8 Land suitability assessment

An updated land suitability map of the Project area for dry land cropping is shown in Figure 3-2, based on the revised criteria discussed in Section 2.2.6 of this technical report.

The revised mapping classified the majority of the site at Class 3 for cropping, with Kinnoul, which occurs on upper slopes, being classified as Class 4. The EIS classification mapping comprised a large portion of Class 4 land over the site. The basis for the revised land suitability assessment is provided in Appendix E.

This distribution of agricultural land differs to the GQAL distribution under the Taroom Planning Scheme, in that the GQAL mapping classifies the drainage lines as Class B (limited cropping land), and the remainder of the site as Class A (cropping land), where as the studies for the Supplementary EIS found limitations of the hill crests and upper slopes due to soil depth and slope gradient, classifying this land as Class 4 (marginal land) for cropping, where as lesser limitations were identified on the floodplains, with this land being classified Class 3 (suitable moderate limitations) for cropping, as per the EIS.

3.9 Good quality agricultural land

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

3.10 Soil conservation plans

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

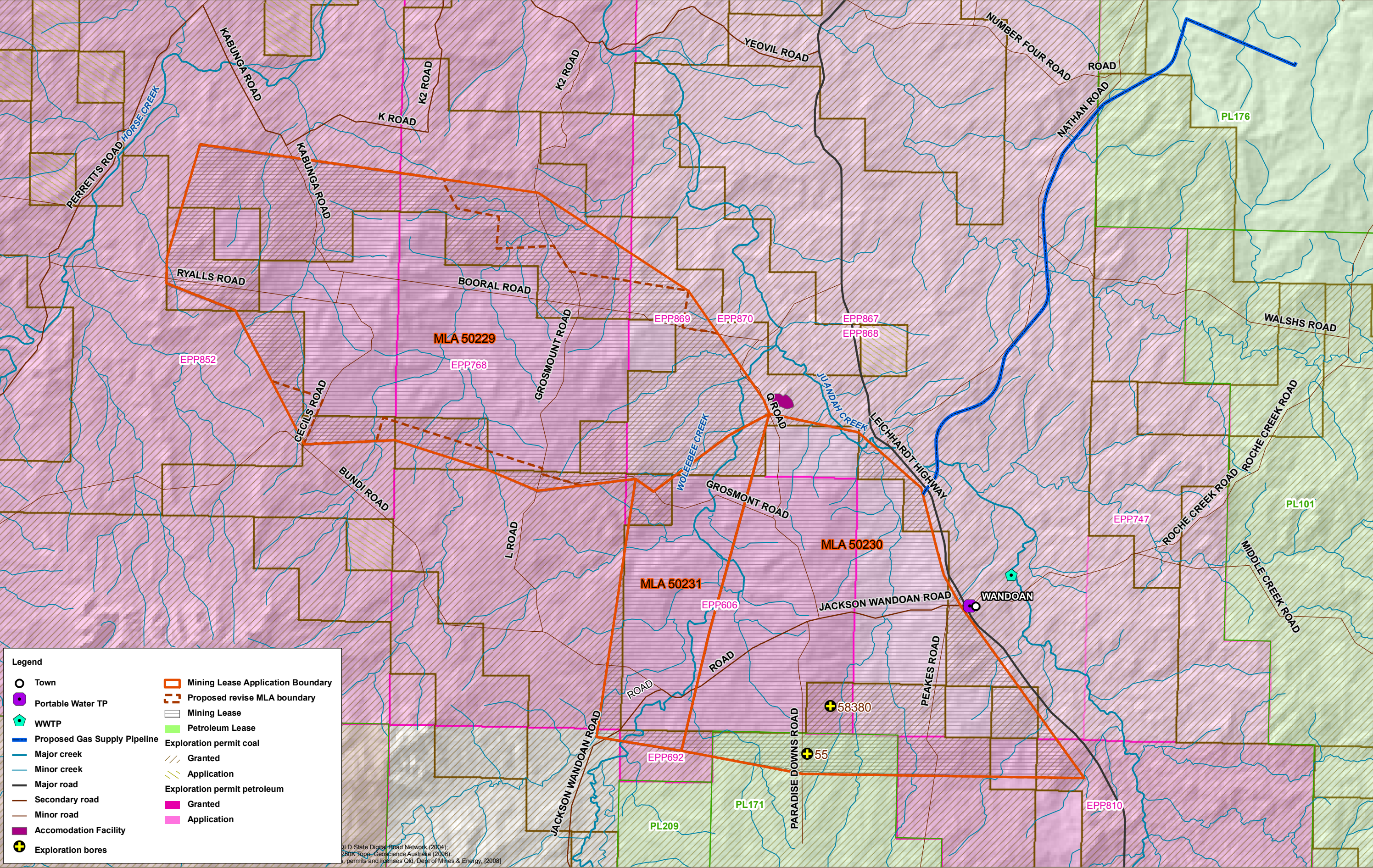
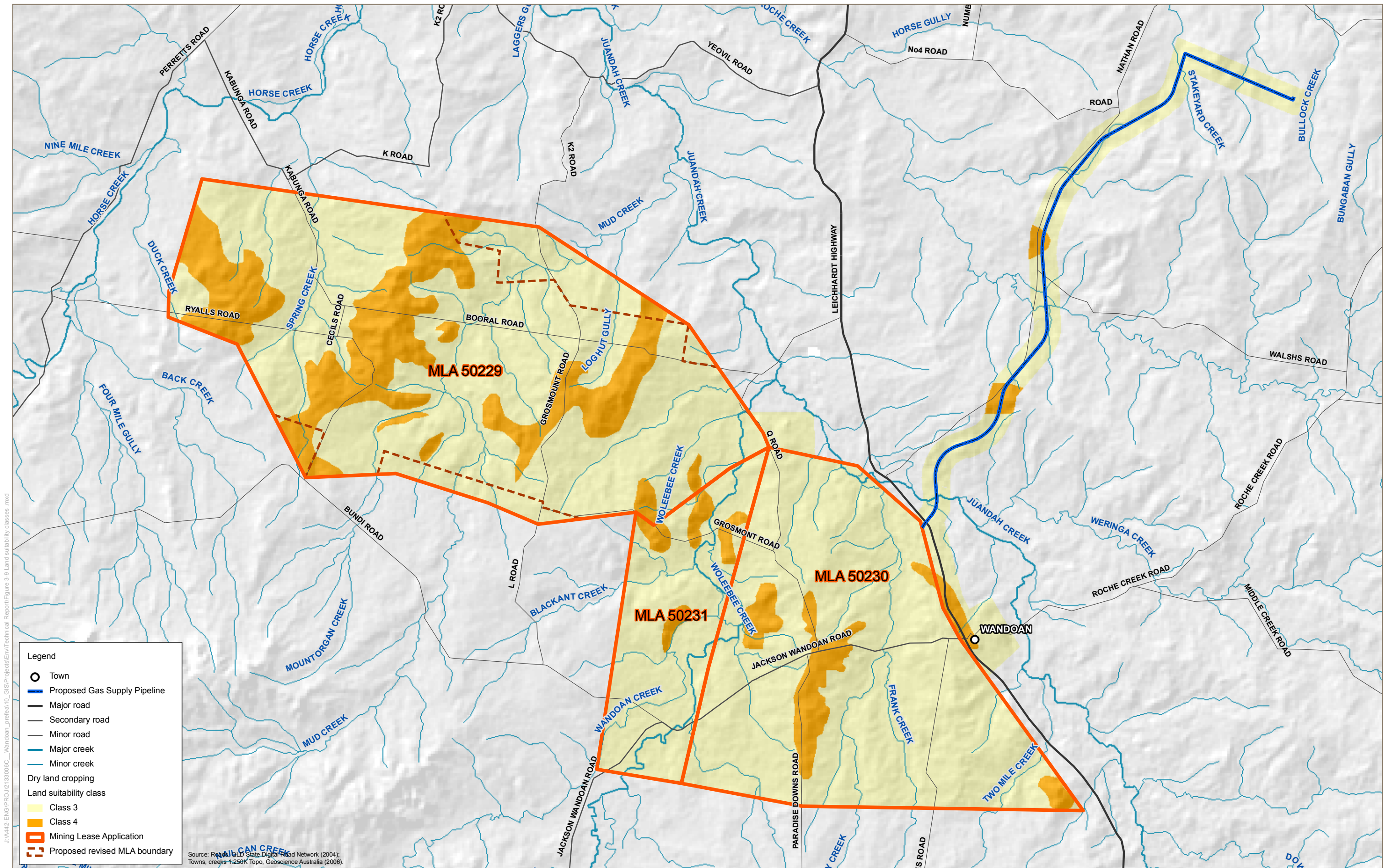


Figure 3-1
Extractive resources, permits and leases within the Project area



J:\A442-ENG\PROJ\2133006C_Wandoan_prefea10_GIS\Projects\Env\Technical Report\Figure 3-9 Land suitability classes .mxd

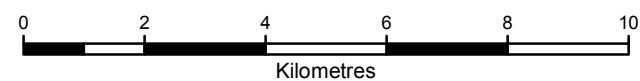


Figure 3-2
Land suitability for dry land cropping

4. Description of proposed development

4.1 Project scope refinements

Refinements to the Project scope have been made following and subsequent to the advertising of the EIS. These refinements are described in detail in Chapter 6 Project Operations of the Supplementary EIS, and are shown in Figure 4-1 and summarised below.

Due to submissions on the EIS and consultation with the community, the extent of mining in Frank Creek Pit has reduced, and mining in Woleebee South Pit will no longer occur within the timeframe of this Project. A new pit, Wubagul Pit, in the southeast portion of the MLA areas will replace mining in these two pits. The mining methods for Wubagul Pit will generally be the same as for other mine pits.

Further assessment of tailing requirements found that greater tailings disposal requirements are required compared to the EIS. A revised indicative tailings strategy for the Project has resulted in the Austinvale North, Austinvale, Leichhardt, Frank Creek, Woleebee North and Woleebee Pits being used for tailings disposal, and therefore no final voids will remain in the final landform for these pits. The tailings will be disposed of in-pit, and covered with approximately 20 m of overburden. The refinements to the pit layout and revised tailing strategy have resulted in changes to the scheduling of when mining of each pit will occur.

In the EIS and the EIS technical report it was anticipated that the final landform would be similar to the existing topography, with around 5 m, and a maximum of 25 m increased elevation compared to the existing landform. Reassessment of the overburden bulking factor (that is, expansion in volume of overburden as it is excavated), and the revised tailings strategy have resulted in this increase in elevation being reassessed to being an average of about 20 m above the existing landform, with a maximum of 25 m increased elevation compared with existing landform.

Changes are also proposed to the northern and southern boundary of MLA 50229, as shown on Figure 4-1.

4.2 Final landform

As noted in the EIS Technical Report, the Year 30 landform presented in the EIS was not a final landform, as mining is proposed to continue beyond Year 30 of the mine, under a new license. Post mining land suitability areas presented in the EIS were based on the Year 30 landform, as opposed to the final landform, due to information available at the time of EIS preparation. In the Year 30 landform presented in the EIS, ramps and voids had not been rehabilitated.

While coal resources in the region indicate that mining can continue beyond Year 30, a final landform based on completion of mining in Year 30 has now been prepared, as presented in Figure 4-6. This final landform represents how the landscape would be rehabilitated in the event that mining does not continue past Year 30, and represents approximately Year 32. Typically, a single final void will remain after completion of mining for each pit. However, no final voids will remain for the pits used for tailings disposal as discussed above. Final void slope gradients will be up to 1(v):7(h), or 14.2% gradient. The upper surface of overburden stockpiles will be levelled out and shaped to provide a gently undulating landform.

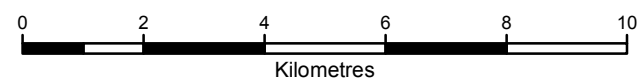
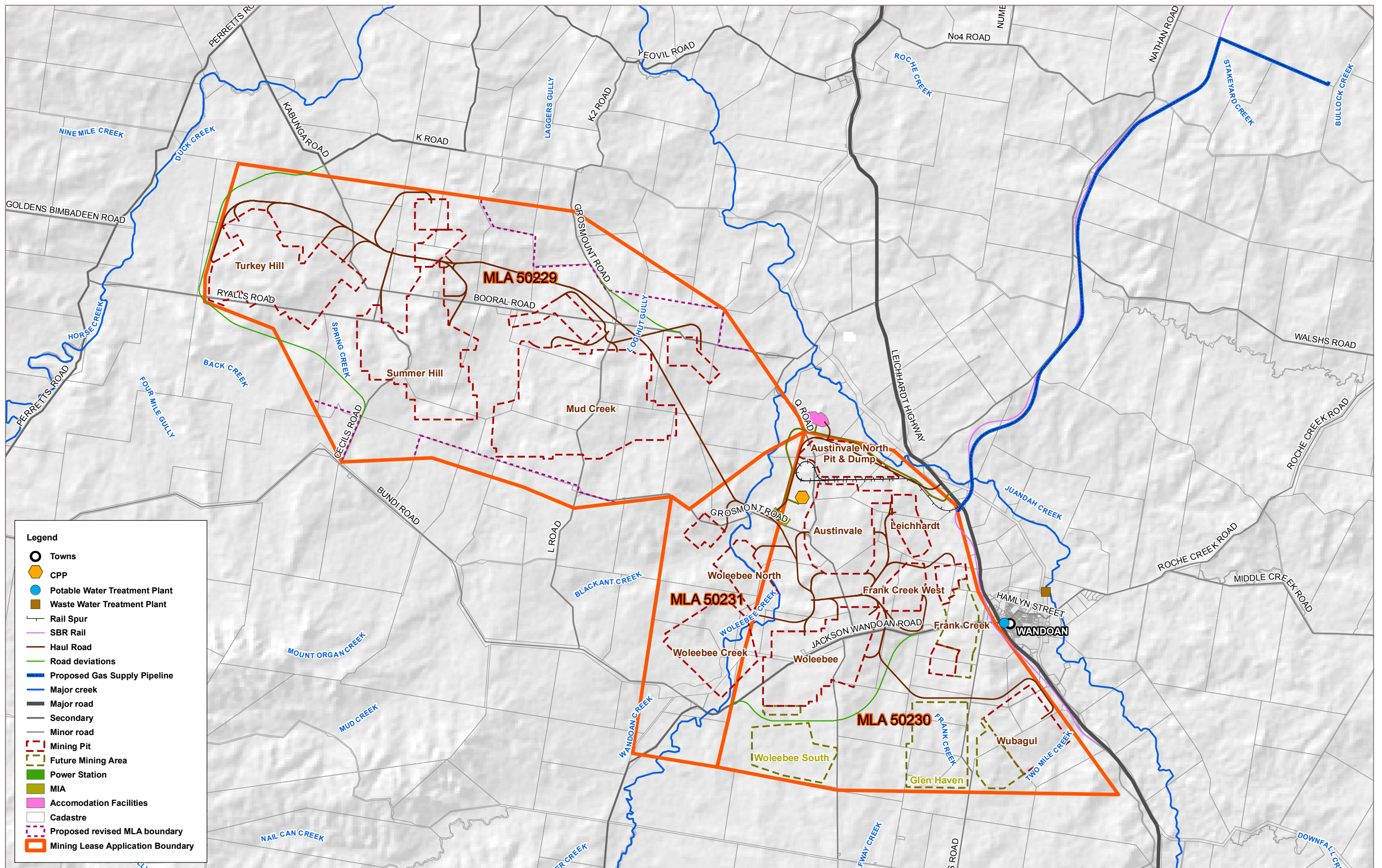
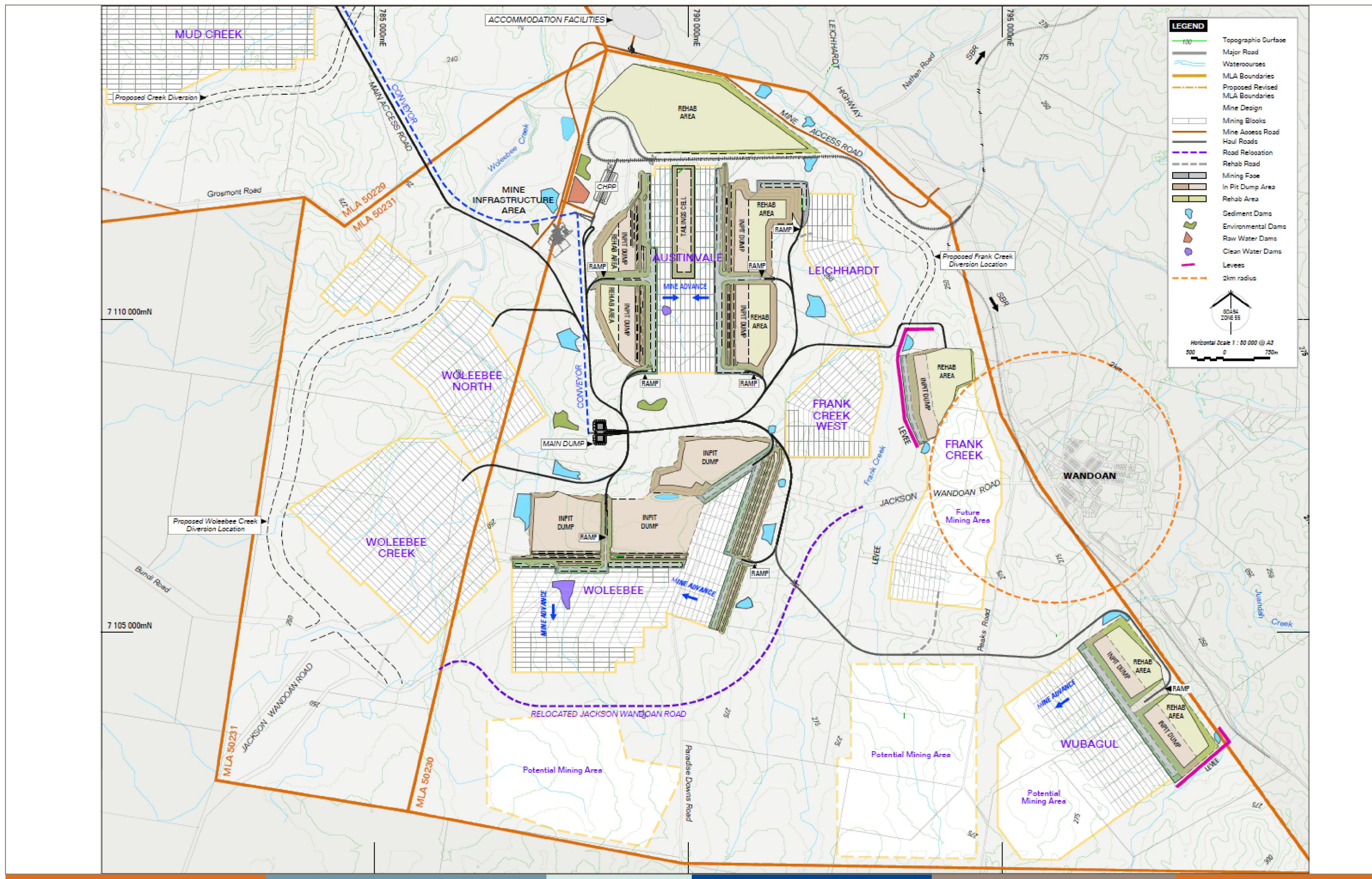
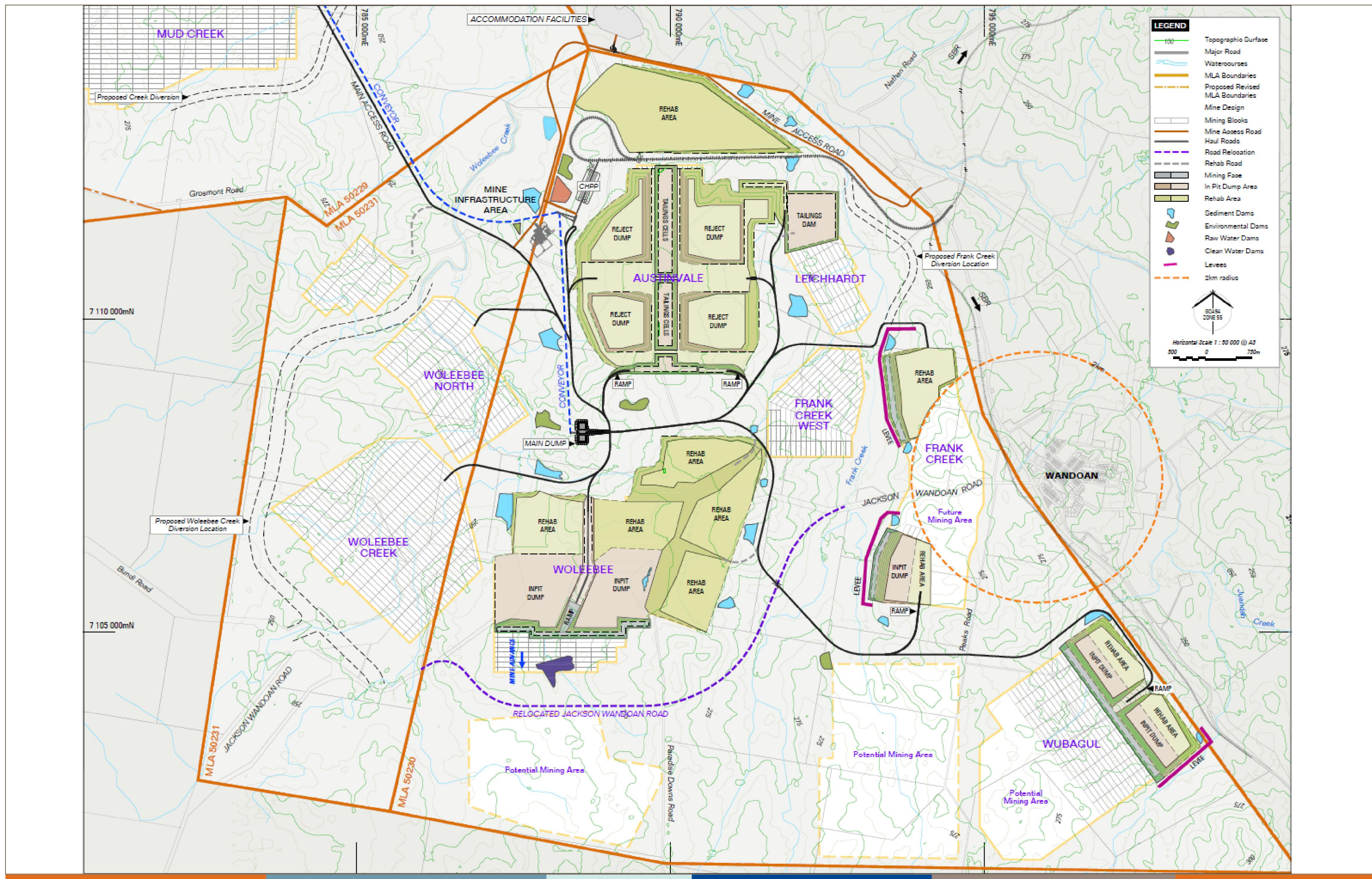
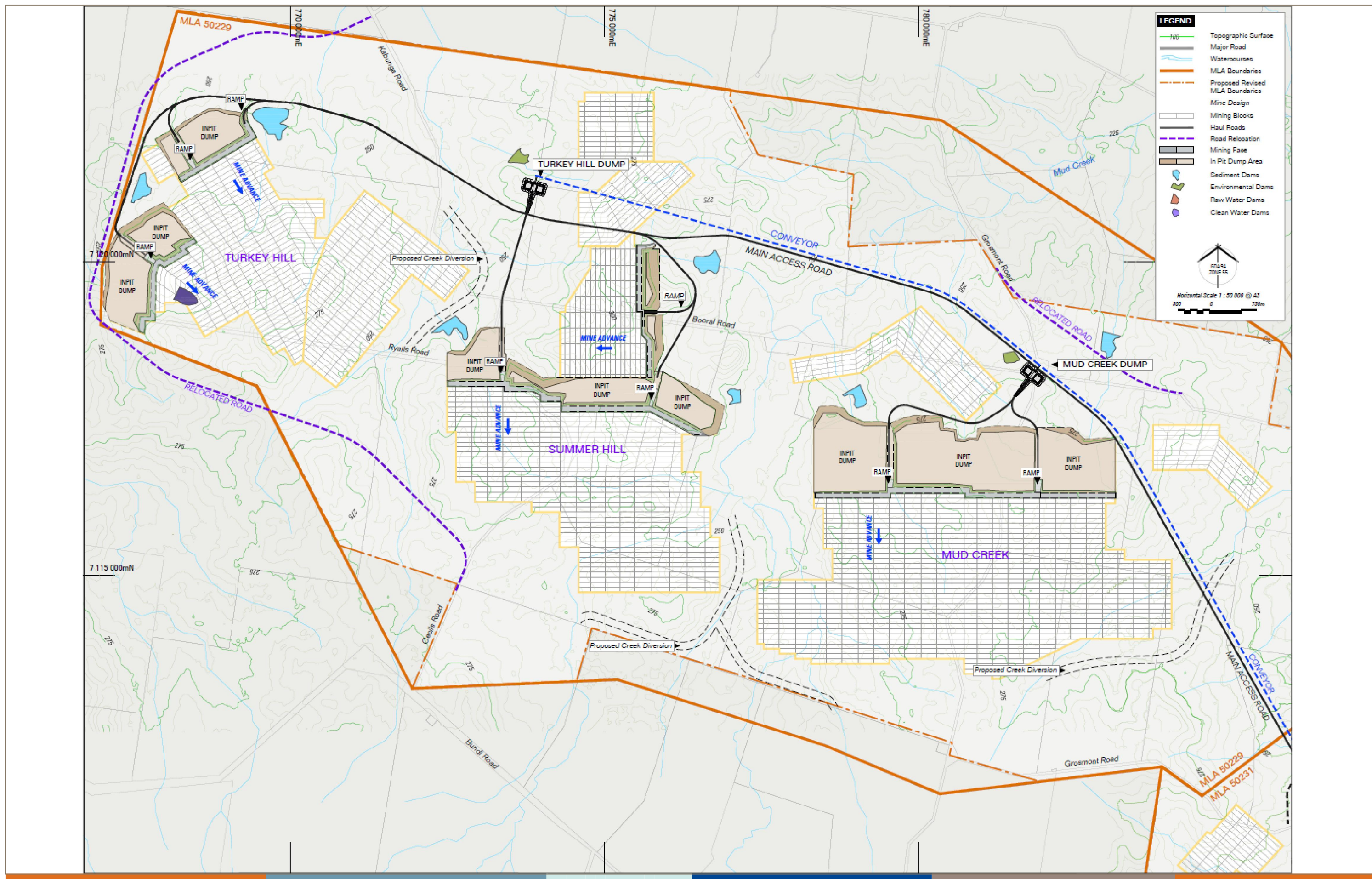
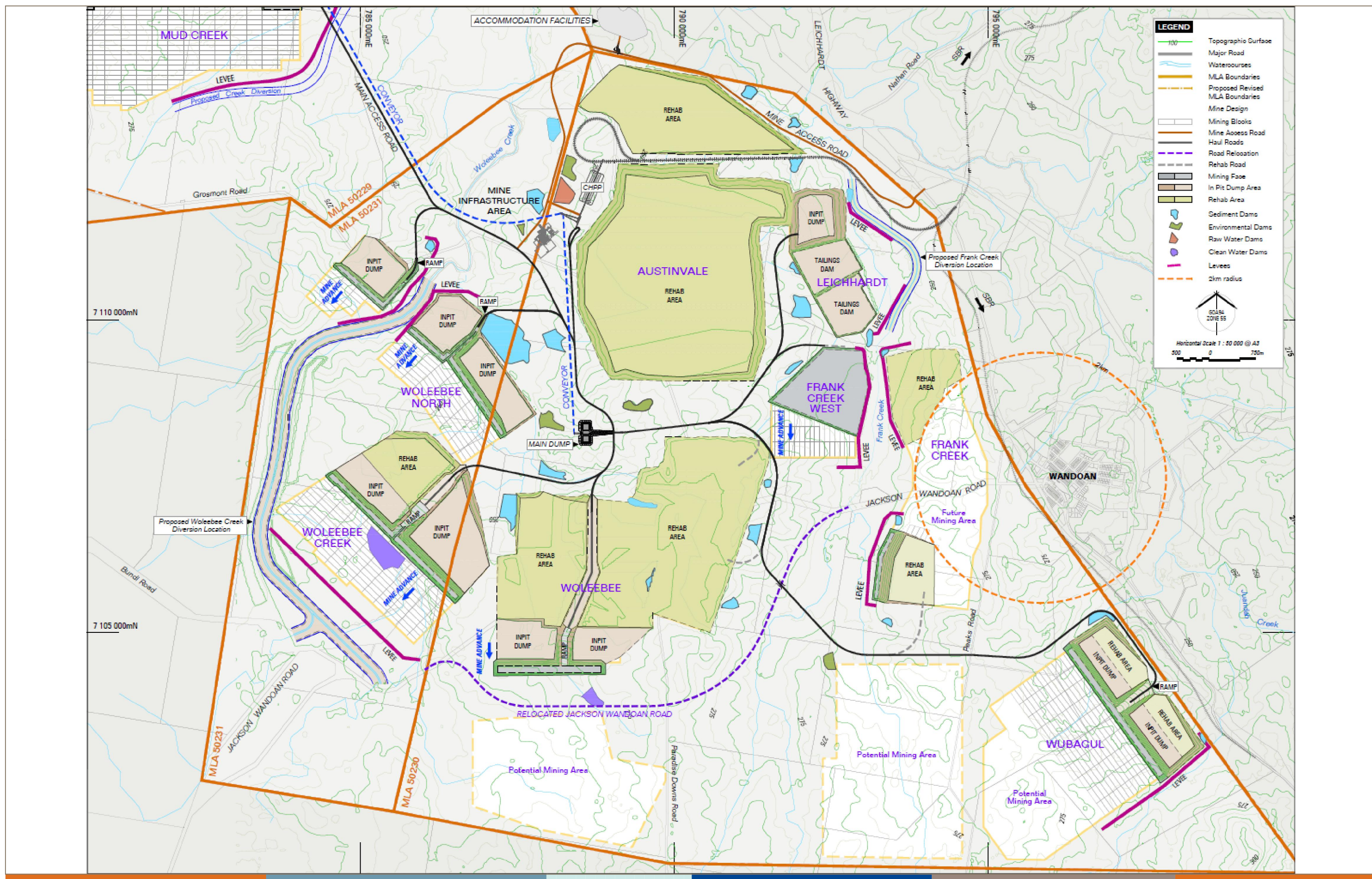


Figure 4-1
Mine layout









| **Figure 4-4a**

Year 20 Excavation & Refill Plan for MLAs 50230 & 50231

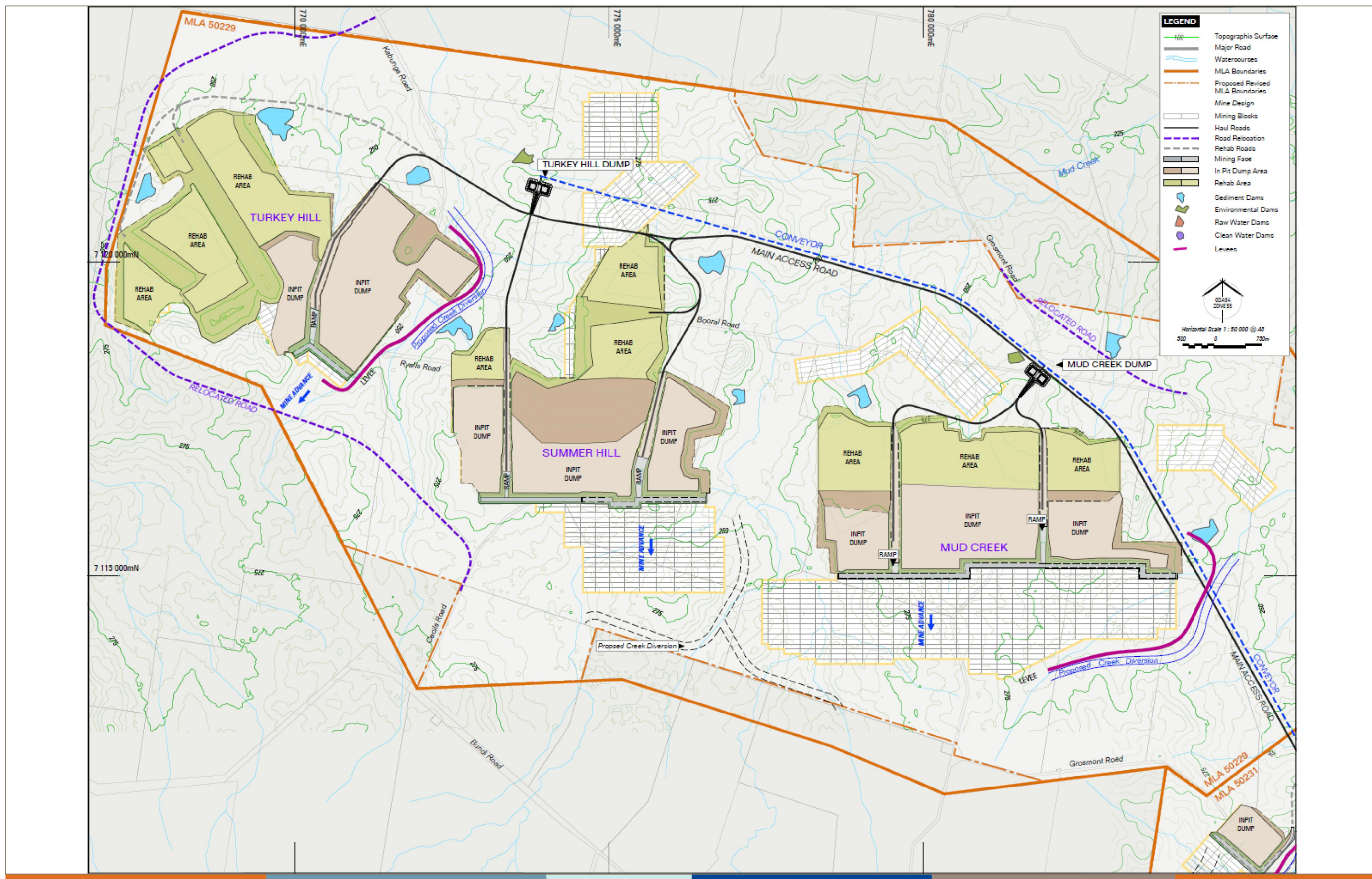
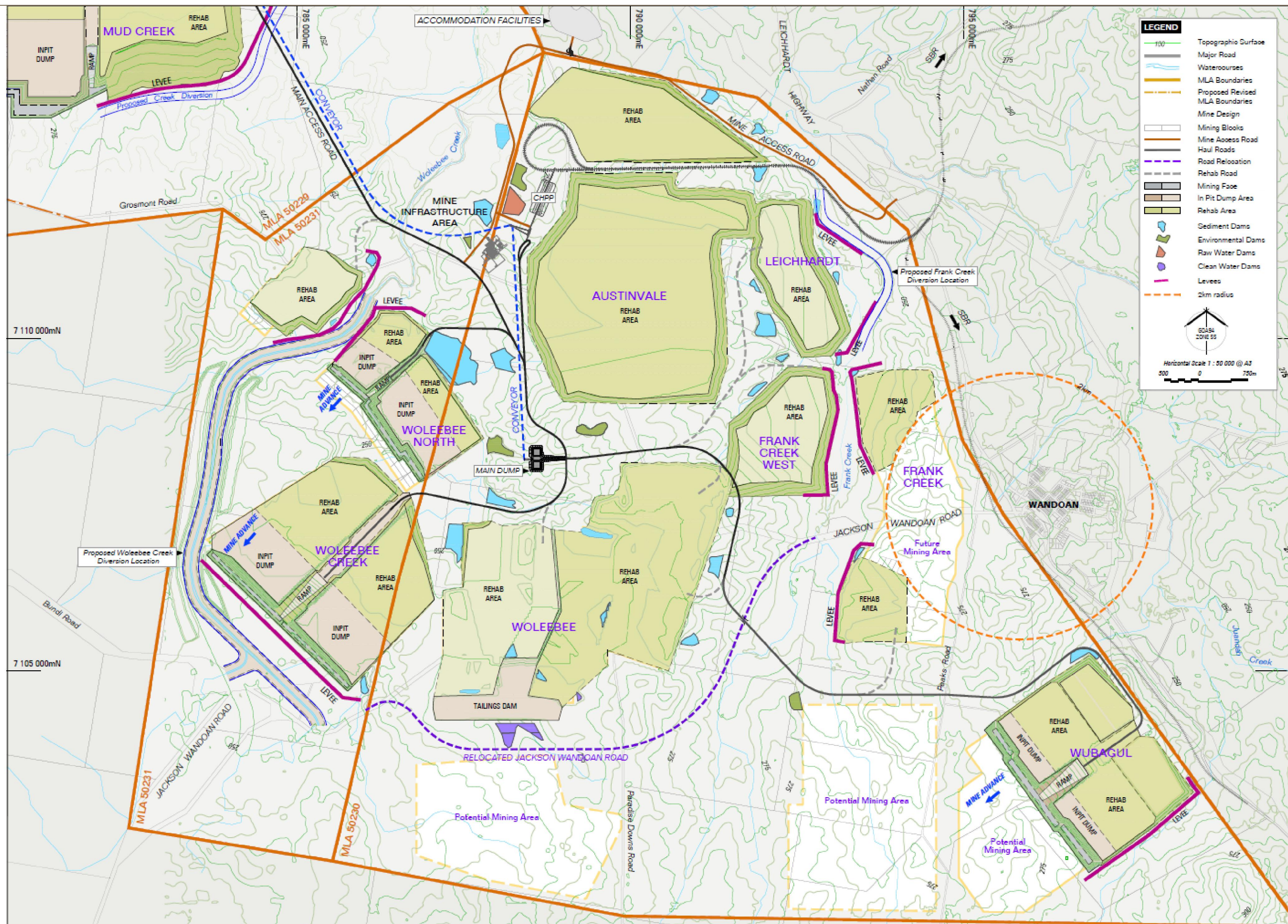
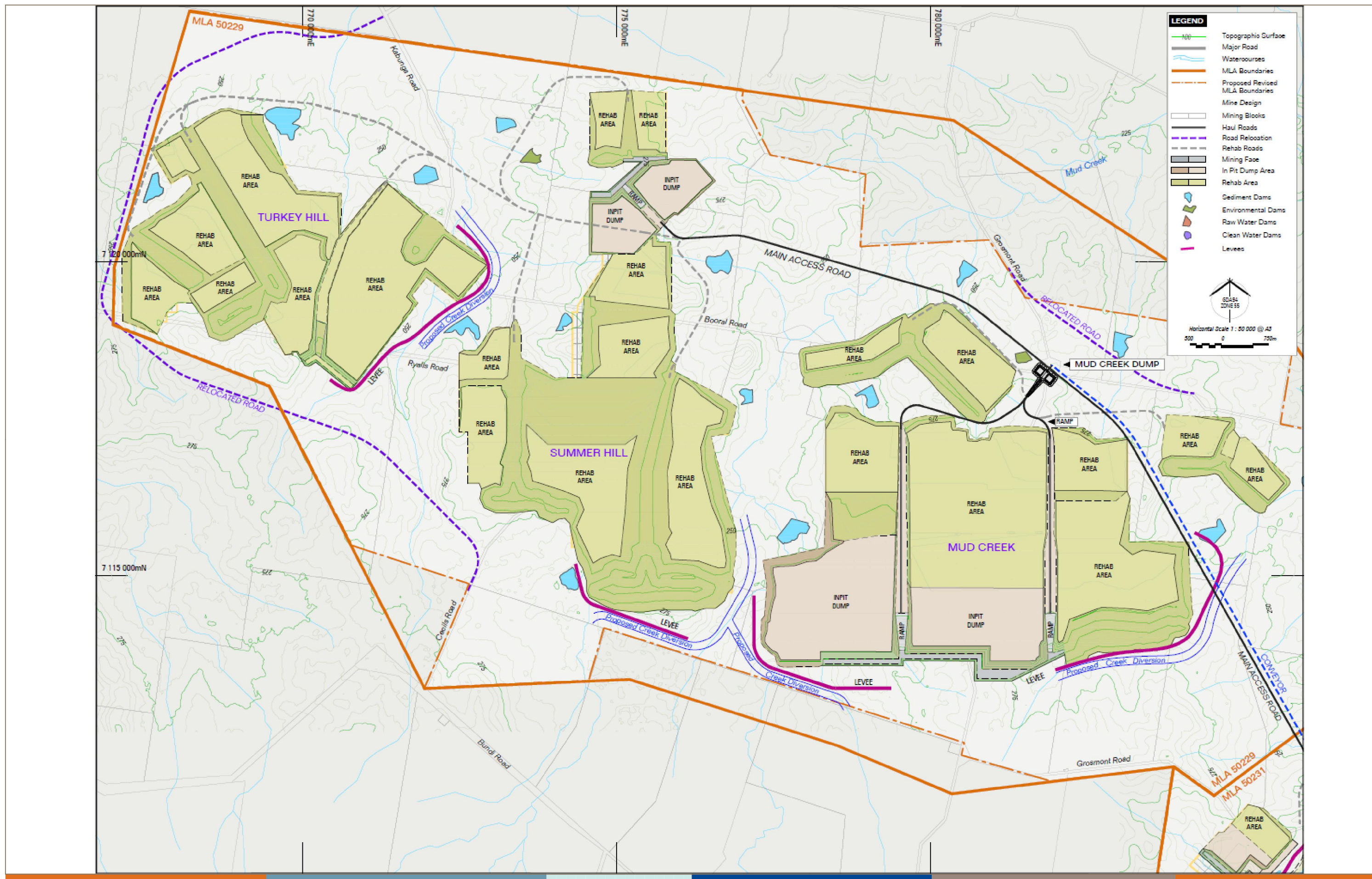
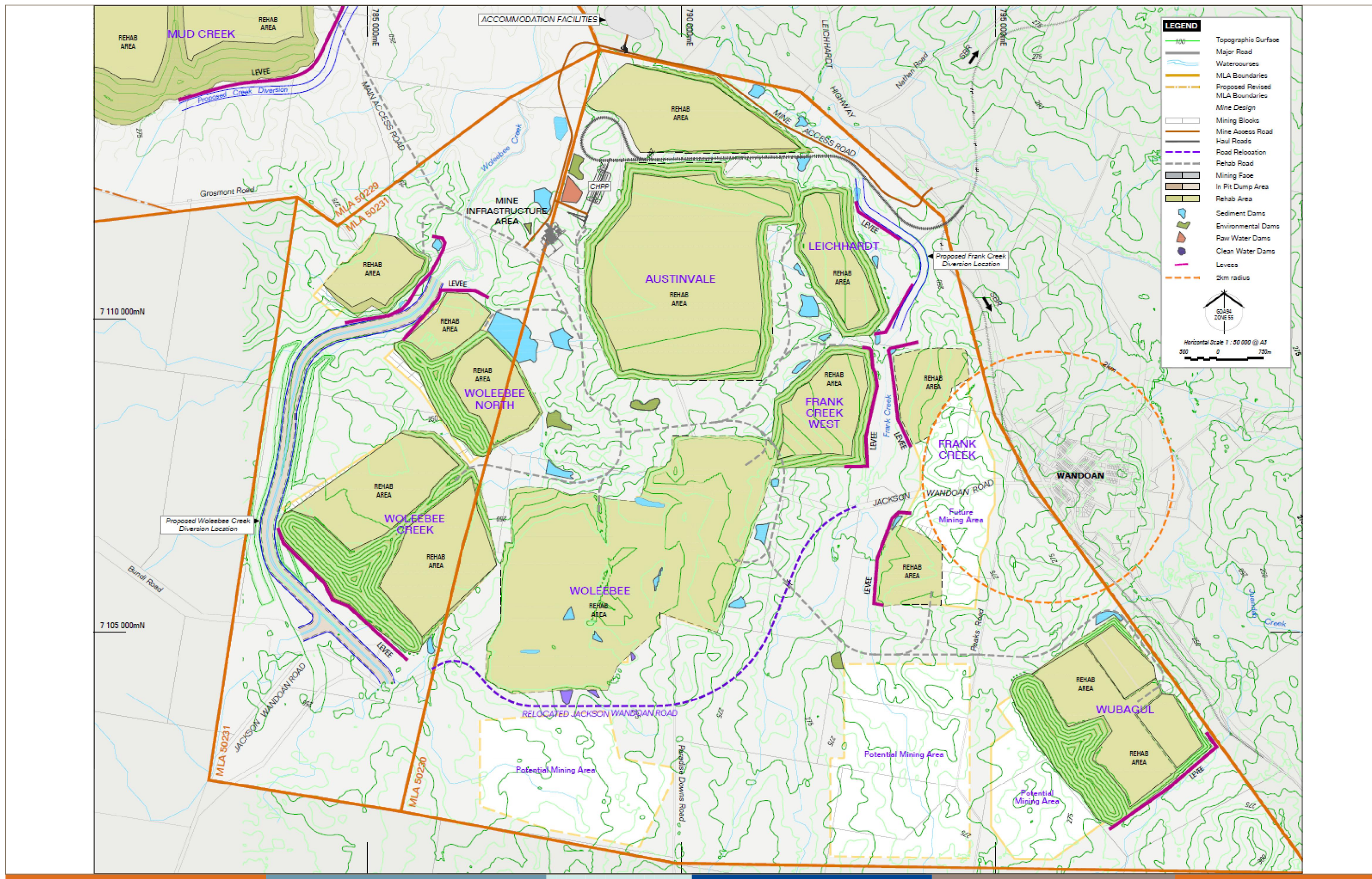
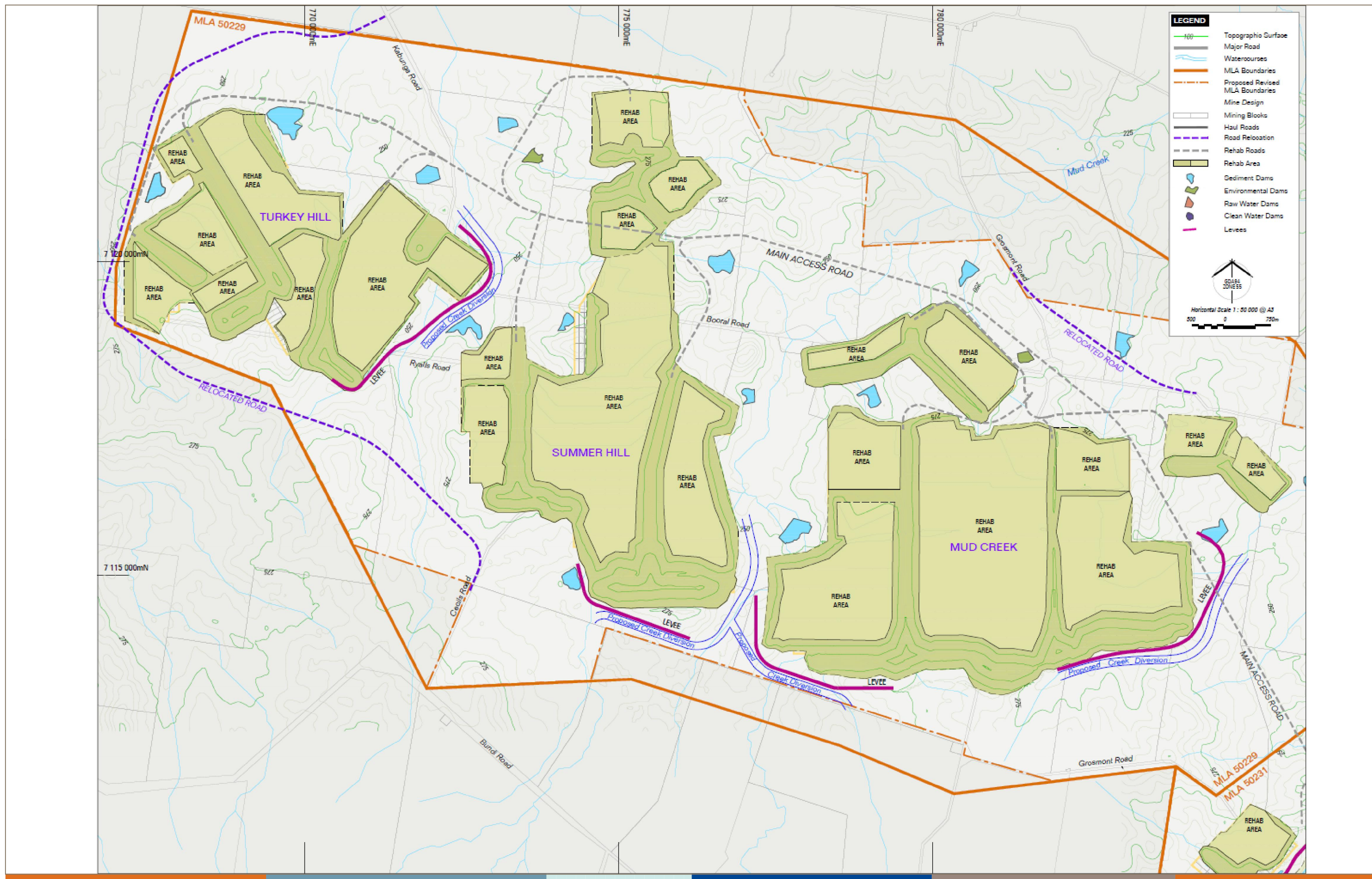


Figure 4-4b









5. Potential impacts

5.1 Topography

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

5.2 Overburden

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

5.3 Uncovering fossil material

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

5.4 Soils

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

5.5 Land use suitability

5.5.1 Post mining land suitability

Following the refinement of the mine plan and development of a final landform, the final landform land suitability classes have also been refined and are expected as follows:

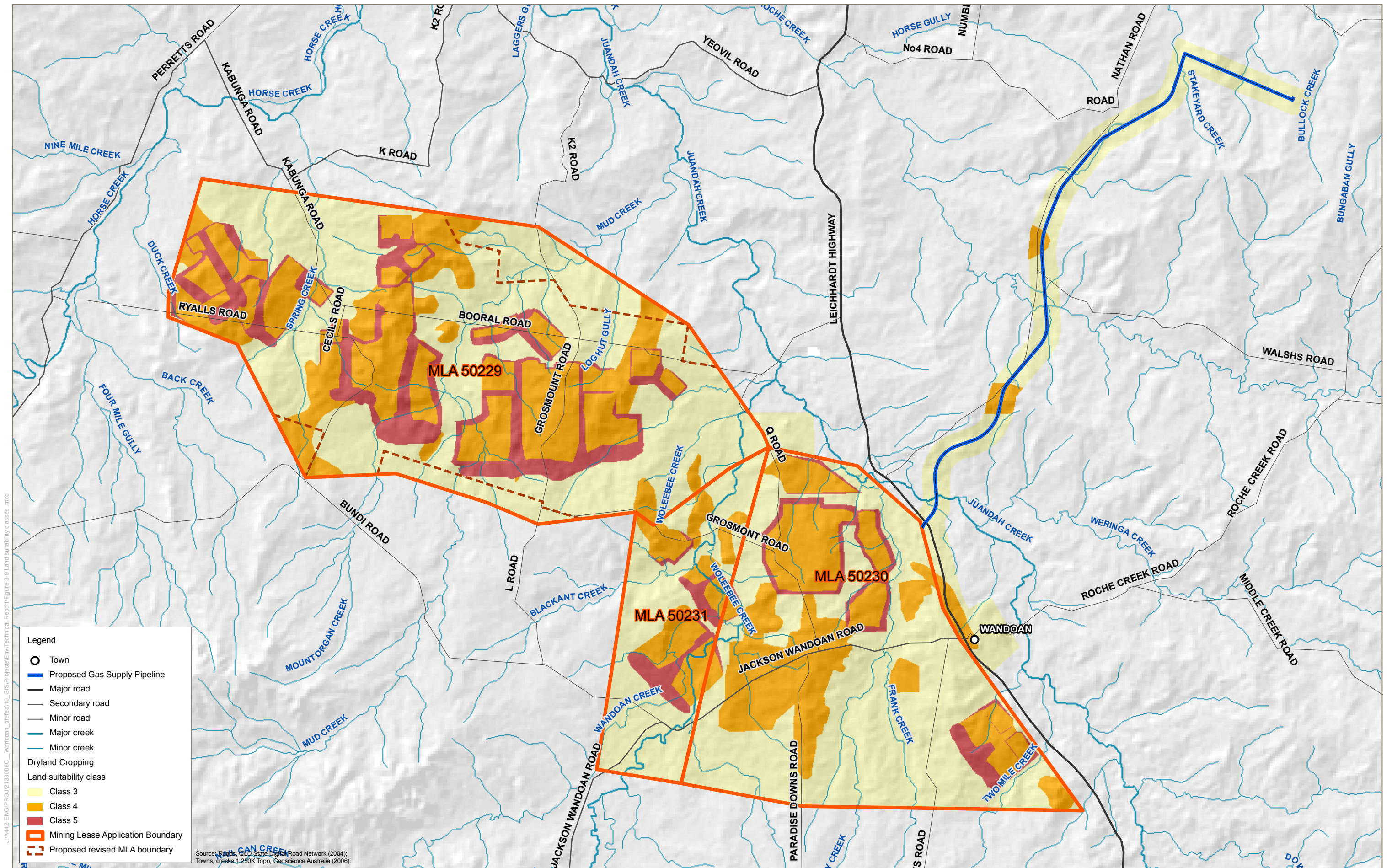
- undisturbed land will be returned to (or retained in) its pre-mining land suitability class
- land used for infrastructure components of the Project (roads, MIA, etc) will have limitations related to water availability (through compaction and breakdown of the subsoil structure). Where practicable this land will be returned to Class 3 cropping land or Class 2 grazing land, otherwise it will be returned to Class 4 cropping land or Class 3 grazing land
- spoil stockpiles will have limitations related to plant water availability, salinity, gradient, erosion and nutrient content. Flatter gradient sections of spoil stockpiles will be returned to Class 4 cropping land or Class 2 grazing land where practicable. Steeper gradient spoil slopes will be returned to Class 5 cropping land or Class 4 grazing land
- tailings will be disposed of in-pit, and covered with approximately 20 m of overburden. As such, no tailings dam sites are expected in the final landform
- final voids will be re-contoured to reduced gradients, and will have limitations similar to those listed for spoil stockpiles, and will be Class 4 for cattle grazing or Class 5 for cropping.

These land suitability classes include planned rehabilitation and mitigation measures discussed in the EIS and TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

While much of the rehabilitated spoil stockpiles are being returned to a slope gradient suitable for Class 3 cropping land (suitable land with moderate limitations), cropping as a

post-mining land use of rehabilitated spoil is limited in Australia, and it has therefore been conservatively assumed that the land will be returned to Class 4 cropping land.

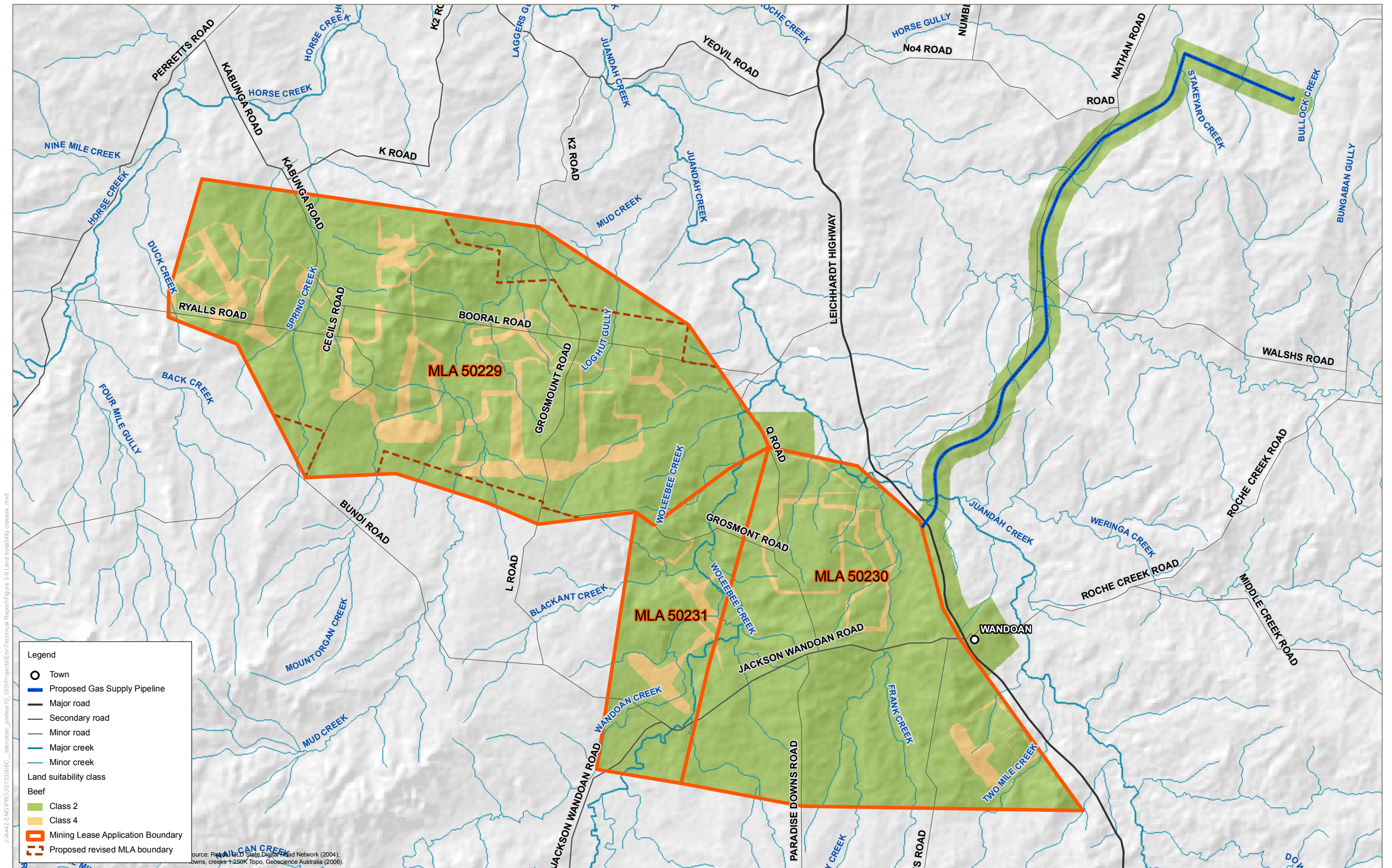
The land suitability classes of the final landform are presented in Figures 5-1 and 5-2. Due to the small spatial area covered by infrastructure components at the resolution of the figures, these areas have been assumed to be rehabilitated to the pre-mining land suitability classes.



0 2 4 6 8 10
Kilometres



Figure 5-1
Post mining land suitability for dryland cropping



0 2 4 6 8 10
Kilometres



Figure 5-2
Post mining land suitability for beef cattle grazing

5.5.2 Land suitability during mine operations

An indicative estimate of land potentially available for agriculture during mine operations at Years 5, 10, 20 and 30, with the accompanying land suitability classification of these lands, are shown in Figures 5-3 to 5-10. The parameters and assumptions made in conducting this assessment were provided in Section 2.2.7.

It is highlighted that these figures present the potential for agriculture. These figures must not be taken to infer that agriculture will necessarily take place, or will take place in accordance with the figure. It must also be noted that the land will not necessarily be available for agricultural use by existing landowners. The figures only show the potential for agricultural use – not use of the land for agricultural purposes.

During Year 5, mining operations are progressing on MLA 50230, with a large portion of this land already unavailable for agriculture. Mining operations have also commenced in Mud Creek Pit, and road, conveyor and other infrastructure is located or will be under construction on MLA50229 and MLA50231. However, MLA50229 and MLA50231 largely retain their pre-mining land suitability class.

Rehabilitation works have commenced for the Austinvale Pit, Frank Creek Pit and Wubagul Pit. However this rehabilitation is generally small in area and is in close proximity to active mining operations and will not be available for agriculture.

During Year 10 the area of land unavailable on MLA 50230 and MLA 50231 has only slightly increased, while unavailable areas on MLA 50229 have increased significantly with mining in Summer Hill and Turkey Hill Pits. Rehabilitation is progressing on a number of pits in MLA 50230, however these areas remain in close proximity to mine operations or land locked by haul roads, and as such, are assumed not available for agriculture.

During Year 20 the area of land unavailable has increased across the site with the progression of mining. Rehabilitation has also been progressing, with large portions of the areas being disturbed by mine pits having been rehabilitated. In Year 20, rehabilitated land not in close proximity to mining infrastructure becomes 'available' at the Turkey Hill Pit and being relatively flat, has been classified Class 4 for cropping or Class 2 for cattle grazing.

During Year 30 mining has been completed in a number of pits, and rehabilitated land is available for agriculture, with flat land being Class 4 for cropping or Class 2 for cattle grazing, and steeper slopes being Class 5 for cropping or Class 4 for cattle grazing. However, large areas of rehabilitated land on MLA50230 are still classified as unavailable due to their proximity to or being land locked by haul roads and other mine infrastructure.

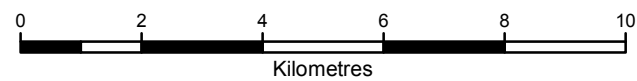
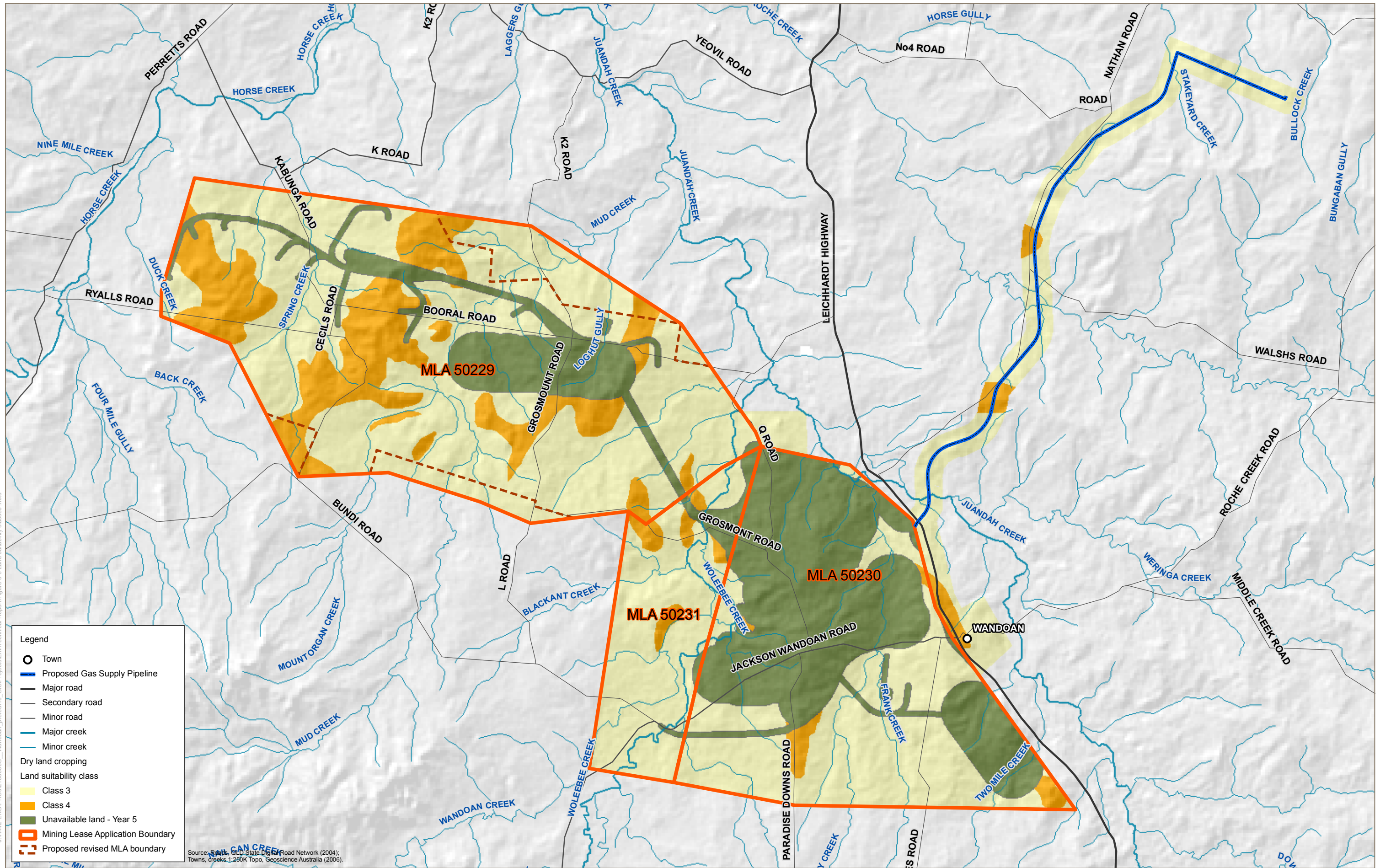
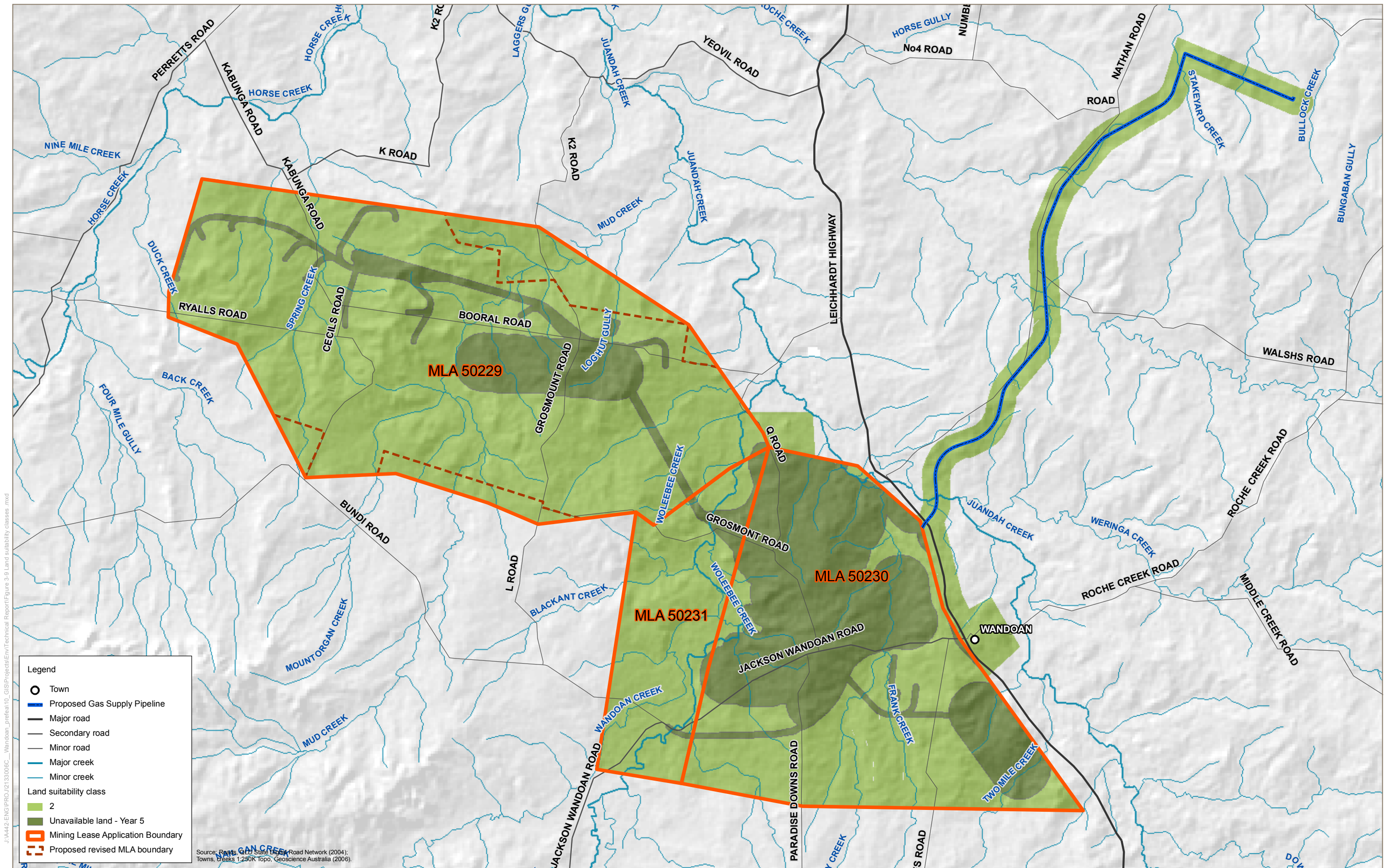


Figure 5-3
Year 5 Land suitability for dry land cropping



0 2 4 6 8 10
Kilometres



Figure 5-4
Year 5 Land suitability for beef cattle grazing

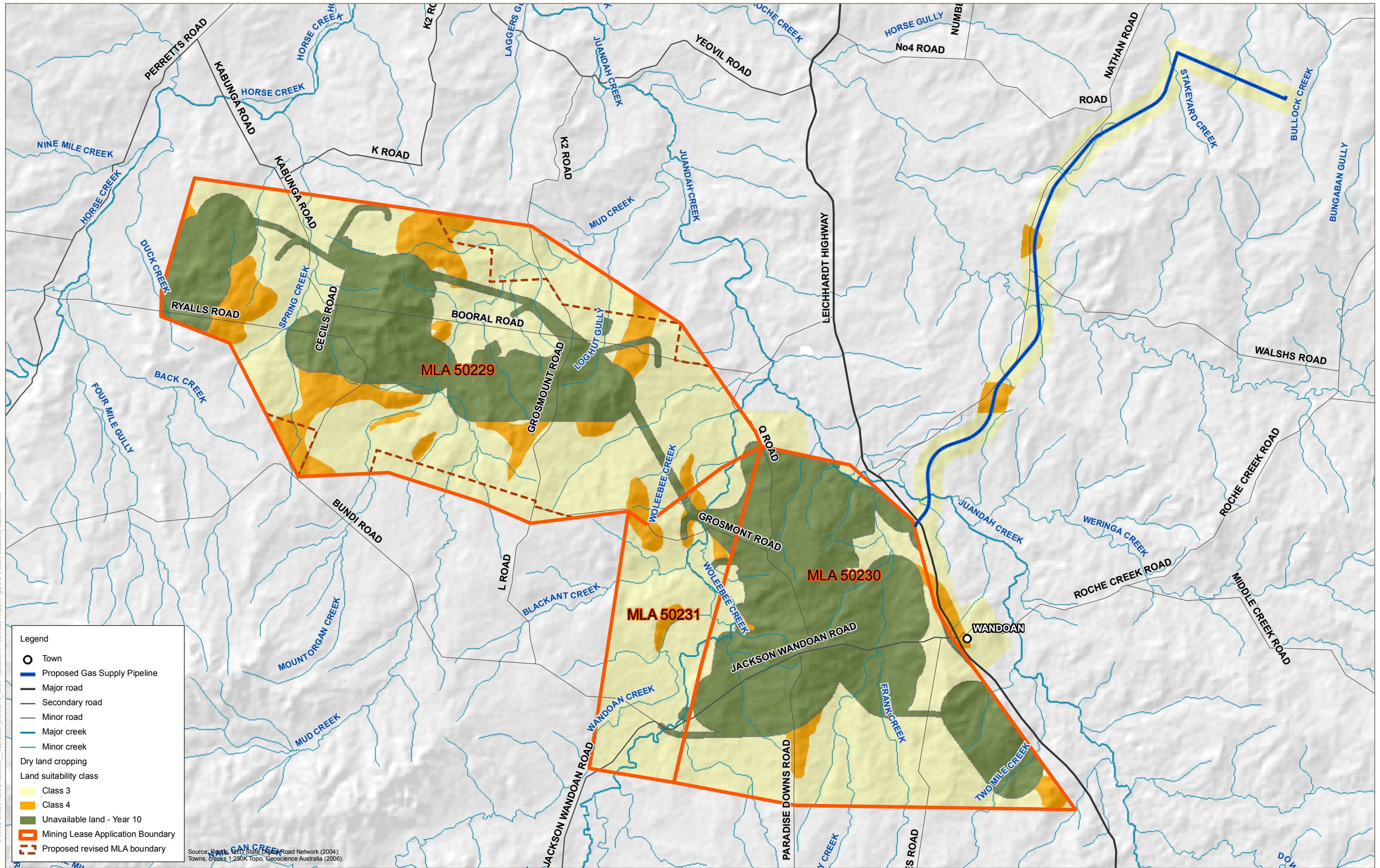
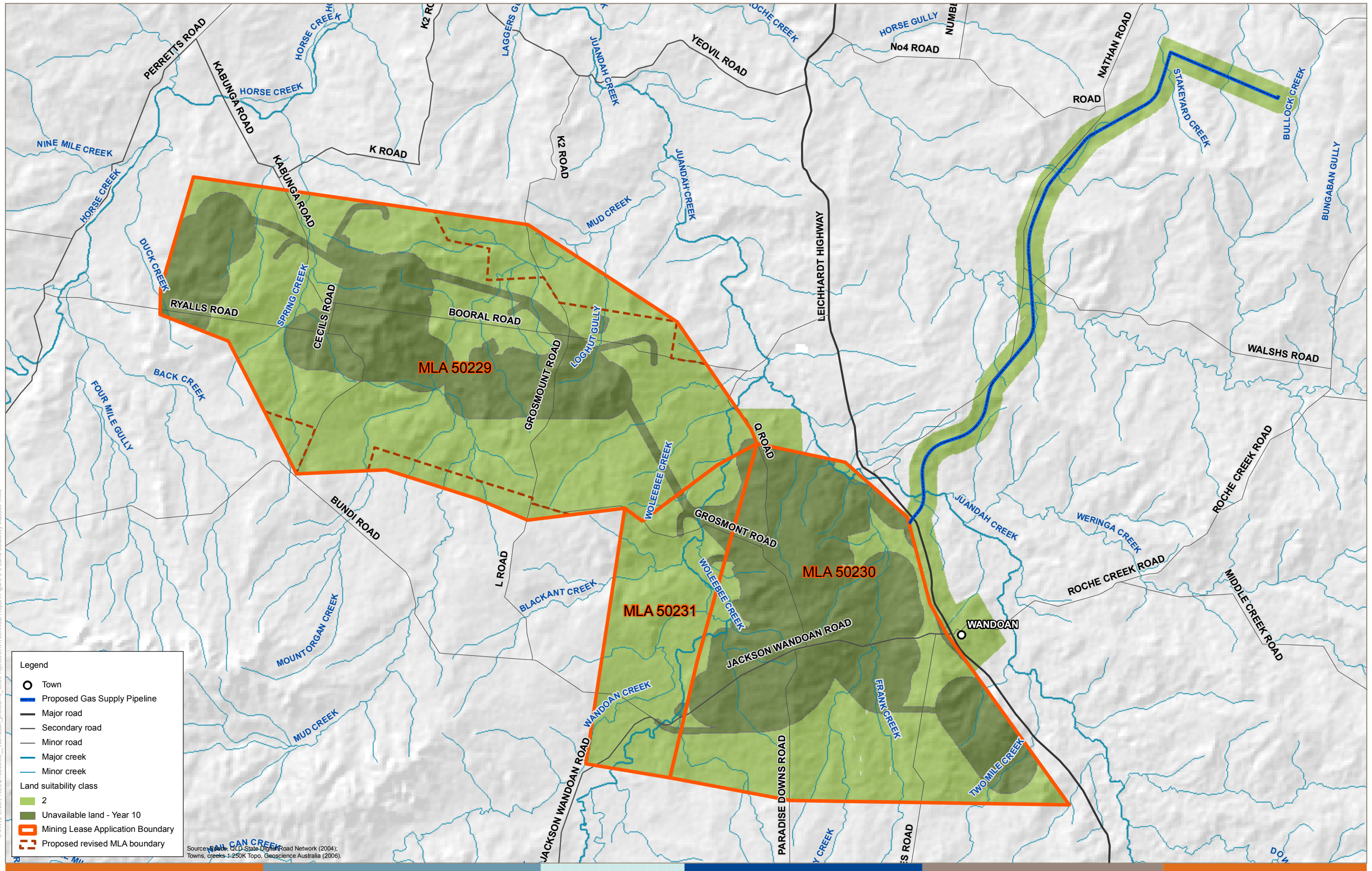


figure 5-5
Year 10 Land suitability dryland cropping



0 2 4 6 8 10
Kilometres



Figure 5-6
Year 10 Land suitability for beef cattle grazing

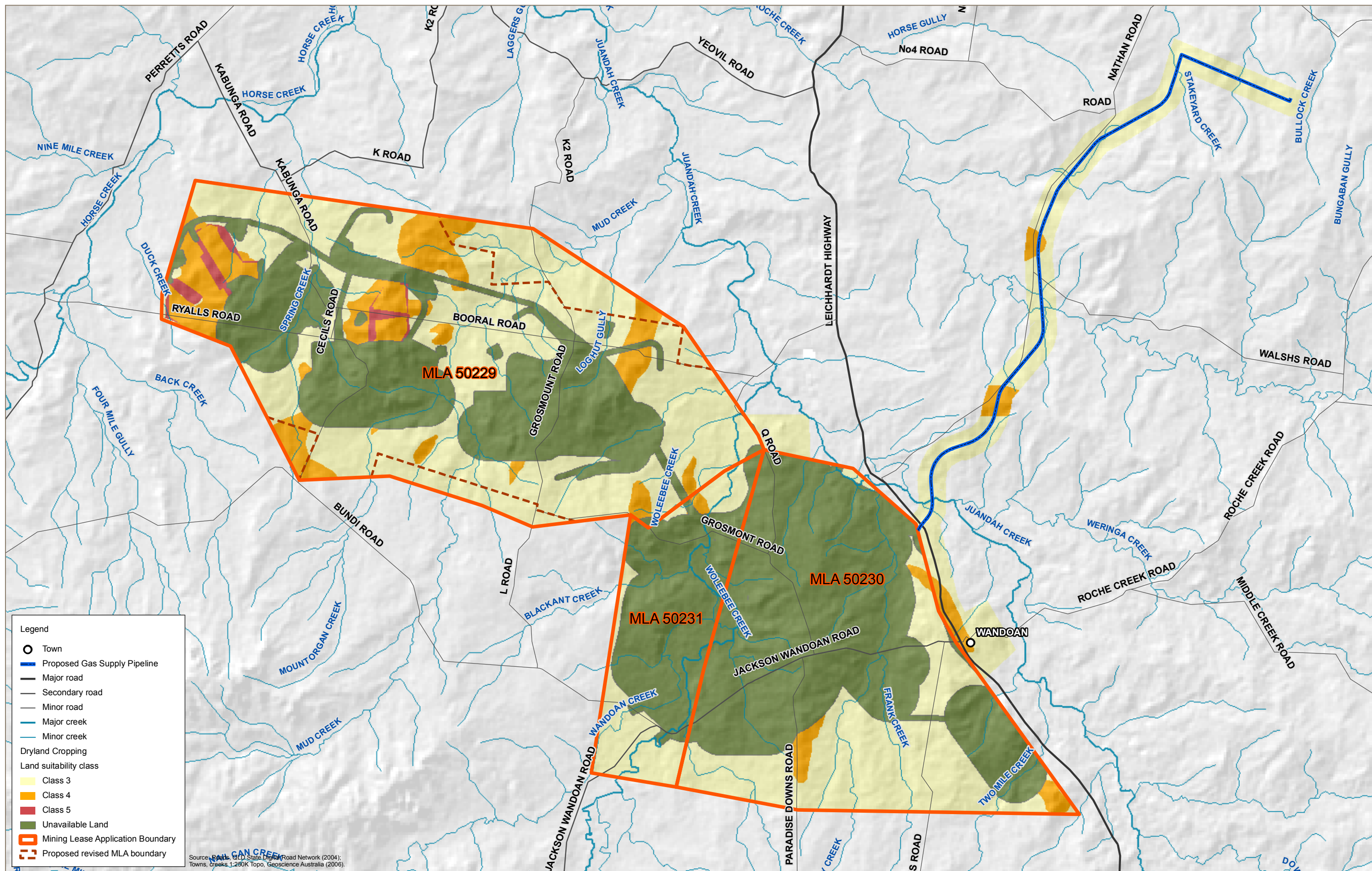


Figure 5-7
Year 20 Land suitability dryland cropping

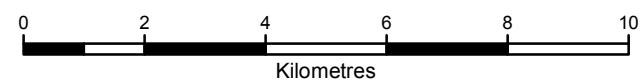
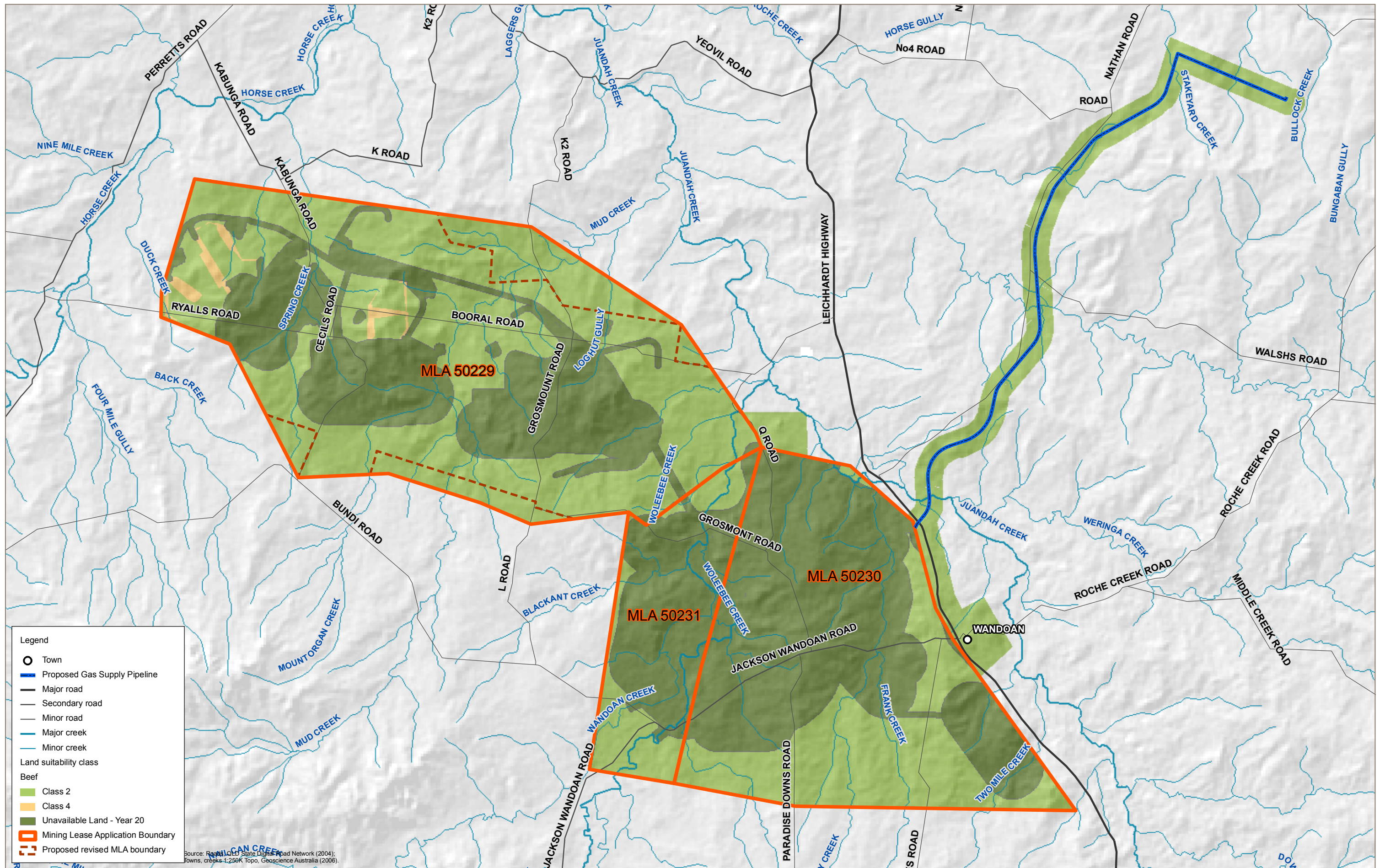


Figure 5-8
Year 20 Land suitability for beef cattle grazing

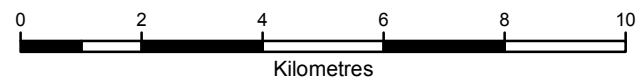
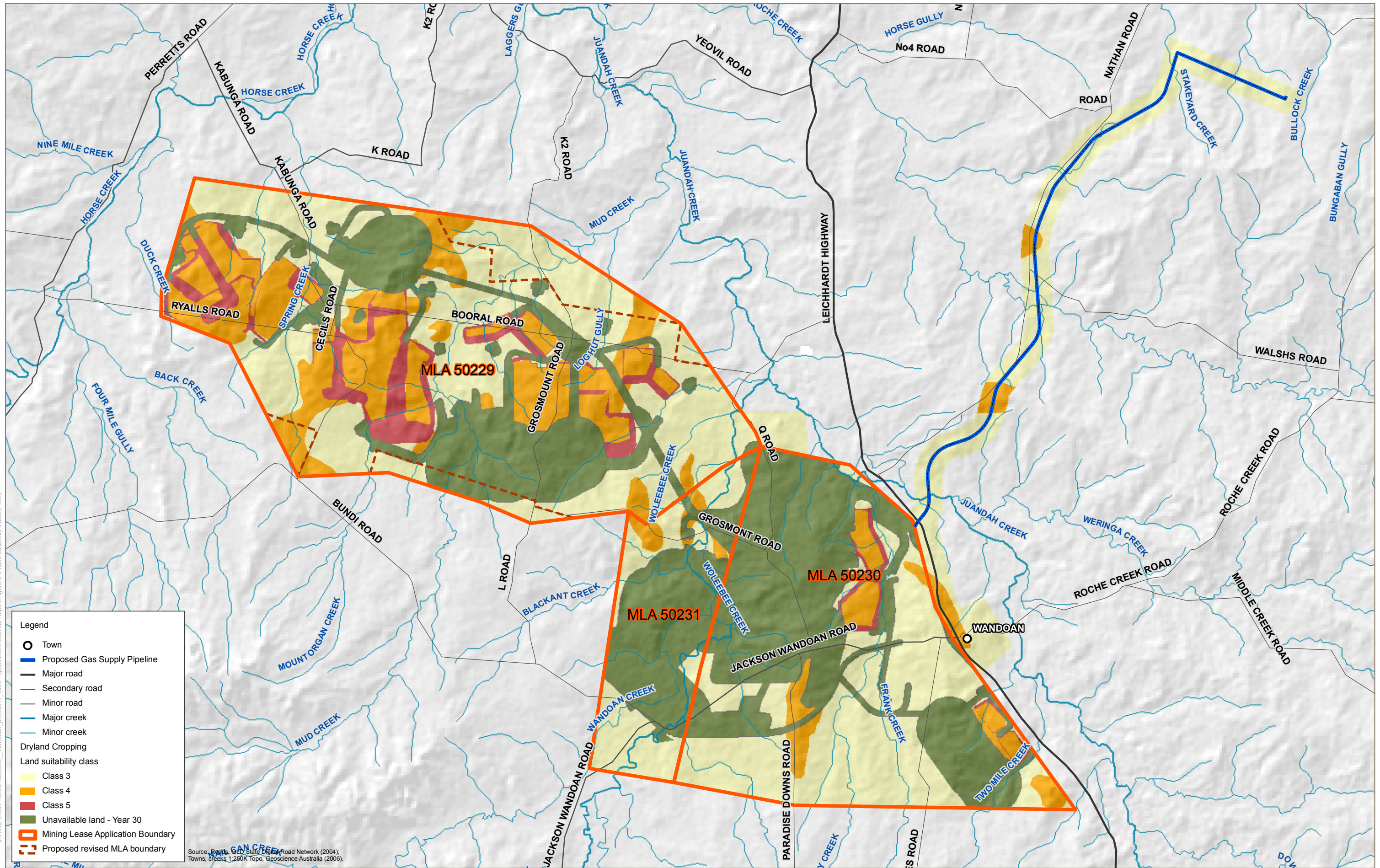
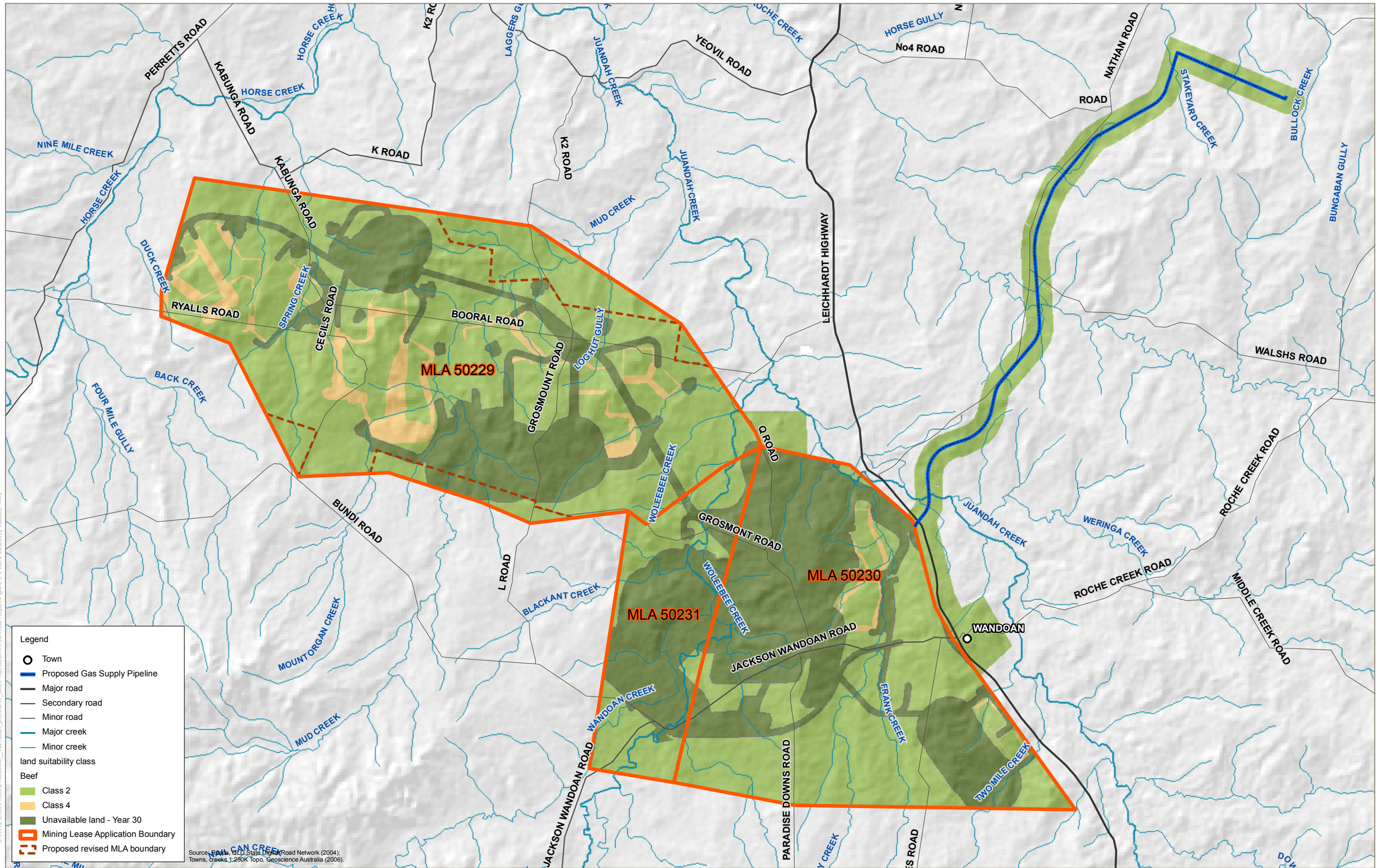


Figure 5-9
Year 30 Land suitability for dryland cropping



0 2 4 6 8 10
Kilometres



Figure 5-10
Year 30 Land suitability for beef cattle grazing

6. Mitigation measures

6.1 Topography

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.2 Overburden

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.3 Uncovering fossil material

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.4 Soils

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.5 Construction materials

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.6 Post mining land use

The revised expected changes in pre- and post-mine land suitability areas for the Project site are shown in Table 6-1 below, based on the areas of disturbance and post-mining land classes discussed in Section 5.5.1. The areas of pre- and post-mine land suitability classes are approximations only as rehabilitation methods will impact the land suitability, and the mine layout may be further refined as more detailed design progresses.

Table 6-1: Estimated pre- and post-mine land suitability areas

Land suitability class	Estimated area of land (ha)			
	Pre-mining dry land cropping (ha)	Post-mining dry land cropping (ha)	Pre-mining beef cattle grazing (ha)	Post-mining beef cattle grazing (ha)
1	0	0	0	0
2	0	0	32,191	28,784
3	26,335	18,222	0	0
4	5,856	10,562	0	3,407
5	0	3,407	0	0

As shown in Table 6-1 above, 3,407 ha of land will to be reduced from land suitability Class 2 to Class 4 for beef cattle grazing. This land comprises the rehabilitated final voids

and ramps, as well as steeper sections of overburden stockpiles, and equates to approximately 10.5% of the MLA areas. As a comparison, the assessment conducted for the EIS estimated a downgrading to classes 3 and 5, with approximately 10,950 ha or 35% of the site downgraded from Class 2 to Class 3 and 1,452 ha or 4.5% being downgraded from Class 2 to Class 5 for beef cattle grazing. The agricultural productivity and economic impact of this reduction in land class is discussed in Technical Report STR22-1-SV1.5 Economic Evaluation of Agricultural Production under Mining Lease.

In terms of land suitability for dryland cropping, the Project is going to result in a reduction in Class 3 cropping land by 8,113 ha, and the introduction of 3,407 ha of Class 5 cropping land. The Class 5 land comprises the rehabilitated final voids and ramps, as well as steeper sections of overburden stockpiles.

While much of the rehabilitated land is being returned to a slope gradient suitable for Class 3 cropping land (suitable land with moderate limitations), cropping as a post-mining land use of rehabilitated spoil is limited in Australia, and it has therefore been assumed that the land will be returned to Class 4 cropping land.

There is a potential high risk of rill and gully erosion from cropping land use on rehabilitated land, including from tillage and fallow periods exposing the soil to erosion. Although the generic land suitability assessment suggests land will be Class 3 for cropping post-mining, cropping is not recommended as a post-mining land use on rehabilitated spoil due to the high potential for erosion.

However, research and technological advances over the 30 year operations of the mine may mean that cropping becomes a viable land use during rehabilitation later in the life of the mine. It is recommended the WJV participates in research into the potential for cropping as a post-mining land use.

Based on the revised mine plan, the following post-mining land uses are recommended, subject to field trials showing these uses are sustainable:

- undisturbed land should be able to be used for beef cattle grazing or dry land cropping as existed prior to mining
- land used for infrastructure components of the Project (roads, MIA etc) should generally be able to be used for beef cattle grazing
- the top surface of spoil stockpiles should generally be able to be used for beef cattle grazing
- the side slopes of spoil stockpiles should generally be able to be used for low density beef cattle grazing, or alternatively for nature conservation
- final voids should generally be able to be used for low density beef cattle grazing, or alternatively for nature conservation
- investigations and trials into the potential for cropping on the top surface of rehabilitated spoil stockpiles and infrastructure areas are recommended be conducted during the life of the mine.

6.7 Final landform design

Final voids

The final void planning has been revised from the EIS. As discussed in Section 4, the number of final voids in the post-mining landform has reduced, with no voids remaining for the Austinvale North, Austinvale, Leichhardt, Woleebee North and Woleebee Pits.

Final voids will be formed by reducing the outer/boxcut slopes and adjacent overburden stockpiles to a maximum of 1(v):7(h), or 14.2% gradient to infill the void, bringing the pit floor up towards natural topographical surface. Depths of final voids will vary with the volume of material available at each pit for infilling. A 14.2% gradient means that a final void of 30 m depth would be approximately 400 m in width.

To ensure safe access for cattle and humans, as per the EIS, the final slope gradients of each void, including the outer boxcut spoil slopes, low wall of the final voids, and highwall slopes should be assessed and recommended by a suitably qualified person based on the risk of long term geotechnical instability. The assessment can be based on the preliminary investigations undertaken by Golders Associates (2008), and should consider the implications of the final voids filling with water, and the proximity of final voids to creek and drainage lines.

Infrastructure areas and roads

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

Spoil dumps and tailing disposal facilities

Spoil dumps, including both in-pit and out-of-pit dumps, will be managed as per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

As discussed in Section 4 of this report, tailings are being disposed of in-pit, and buried with approximately 20 m of overburden. In relation to final landform design, tailings disposal facilities will no longer be present, and will be managed as per spoil dumps.

Creek diversions

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8 Rehabilitation

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8.1 Rehabilitation hierarchy

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8.2 Rehabilitation and decommissioning strategy

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8.3 Rehabilitation strategies

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8.4 Rehabilitation monitoring

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.8.5 Rehabilitation maintenance

As per TR9-1-V1.5 Geology, mineral resources, overburden and soils impact assessment.

6.9 Operational land use

Tables 6-2 and 6-3 presents an estimate of the land unavailable for agriculture, and the land suitability classification of available land during the operation of the mine, based on the areas contained in Section 5.5.2 of this report.

Table 6-2: Estimated operational land suitability areas for beef cattle grazing

Land suitability class	Estimated area of land (ha)				
	Pre-mining	Year 5	Year 10	Year 20	Year 30
2	32,191	23,275	20,220	16,722	18,682
3	0	0	0	0	0
4	0	0	0	233	1,812
5	0	0	0	0	0
Unavailable due to mine operation	0	8,916	11,971	15,236	11,697

Table 6-3: Estimated operational land suitability areas for dry land cropping

Land suitability class	Estimated area of land (ha)				
	Pre-mining	Year 5	Year 10	Year 20	Year 30
3	26,335	18,722	17,241	13,821	13,361
4	5,856	4,501	2,931	2,852	5,292
5	0	0	0	233	1,812
Unavailable due to mine operation	0	8,916	11,971	15,236	11,697

As can be seen from Tables 6-2 and 6-3, a considerable portion of the MLA area is already unavailable for agriculture by Year 5. The area unavailable for agriculture increases up to Year 20. Progressive rehabilitation, and the consequential return of rehabilitated land to potential agriculture use, results in the area potentially available for agriculture increasing by approximately 3,540 ha between Year 20 and Year 30.

In terms of land suitability for beef cattle grazing, in Year 20 approximately half the pre-mining Class 2 land is unavailable. Rehabilitated land returned to the land suitability classification calculations is largely Class 2, with minimal Class 4 land until Year 30.

In terms of land suitability for dryland cropping, the area of Class 3 cropping land reduces significantly by Year 5, and then remains relatively constant until Year 10. Another significant reduction in Class 3 land occurs between Year 10 and Year 20 with the development on MLA 50229, after which time the amount of Class 3 land remains relatively constant. The area of Class 4 land available almost doubles between Year 20 and Year 30, representing rehabilitated spoil stockpiles becoming 'available' for agricultural use.

Discussion on the economic implications of the operational land use for agricultural purposes is discussed in Technical Report STR22-1-SV1.5 Economic Evaluation of Agricultural Production under Mining Lease.

7. Residual impacts

The reassessment to the pre-mining land suitability classification for dry land cropping and the provision of a final landform have not significantly altered the residual impacts of the Project compared to the EIS technical report. However the post-mining landscape now has fewer final voids compared to the EIS technical report.

As discussed in Section 5.5.1, the final landform land suitability classes are expected as follows:

- undisturbed land will be returned to (or retained in) its pre-mining land suitability class
- land used for infrastructure components of the Project (roads, MIA, etc) will have limitations related to water availability, through compaction and breakdown of the subsoil structure. Where practicable this land will be returned to Class 3 cropping land or Class 2 grazing land, otherwise it will be returned to Class 4 cropping land or Class 3 grazing land
- spoil stockpiles will have limitations related to water availability, salinity, gradient, erosion and nutrient content. Flatter gradient sections of spoil stockpiles will be returned to Class 4 cropping land or Class 2 grazing land where practicable. Steeper gradient spoil slopes will be returned to Class 5 cropping land or Class 4 grazing land
- tailings will be disposed off in-pit, and covered with approximately 20 m of overburden. As such, no tailings dam sites are expected in the final landform
- final voids will be re-contoured to reduced gradients, and will have limitations similar to those listed for spoil stockpiles, and will be Class 4 for cattle grazing or Class 5 for cropping.

8. Conclusions

This addendum has updated the geology, mineral resources, overburden and soils impact assessment in relation to the pre-mining land suitability classification for dry land cropping, the provision of a final landform, and an assessment of land suitability during mine operation.

As per the EIS, it is expected that the Project will reduce areas of Class 3 dry land cropping and Class 2 beef cattle grazing. Large portions of the disturbed areas, including overburden stockpiles are recommended to be rehabilitated to Class 2 beef cattle grazing, and the final land use is suggested as a combination of cattle grazing and nature conservation.

Compared to the EIS technical report, the impact to land suitability classification is much less, with a reduction of only 3,407 ha of Class 2 land for cattle grazing, and with 18,222 ha of Class 3 cropping land present in the final landform.

9. Summary of mitigation strategies

The following mitigation strategies, as previously described in this addendum to this geology, mineral resources, overburden and soils impact assessment, are summarised below:

- it is recommended the WJV participates in research into the potential for cropping as a post-mining land use
- based on the revised mine plan, the following post-mining land uses are recommended, subject to field trials showing these uses are sustainable:
 - undisturbed land should be able to be used for beef cattle grazing or dry land cropping as existed prior to mining
 - land used for infrastructure components of the Project (roads, MIA etc) should generally be able to be used for beef cattle grazing
 - the top surface of spoil stockpiles should generally be able to be used for beef cattle grazing
 - the side slopes of spoil stockpiles should generally be able to be used for low density beef cattle grazing, or alternatively for nature conservation
 - final voids should generally be able to be used for low density beef cattle grazing, or alternatively for nature conservation
 - investigations and trials into the potential for cropping on the top surface of rehabilitated spoil stockpiles and infrastructure areas are recommended to be conducted during the life of the mine.

10. References

Biggs, AJW and Coutts, AJ and Harris, PS 1999, *Central Darling Downs Land Management Manual*. Department of Natural Resources, Queensland. DNRQ990102.

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Slater, B 1986, *Edaphic Properties of Soil and Overburden from a Potential Coal Mine near Wandoan, Queensland*. University of Queensland Department of Agriculture.

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Attachment A

Land suitability criteria

Attachment A – Land suitability criteria

Table SA-1: Revised suitability criteria for rainfed broadacre cropping. The two limitations listed supersede these two elements presented in Table E-1 of the EIS technical report, Attachment E

Limitation	Land suitability class				
	1	2	3	4	5
Nutrient deficiency ¹	Bicarbonate phosphorus >10 ppm	Bicarbonate phosphorus 5-10 ppm and exchangeable potassium (K) >0.3 meq%	Bicarbonate phosphorus 5-10 ppm and exchangeable potassium (K) ≤0.3 meq%	Bicarbonate phosphorus <10 ppm and exchangeable potassium (K) ≤0.3 meq% and exchangeable calcium (Ca) <3 meq% or pH <5 30-60 cm below surface	pH <5 within 30 cm of surface
Water erosion ²	Slopes <0.5% on cracking clays without melonholes, or Slopes <1% on melonhole clays, or Slopes <1% on nonsodic rigid soils, or Slopes <0.5% on sodic rigid soils	Slopes 0.5-1% on cracking clays without melonholes or Slopes 1-3% on melonhole clays, or Slopes 1-2% on non-sodic rigid soils, or Slopes 0.5-1% on sodic rigid soils	Slopes 1-3% on cracking clays without melonholes or Slopes 2-4% on non-sodic rigid soils or Slopes 1-2% on sodic rigid soils	Slopes 3-5% on all cracking clays or Slopes 4-6% on non-sodic rigid soils or Slopes 2-3% on sodic rigid soils	Slopes >5% on all cracking clays or Slopes >6% on nonsodic rigid soils or Slopes >3% on sodic rigid soils

Notes: 1. based on the top 10 cm of soil

2. As per EIS Table E-1 of Appendix E of Technical Report 9-1-V1.5, but only based on the top 10 cm of soil.

Table SA-2: Revised suitability assessment for dryland cropping (changed information provided in bold)

	Brigalow uplands – non-cracking clay		Brigalow uplands – cracking clay			Poplar Box Alluvia		
	Cheshire	Kinnoul	Downfall	Teviot	Rolleston	Juandah	Woleebee	Retro
Water availability	3	4	2	3	3	2	2	2
Nutrient deficiency	1	1	3	2	1	1	3	2
soil physical factors	1	1	2	2	1	2	2	2
workability	2	2	2	2	2	1	1	1
salinity	1	1	1	1	1	1	2	2
rockiness	2	2	1	1	2	1	1	1
wetness	1	1	2	1	1	3	3	3
topography	2	2	2	2	2	1	1	1
Water erosion	3	3	3	3	3	2	2	2
Flooding	1	1	2	1	1	3	3	3
Land suitability class	3	4	3	3	3	3	3	3