Mining & Petroleum Gateway Panel

Report by the Mining & Petroleum Gateway Panel to accompany a Conditional Gateway Certificate for the Maxwell Coal Project

December 2018

Contact

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Executive Summary

The Mining & Petroleum Gateway Panel (the Panel) has determined an Application for a Gateway Certificate by Malabar Coal Limited (the Applicant) for its proposed Maxwell Coal Project in the Upper Hunter region of New South Wales. The Gateway Panel finds that the Application does not meet all the Relevant Criteria and consequently issues the Applicant with a Conditional Gateway Certificate. This report provides both the opinions and the reasoning of the Panel.

The Maxwell Coal Project proposes an underground coal mine within a 3,215 ha Gateway Certificate Application Area (GCAA) that incorporates 72 ha of protocol-verified Biophysical Strategic Agricultural Land (BSAL) as determined by the Applicant. The Applicant states that no verified BSAL will be used for mining infrastructure.

Proposed underground mining using bord and pillar and longwall techniques within the GCAA is predicted to result in subsidence of 2,134 ha of the GCAA and cause direct subsidence impacts to the 72 ha of applicant-verified BSAL. The direct impacts resulting from subsidence associated with the underground mining are predicted to include surface cracking of 25 to 50 mm (with isolated cracks to 100 mm) and depressions in the land surface up to 3200 mm.

Subsidence impacts on the agricultural productivity of the soil will range from changes to soil water drainage, access to soil water stores, increased surface water ponding and potential inundation of subsoil layers with associated physical and chemical degradation issues, potential changes to soil bulk density and increased erosion potential. Mining induced land surface changes will result in localised, short-term disruptions to land use practices and access.

With regard to verified BSAL, it is the opinion of the Gateway Panel that:

- Verification of the extent of BSAL within the GCAA is incomplete. Further site sampling and analysis for an improved application of the BSAL Protocol is required.
- More detailed modelling of the expected subsidence (and associated uncertainty) is required to determine the site-specific impacts on BSAL within the GCAA.

With regard to Critical Industry Clusters (CIC):

- There is no CIC land located inside the GCAA. The Panel acknowledges that a substantial equine industry exists approximately 500m south of the GCAA.

The proposed mining has the potential for some indirect impacts on local groundwater resources/surface waters and their environs. The Panel finds that the groundwater flow model, is adequate for the requirement of predicting water impacts, at this early Gateway stage of assessment. The Panel has considered the concerns about the modelling, summarised in IESC (2018), and welcomes the additional data collection/analysis, monitoring and modelling work that the Applicant has proposed to be undertaken for an EIS.

The greatest water impacts will occur on the 'less productive' Permian aquifers. These aquifers can supply low yields of brackish water to a bore. Level 2 impacts are predicted. This level of impact requires further studies. The impacts extend over many kilometres.

The Saddlers Creek alluvium and Hunter River alluvium occur outside of the GCAA, but in close proximity. Both have been classified as 'highly productive' by the NSW Government. The Applicant's assessment is that a small amount of water will move from the alluvium to the Permian Basement

strata, as a result of mine dewatering. The Panel agrees with the level 1 impact predicted for the Hunter alluvium but considers the impact for the Saddlers Creek alluvium may be a Level 2 impact, requiring additional studies or a mitigation strategy. The Applicant holds sufficient water licences in the Hunter alluvium and will trade water to account for the predicted water losses in the Saddlers Creek alluvium. The Panel recommends that future groundwater flow modelling be independently peer reviewed and include both sensitivity and uncertainty analysis. This will improve the reliability of the results.

The Panel concludes that at this early staged of assessment, mine dewatering is unlikely to have a significant indirect impact on groundwater resources of the Hunter alluvium but may have a significant impact on the Saddlers Creek alluvial aquifer, when cumulative impacts from other mines are fully considered and groundwater dependent ecosystem studies are completed.

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1 Purpose and Methodology

In accordance with the *Section 17H(2)(b), Part 4AA Mining and Petroleum Development on Strategic Agricultural Land, State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP), this report states the Mining & Petroleum Gateway Panel's (the Panel) reasons for the opinions expressed in the Gateway Certificate issued on this day to the Maxwell Coal Project.

1.1 Terms of Reference

The Mining SEPP provides the Gateway Panel's Terms of Reference.

The Gateway Panel must determine an Application and issue a Gateway Certificate in accordance with *Section 17H* of the Mining SEPP.

Section 17H(4) provides the following *relevant criteria* for the Gateway Panel's determination and recommendations.

> *(a) in relation to biophysical strategic agricultural land- that the proposed development will not significantly reduce the agricultural productivity of any biophysical strategic agricultural land, based on a consideration of the following:*
>
> > *(i) any impacts on the land through surface area disturbance and subsidence,*
> >
> > *(ii) any impacts on soil fertility, effective rooting depth or soil drainage,*
> >
> > *(iii) increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH,*
> >
> > *(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy),*
> >
> > *(v) any fragmentation of agricultural land uses,*
> >
> > *(vi) any reduction in the area of biophysical strategic agricultural land,*
>
> *(b) in relation to critical industry cluster land-that the proposed development will not have a significant impact on the relevant critical industry based on a consideration of the following:*
>
> > *(i) any impacts on the land through surface area disturbance and subsidence,*
> >
> > *(ii) reduced access to, or impacts on, water resources and agricultural resources,*
> >
> > *(iii) reduced access to support services and infrastructure,*
> >
> > *(iv) reduced access to transport routes,*
> >
> > *(v) the loss of scenic and landscape values.*

Section 17H(5) states that in *forming an opinion as to whether a proposed development meets the relevant criteria, the Gateway Panel is to have regard to:*

> *(a) the duration of any impact referred to in subclause (4), and*
>
> *(b) any proposed avoidance, mitigation, offset or rehabilitation measures in respect of any such impact.*

1.2 Methodology

1.2.1 The Gateway Panel

The Gateway Panel that evaluated this Gateway Application is as follows.

> Associate Professor Brett Whelan, Chairperson – agricultural discipline;
> Mr Geoff Sharrock – mining discipline; and,
> Mr George Gates – hydrogeology discipline.

1.2.2 Referrals

In accordance with Section 17G of the Mining SEPP, this Gateway Application was referred to the Commonwealth Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) and the NSW Minister for Primary Industries.

- On 12 November 2018, the Gateway Panel received advice from IESC (IESC, 2018).
- On 20 December 2018, the Gateway Panel received advice from NSW Minister for Primary Industries (IESC, 2018).

1.2.3 Meetings with the applicant or third parties

The Gateway Panel did not hold any formal or information discussions in relation to this Gateway Application with either the Applicant or any stakeholder who may have an interest in this Project.

1.2.4 Gateway Panel meetings

The Gateway Panel has held the following meetings in relation to this Application.

- On 16th October 2018 in Sydney, to consider the information included in the application
- On 16th November 2018 by teleconference, following receipt of requested advice from IESC.
- On 18th December 2018 by teleconference, to progress this report and finalise work plans.

1.2.5 Document review

The Gateway Panel has reviewed the following documentation provided by the Applicant as their submission for the panel to assess.

2rog Consulting, 2018. *Maxwell Project: Agricultural Impact Assessment in Support of an Application for a Gateway Certificate. 66p.*

Gateway Schedule of Lands, 2018. *PDF as provided by Malabar Coal Ltd in Support of an Application for a Gateway Certificate.*

HydroSimulations, 2018. *Maxwell Project: Agricultural Impact Assessment in Support of an Application for a Gateway Certificate. Attachment C – Preliminary Groundwater Assessment. 239p.*

Malabar Coal Ltd, 2018. *Maxwell Project: Technical Overview in Support of an Application for a Gateway Certificate. 31p.*

Mine Subsidence Engineering Consultants (MSEC), 2018. *Maxwell Project: Agricultural Impact Assessment in Support of an Application for a Gateway Certificate. Attachment B - Subsidence Assessment.*

SLR Consulting Australia Pty Ltd (SLR), 2018. *Maxwell Project: Agricultural Impact Assessment in Support of an Application for a Gateway Certificate. Attachment A - Biophysical Strategic Agricultural Land Verification Assessment. 35p plus Appendices A: F.*

Upper Hunter Valley Local Newspaper Advertisements, 2018. *PDF as provided by Malabar Coal Ltd in Support of an Application for a Gateway Certificate.*

The Gateway Panel has also reviewed the following documentation relevant to this Application.

Mining and Petroleum Gateway Panel (MPGP), (2015). Report by the Mining and Petroleum Gateway Panel to Accompany a Conditional Gateway Certificate for the Drayton South Coal Project.

SLR Consulting Australia Pty Ltd (SLR), 2015. *BSAL Site Verification Assessment for Drayton South Coal Project – Revision 2. Provided as Appendix F to the Drayton South Coal Project Response to Submissions. 48p plus Appendices A: D.*

The Gateway Panel has also reviewed the following Referral Agency advice relevant to this Application.

IESC, 2018. *Advice to the decision maker on coal mining project, ISEC 2018-098: Maxwell Project – Expansion.* Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development, Department of Environment, Canberra, 9 November 2018.

Minister for Primary Industries (MPI), 2018. *Advice to the Mining and Petroleum Gateway Panel on the Maxwell Project. Including covering letter and Attachment C: Technical assessment by the NSW DoI Water for the Minister for the Minister for Regional Water (Maxwell Project – Application for Gateway Certificate*, 20 December 2018.

The Gateway Panel has reviewed the following publications relevant to Gateway Applications.

DP&I, 2012. *Upper Hunter Strategic Land Use Plan.* State of New South Wales through the Department of Planning & Infrastructure, September 2012.

DP&I, 2013 *Strategic Regional Land Use Policy, Guideline for Gateway Applicants, Fact Sheet, (the Guideline).* State of New South Wales through the Department of Planning & Infrastructure, September 2013.

DPI, 2013 *Agricultural Impact Statement technical notes: A companion to the Agricultural Impact Statement guideline.* State of New South Wales through the Department of Primary Industries, April 2013.

NSW Government, 2007 *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007, Part 4AA Mining and Petroleum Development on Strategic Agricultural Land (the Mining SEPP)*. NSW Legislation, State of New South Wales, 2007.

OEH and OAS&FS, 2013. *Interim protocol for site verification and mapping of biophysical strategic agricultural land (BSAL).* State of New South Wales through the Office of Environment & Heritage and the Office of Agricultural Sustainability & Food Security.

With specific regard to its assessment of BSAL verification and potential mining and groundwater-related impacts, the Gateway Panel has, through its own enquiry, also considered the following publications.

Bacon P., 2013. *The risks and impacts of coal mine subsidence on irrigation areas.* A report prepared for Cotton Australia. Woodlots & Wetlands Pty Ltd. 38p.
http://cottonaustralia.com.au/uploads/blog/Subsidence_paper_QLD.pdf
[last accessed Dec, 2018].

Barnett B, Townley LR, Post V, Evans RE, Hunt RJ, Peeters L, Richardson S, Werner AD, Knapton A and Boronkay A, 2012. *Australian groundwater modeling guidelines*, National Water Commission report, June 2012.

DTIRIS, 2012. *NSW Aquifer Interference Policy, NSW Government policy for the licensing and assessment of aquifer interference activities.* Department of Primary Industries, NSW Office of Water (NOW), State of New South Wales through Department of Trade and Investment, Regional Infrastructure and Services.

Isbell R., (2002). *The Australian Soil Classification*, Revised Edition CSIRO, Melbourne.

National Committee on Soil and Terrain (NCST), 2009. *Australian Soil and Land Survey Field Handbook* Third Edition. CSIRO Publishing, Collingwood.

1.2.6 Field inspection

The Gateway Panel did not conduct a field inspection for the assessment of this Gateway Application. Panel members Gates and Sharrock have been on site in 2015 for a previous Gateway application.

2 The Proposed Project

Maxwell Ventures Pty Ltd, a subsidiary of Malabar Coal Limited (Malabar), is the proponent for the Maxwell coal Project (the Project), an underground mining operation proposed within Exploration License (EL) EL5460. Malabar also owns and manages the existing infrastructure within Coal Lease (CL) 229, Mining Lease (ML) 1531 and CL 395 (together known as the Maxwell Infrastructure).
The Maxwell Infrastructure includes an existing coal handling and preparation plant (CHPP), rail facilities and other infrastructure and services.

The Project is located in the Upper Hunter Valley of New South Wales (NSW), approximately 16 kilometres east-southeast of the township of Denman and 20km south-southwest of the township of Muswellbrook (Figure 1). The Project would include the proposed underground mining operation using bord and pillar and longwall mining of coal, the use of the existing Maxwell Infrastructure and the development of new infrastructure.

The proponent of the Project is required to make a Gateway Application because:

- The Project is a proposed development specified in Clause 5 (Mining) of Schedule 1 to State Environmental Planning Policy (State and Regional Development) 2011 that a mining lease under the Mining Act 1992 is required to be issued to enable the development to be carried out because there is no current mining lease in relation to the proposed development; and,
- The proposed development is on land shown on the Strategic Agricultural Land (SAL) Map in the Mining SEPP to potentially be Biologically Strategic Agricultural Land (BSAL).

The Project is located on land subject to the Upper Hunter Strategic Regional Land Use Plan (DP&I, 2012). Of the 5,580 hectares (ha) covered by EL5460, approx. 3,215 ha have been submitted by the applicant as the Gateway Certificate Application Area (GCAA) (2rog Consulting, 2018).

The extent of EL5460, the GCAA, the indicative underground mining layout, surface infrastructure placement and indicative transport corridor are shown in Figure 2. The Project would involve extraction of coal from four seams within the Wittingham Coal Measures, using bord and pillar with partial pillar extraction in the Whynot Seam and longwall extraction in the Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam. The Project would produce approximately 150 million tonnes (Mt) of run-of-mine (ROM) coal over the extraction period of approximately 26 years. Within the Project underground mining area, the target seams from the Wittingham Coal Measures have a thickness ranging between 1.3 to 3.7 metres (m) and a depth of cover of between 40 and 435 m (Malabar Coal Ltd, 2018).

Other notable elements of the proposed project are as follows:

- production of up to approximately 8 million tonnes per annum (Mtpa) of run-of-mine coking and thermal coal;
- development and use of mine access drifts and underground roadways and shafts to access and service the underground mining areas;
- development and use of a mine entry and associated infrastructure, services and facilities that support underground mining and coal handling activities and provide for personnel and materials access to the underground mine;

- establishment of an internal access road from Thomas Mitchell Drive to the underground mine entry;
- establishment of power transmission infrastructure including power lines and substations;
- establishment of infrastructure associated with mine ventilation and gas management;
- use of the existing water management systems;
- progressive development of dams, sumps, pumps, pipelines, water storages, water treatment and other water management infrastructure;
- construction and use of a conveyor system to transport coal from the underground mine entry area to the existing CHPP at the Maxwell Infrastructure for processing;
- transportation of early ROM coal via internal roads from the mine entry area to the existing CHPP;
- handling and processing of coal and loading of coal onto trains at the existing Maxwell Infrastructure;
- transport of product coal via the existing Antiene Rail Spur and Main Northern Railway to market either to the Port of Newcastle for export, or via conveyor to the Bayswater and/or Liddell Power Stations;

The land within the GCAA is primarily used for beef cattle grazing and fodder cropping. No equine or viticulture enterprises are located within the GCAA. The types of agricultural industries surrounding the GCAA include beef cattle production, equine and viticulture operations (2rog Consulting, 2018). The Upper Hunter Strategic Regional Land Use Plan (DP&I, 2012) identifies a proportion of the land in EL5460 as potential Biophysical Strategic Agricultural Land (BSAL). The total proposed mining area of the Project is approximately 2134 hectares, and Malabar have been provided with a report (2rog Consultants, 2018) identifying 72ha of verified BSAL located within the GCAA (Figure 3).

Extraction of coal by bord and pillar and longwall mining methods result in the vertical and horizontal movement of the land surface (subsidence impacts). MSEC (2018) report the maximum subsidence in the GCAA to be 5.8m where all four seams are mined, and all of the verified 72 ha BSAL is predicted to experience subsidence impacts as a result of the Project.

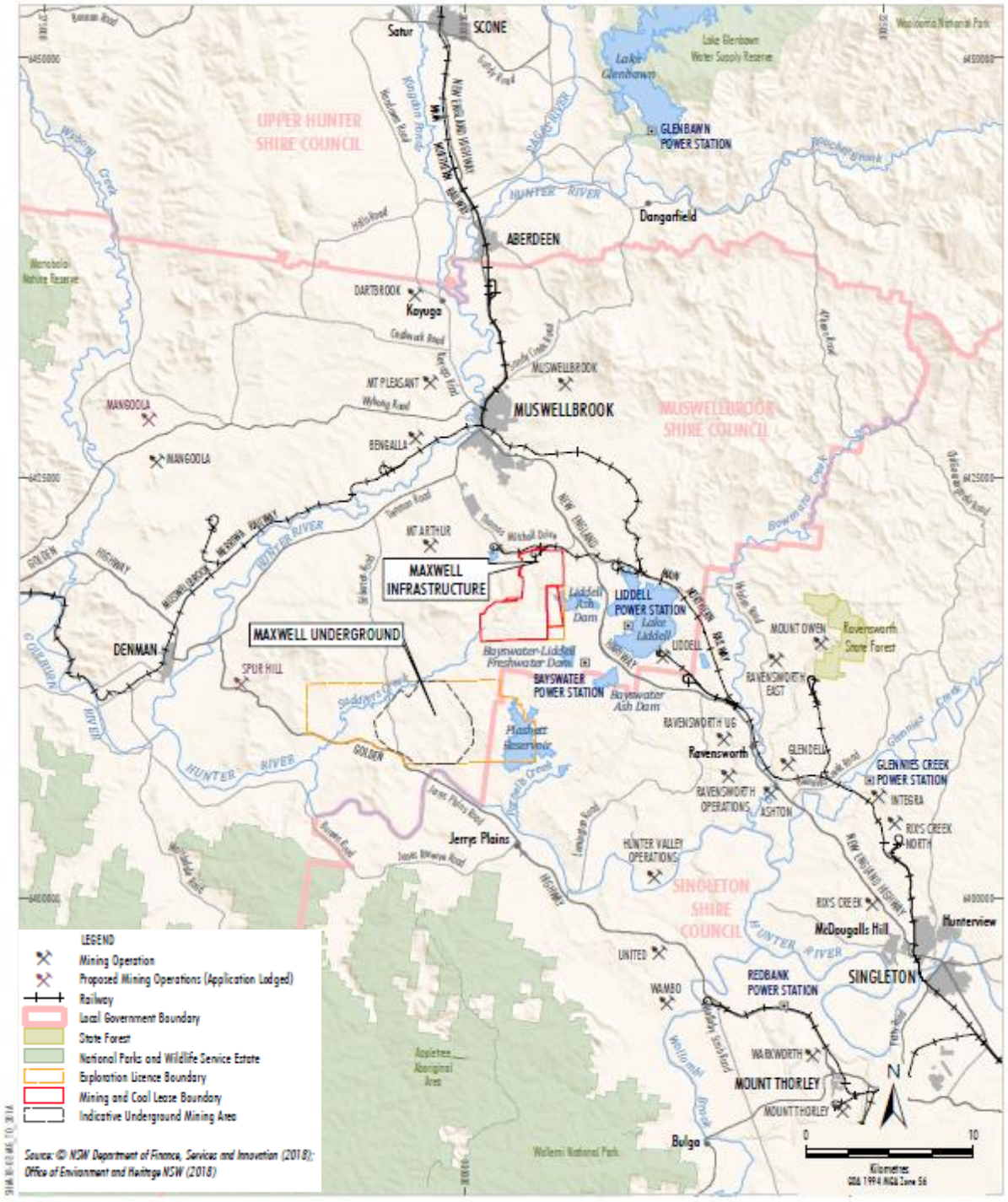

Figure 1. Project location within the region (Malabar Coal Ltd, 2018).

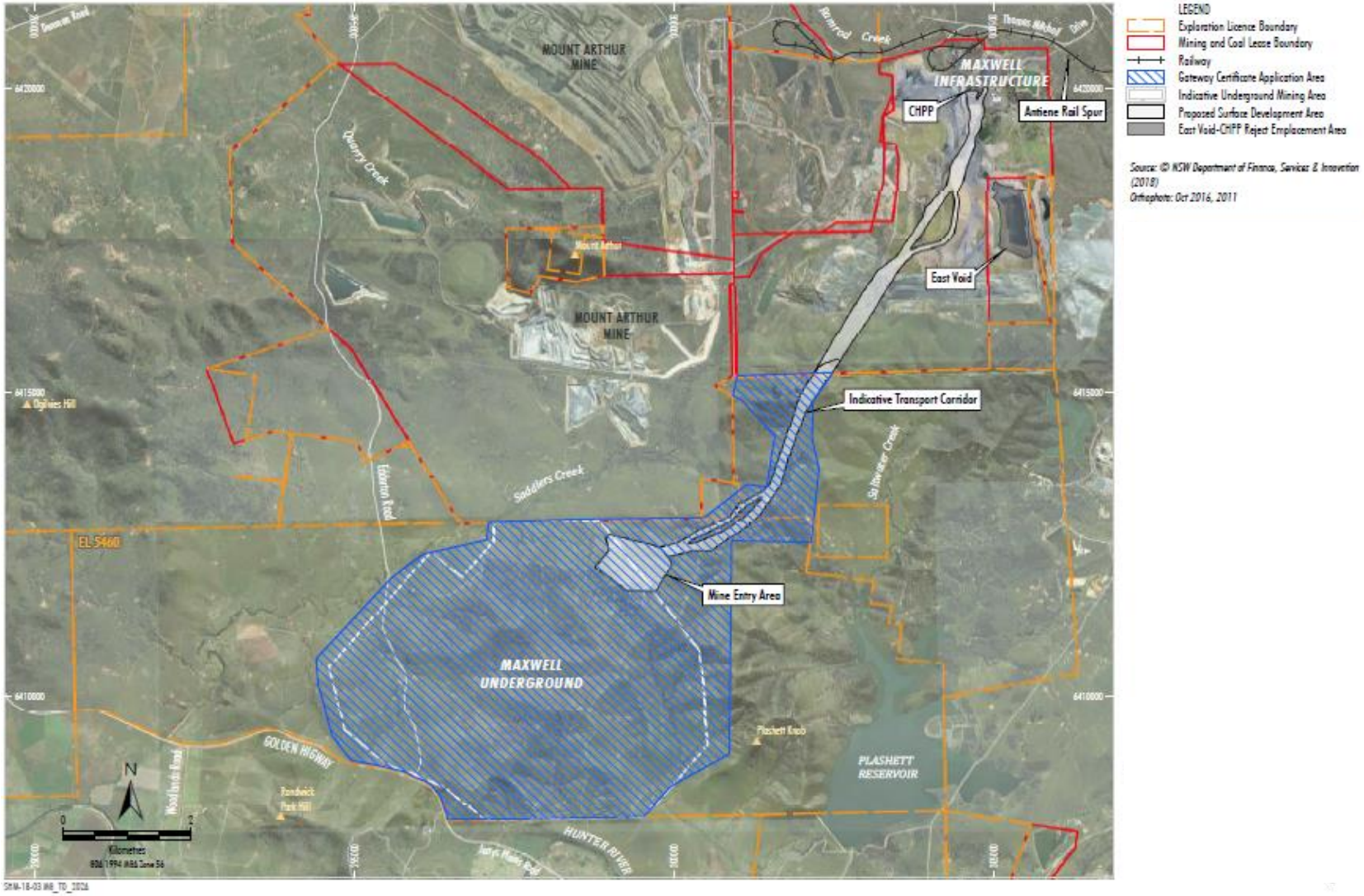

Figure 2. The extent of EL5460, the GCAA, the indicative underground mining layout, the surface infrastructure placement and indicative transport corridor (Malabar Coal Ltd, 2018).

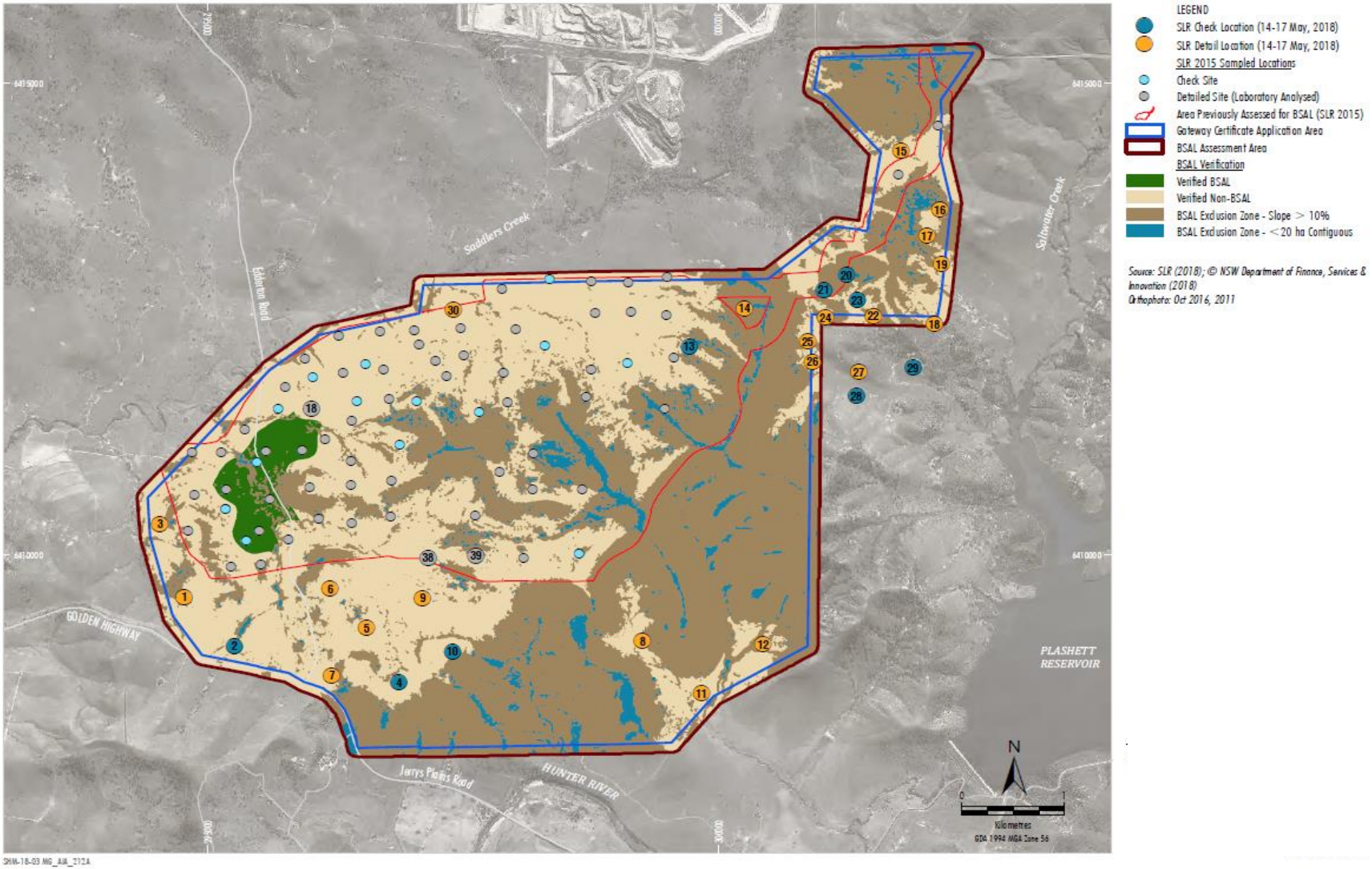

Figure 3. Location of verified BSAL in GCAA (2rog Consultants, 2018).

3 Strategic Agricultural Land Verification

3.1 Biophysical Strategic Agricultural Land (BSAL) verification

For the identification of BSAL within the 3,215 ha of the GCAA the applicant has applied the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (BSAL Protocol) (OEH & OASFS, 2013). Through this process an area of 1708 ha was reported as excluded from more detailed site analysis due to Applicant-identified failure of the land to meet slope and contiguous area criteria of the BSAL Protocol (SLR (2018). An area of 1,507 ha within the GCAA was subsequently identified to be considered for detailed soil survey and assessment as per BSAL Protocol.

The detailed soil survey and assessment for this project used data gathered in two survey operations, one undertaken in 2015 and reported in SLR (2015) and one undertaken in 2018 and reported in SLR (2018). Figure 4 shows the sample site locations and numbers for the 2015 survey. The SLR (2018) report is also a document that aims to coalesce the findings of the two soil surveys that together cover the GCAA for this Maxwell Coal Project application. The Panel notes that there are discrepancies between the two survey documents in the total GCAA application area (-13 ha), the exclusion area (+97 ha) and the final detailed soil survey area (-110 ha) reported in SLR (2018) as representing the respective assessment areas in SLR (2015). The panel is assuming this occurrence may be due to refinements in border and elevation mapping techniques since the 2015 survey, however it is recommended that this issue be addressed/rectified in future documentation. The GCAA, exclusion and final survey areas quoted for the two surveys in SLR (2018) will be applied herein.

BSAL Protocol requires that a risk of impact to agricultural resources be qualified and used to determine the minimum observation site density for detailed soil surveys. The Panel notes that the 928 ha of the GCAA examined in detail in the 2015 survey (SLR, 2015) was sampled at a resolution of 1 analysed site per 16 ha plus 15 check sites. This is within the resolution required for a project identified as high risk of significant impact to agricultural resources (≥ 1 analysed site per 25ha) due to the nature of the original open cut mine proposal. With an underground mine now proposed, the new assessment conducted by the Applicant identified the majority of the project activity to be at low risk of significant impact to agricultural resources (SLR, 2018) for which BSAL Protocol requires a minimum observation density of ≥ 1 site per 400 ha.

The Panel however, using Table 7, 8 and 9 of the BSAL Protocol assesses the consequence of the activity in the Project prior to 2018 survey to be minimum level C3, which is not low risk, owing to the known presence of BSAL on the site (SLR, 2015), the mapping of potential BSAL close to unsampled areas of the site (DP&I ,2012), the irreversibility of subsidence and the potential site-specific impacts. The detailed soil survey in 2018 covered the remaining 579 ha with 22 analysed sites (including the analysis of check site 18 from the 2015 survey) providing a resolution of 1 detailed site : 26ha plus 9 check sites. The Panel accepts that, with latitude, this detailed survey on the whole is within the general scope of a high-risk sampling regime.

The Panel does however wish to note that in the southwestern area of the GCAA that was examined in the new survey (SLR, 2018), close to the identified BSAL (SLR,2015) and the potential BSAL (DP&I,

2012), the Applicant has taken only 6 detailed sample sites plus 3 check sites in an area that, with minimal access by the Panel to spatial data sets, is estimated at greater than 300ha. This results in a detailed survey resolution of 1 detailed site : 50ha. The Panel suggests that the sample density in this area of the GCAA is below that required to adequately determine BSAL condition in this case.

The Panel also refers to it's report for the previous Gateway application for an open cut mine within the lease EL5460 (MPGP, 2015). Potential issues with the non-identification of Soil Unit 2 (SLR 2015; SLR, 2018) as BSAL were identified and the Panel acknowledges that the new Applicant has responded by fully elucidating the conversion processes used for estimating ECe in the 2015 survey. The Applicant has also undertaken detailed chemical analysis of the soil at check site 18 from the 2015 survey during the 2018 analytical process. Soil Unit 2 contains detailed sites 11, 15, 16 (and now 18) plus check site 17 from the 2015 survey. Sites 11 and 18 fail the ECe ≤4dS/m requirement within the top 600mm of the soil profile. Site 16 is identified as BSAL. Site 15 is rejected as BSAL by the Applicant due to a reported restricted chemical barrier to plant root development within 750mm of the soil surface. The soil sample used to make this decision was taken from below this depth (800-900mm) according to the texture detail analysis in SLR (2015). The Panel believes that Site 15 (SLR, 2015) should be considered BSAL or the soil profile resampled and analysed.

In light of the above, Soil Unit 2 may therefore contain 2 soil profiles that conform to the BSAL Protocol and a check site (site 17) that seems atypical for the Soil Unit description, given that all other profiles are considered "deep" profiles except site 17. Site 17 fails BSAL Protocol based on displaying plant rooting depth restrictions before a profile depth of 750mm. The Panel suggests that more detailed soil survey sites around Soil Unit 2 would be prudent to more accurately assess the BSAL condition of the soil within the Applicant-defined Soil Unit 2.

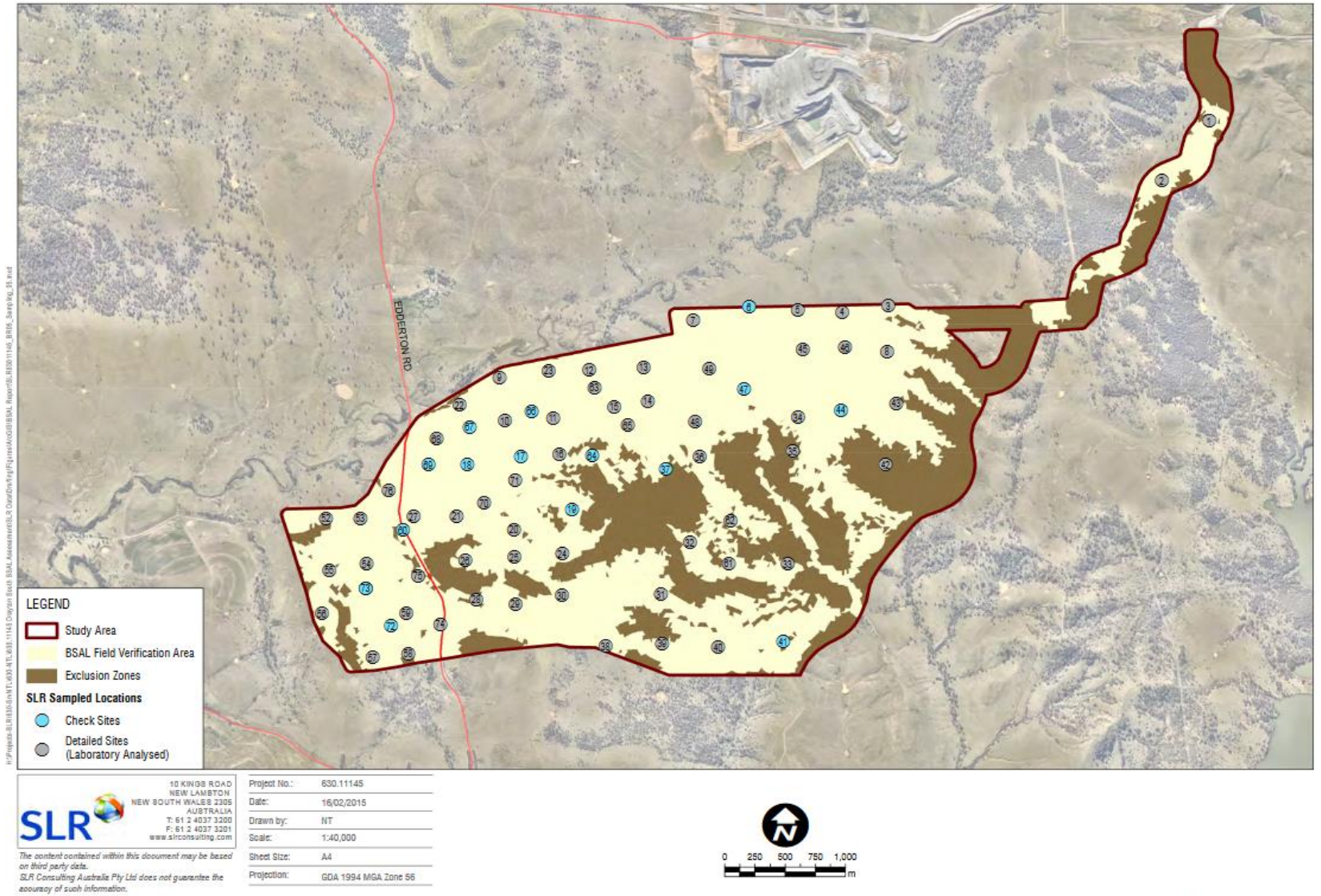

Figure 4. Sample site locations for the 2015 soil survey within the GCAA (SLR, 2015).

3.2 Critical Industry Cluster (CIC)

There are no viticulture or equine industry businesses within EL5460 (DP&I, 2012). The Panel notes that the Applicant acknowledges that equine and viticulture enterprises neighbour EL5460 and the GCAA along the southwestern boundary (Malabar Coal Ltd, 2018).

4 Assessment of Mining Disturbances

The Gateway process requires that the potential impact on BSAL and/or a CIC is evaluated as either:

- A direct mining effect whereby part or all of BSAL or a CIC is either removed, worked upon or subsided, or
- An indirect mining effect whereby the state of either the surface water or sub-surface water is significantly altered by mining which then has a direct impact on BSAL and/or a CIC.

Therefore, the assessment of mining disturbance must consider both direct and indirect impacts as defined above, noting that Malabar has commissioned studies on surface subsidence (MSEC, 2018) and hydrogeological effects (HydroSimulations, 2018) due to the proposed mine.

4.1 Direct mining disturbances

The Project mining operation within EL5460 will subside approximately 2,134 ha of the GCAA due to bord and pillar and longwall mining. The mine infrastructure area, coal handling and preparation and reject emplacement areas are proposed to be sited to avoid impacts on BSAL.

4.1.1 Removal or working upon verified BSAL

The applicant states that no verified BSAL will be removed or used to support infrastructure. Small areas of BSAL (<1 ha) may be temporarily disturbed during monitoring, exploration and remediation activities (2rog Consulting, 2018).

4.1.2 Disturbance due to mining subsidence

The Project will undermine the 72 ha of BSAL verified by the Applicant. The total maximum vertical subsidence for the BSAL is predicted to be 5.8 metres. MSEC (2018) has provided an assessment of the potential impacts of subsidence above the proposed mining area. In the flatter areas (i.e. away from the steep slopes) surface cracking is expected to be typically between 25 mm and 50 mm, with some localised cracking around 100 mm or greater. It is expected that localised topographical depressions will develop above the proposed longwalls, particularly along the alignments of the drainage lines and in the flatter areas. These areas have the potential for increased surface water ponding. MSEC (2018) predict that the identified BSAL could be affected by surface cracking and the development of topographical depressions due to the proposed mining. The individual topographical depressions within the BSAL are predicted to be up to 3.2 m deep with surface area of 2.5 ha (2rog Consulting (2018).

2rog Consulting (2018) have also identified that subsidence and associated surface deformation, cracking at the surface, or subsurface, can alter or create new flow paths altering surface and groundwater flow, effecting surface water drainage and storage, and impact groundwater resources. Cracking can also provide erosion initiation points, increasing the risk of soil loss.

The Panel also notes the potential for increased soil bulk density in the compression areas associated with the central zones of troughs above subsided panels (Bacon 2013). The impact on non-reactive soils such as the Brown Chromosol identified as BSAL will be site-specific and may be significant. The Panel also notes that surface water ponding and subsequent prolonged submersion can reduce the chemical and physical fertility of soils, and this may be a substantial issue in wetter periods where inundation is extended or any potential remediation actions are restricted.

In summary, the direct mining related impacts of the Maxwell Project will result in some impacts on BSAL soil drainage, surface and groundwater processes, surface water ponding and potential inundation of soil with associated soil physical and chemical degradation issues. There is a potential for deleterious changes to soil bulk density. Given the above, and the uncertainty in subsidence modelling highlighted by IESC (2018), the Gateway Panel believes the potential impacts on BSAL from subsidence requires greater investigation and documentation.

4.1.3 Duration of impacts, mitigation and rehabilitation measures

The Project proposes to mine from four coal seams within the Wittingham Coal Measures which all underly the 72 ha of Applicant-verified BSAL (MSEC, 2018). The area will be progressively subsided as each subsequently deeper seam is mined. The actual subsidence from mining the third and fourth seams has a higher level of uncertainty due to the lack of directly comparable examples in the Hunter Valley.

The Applicant states that proposed mining activities will not cause the long-term or permanent fragmentation of agricultural land uses. Fencing is proposed to exclude cattle from areas of active subsidence or under remediation.

The plan for monitoring and remediation of subsidence and other mining impacts is outlined in Malabar Coal Ltd (2018) and further detailed in 2rog Consulting (2018) and MSEC (2018). The Panel notes that a number of operations are proposed to remediate subsidence impacts on the GCAA including identified BSAL (2rog Consulting, 2018). These include:

- where soils and slopes allow; ripping or tyning of larger surface cracks;
- for some larger cracks that don't self-heal, remediation could include infilling with local soil or other suitable materials and/or local regrading and revegetation for erosion protection works;
- where needed, undertake minor works to re-establish drainage lines adversely impacted by ponding. Alternately areas of increased ponding may be developed to provide further water sources within the property, dam banks may be developed to increase pond size.

The applied procedures and the properties of any replacement soil would need to ensure that properties of BSAL are maintained. Detail to determine this outcome would be site-specific and is not supplied in the application. The Panel highlights that developing BSAL subjected to ponding into further water storage areas would result in a reduction in BSAL and require specific consideration in an EIS.

It is the Panel's view that due to the uncertainty associated with the subsidence modelling and the general nature of the proposed mitigation and rehabilitation measures in the application, it is unable to fully assess the site-specific success of the measures. A comprehensive Extraction Plan including subsidence and rehabilitation management plans will need to be developed for the Project.

4.2 Indirect mining impacts

In undertaking this assessment, the Gateway Panel has considered the advice from the Independent Expert Scientific Committee (IESC, 2018) and the Minister for Primary Industries (MPI, 2018).

The Panel must assess applications against specific criteria in the Aquifer Interference Policy (AIP), which includes assessing the impacts on aquifers, connected rivers and associated water dependent assets (including the environment). It also requires accounting for water take through a licencing regime.

The Aquifer Interference Policy includes a set of minimal impact considerations for assessing the impacts of all aquifer interference activities, including mining. All NSW groundwater sources have been categorised as being either 'highly productive' or 'less productive', based on the general character of the water source meeting or not meeting the criteria of 1500 mg/L total dissolved solids and a bore yield rate of greater than 5 L/s. This categorisation applies to a whole groundwater source as it is defined in a water sharing plan, not to the specific groundwater conditions at a particular location (DTRIS, 2012).

Impact thresholds relate to impacts on the water table and aquifer pressure, as well as to groundwater dependent ecosystems and to groundwater and surface water quality. Applicants are required to provide estimates of all quantities of water that are likely to be taken from any water source during and following the end of the activity, and to make predictions of all impacts associated with the activity (DTRIS, 2012).

The Water Management Act 2000 includes the concept of ensuring "no more than minimal harm" for both the granting of water access licences and the granting of approvals. This is not equivalent to a 'no impact' scenario. The approach is one of keeping cumulative impacts in a catchment at an acceptable level and sharing the water resources between the environment and other water users.

Level 1 impacts are considered acceptable, while Level 2 impacts require further studies to assess whether a project will prevent the long-term viability of a dependent ecosystem or water assets, or requires better arrangements to mitigate impacts.

4.2.1 Impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)

Groundwater Flow

The Panel considers the conceptualisation of the local and regional hydrogeology to be broad but adequate at this early stage of assessment and that the processes of groundwater flow from one water source to another are plausible at a broad scale. At a local scale there are still many unknowns such as how geological faults modify groundwater flow, how the presence of basalt sills/dykes might affect flow and how rock fracturing caused by mine subsidence will affect the movement of groundwater. Also, there is a need for hydraulic parameters to be obtained from the Gateway Certificate Application Area to help constrain model input parameters and thus improve the estimates of volumes of water fluxes between water sources and recharge processes in the modelling.

The Applicants supporting documentation identifies the Hunter River alluvium as a 'highly productive' groundwater source which meets the salinity and bore yield criteria in the AIP. They argue however that the Saddlers Creek Alluvium is a 'less productive' aquifer because of its higher salinity levels and lower well/bore yields. Saddlers Creek is a tributary of the Hunter Regulated River and is mapped by the NSW Government as 'highly productive'. The Panel accepts the NSW Government's categorisation of Saddlers Creek alluvium as 'highly productive', however recommends that further dialog occur between the Applicant and DIW on this issue.

The MODFLOW-USG software that was used for the groundwater flow modelling is considered appropriate to determine mine inflows and environmental impacts. The preliminary modelling satisfies the AIP requirement for a simple groundwater model platform and the calibration statistics are adequate for it to be used in predicting mine inflows and water asset impacts.

The modelling predicts water impacts, on both the 'highly productive' Hunter River alluvial aquifer and Saddlers Creek alluvial aquifer, will be a Level 1 minimal impact. The Panel considers the impact on the Saddlers Creek Alluvium may be a level 2 impact, due to the potential for cumulative mining impacts on the water table in the alluvium. Notwithstanding, the groundwater model results appear to contain some systematic bias whereby groundwater levels are overpredicted compared to observed groundwater levels.

The IESC (2018) acknowledges the efforts made by the Applicant to model the complex subsidence fracturing and groundwater impacts caused by mine dewatering, in a multi-seam mining venture. Nevertheless, the IESC believes the current groundwater modelling approach has potentially understated the impacts of the proposed project and overstated the certainty with which the impacts can be predicted. Most of the potential impacts are on groundwater sources that are categorised as 'less productive', i.e. Permian rock aquifers. The IESC also has concerns that underground mining in the proposed location may cause water losses from the Hunter alluvium and Saddlers Creek alluvium that are greater than predicted. Similarly, water losses from the Hunter River and Saddlers Creek may be larger than predicted. It is argued that this could occur as a result of far field fracturing, extending to beneath the alluvium and altering the permeability of sediments.

There is insufficient information to determine if this latter concern is a significant risk. The Panel believes the risk could be addressed through further field testing (drilling and geophysics) of the alluvium and the weathered Permian basement rocks immediately beneath (i.e. 10 – 20m).

The Applicant has indicated that for an EIS the groundwater modelling will be substantially upgraded and refined to better reflect:

- time series climate and river flow data;
- spatially distributed hydraulic parameters;
- fracturing above the goaf areas;
- a wider range of climate change scenarios; and
- the cumulative impacts of mining in this local area.

When completed this work together with a more expansive sensitivity analysis (see IESC, 2018) and a detailed uncertainty analysis will provide more confidence in the predictions. The work should be independently peer reviewed to maximise confidence in the results.

Cumulative Impacts

Limited work has been carried out by the Applicant to date, on the cumulative impacts of the mine on GDEs and on built water assets. The approach adopted is that of adding modelled drawdowns together from nearby mines (Mt Arthur complex). Whilst pragmatic this approach is unlikely to be very accurate. It is considered likely that when more exhaustive modelling is completed, the cumulative impact may well be greater than currently reported, particularly in the Permian sedimentary aquifers, and also the alluvial aquifer associated with Saddlers Creek.

Surface Water

The Applicant has yet to demonstrate how catchment run-off losses, as a consequence of shallow underground mining, will impact on ephemeral streams and their local environment. The IESC (2018) has outlined an approach that may be used to develop an IES.

The groundwater flow model predicts that there will be no measurable impact on water salinity in the Hunter River, because mining will slightly increase River losses. Malabar already holds adequate Hunter River water licences to account for River losses. Most however are General Security Licences and High Security licences may be a better option. The application does not provide any consideration to how the proposed mine would handle water restrictions, should they occur during severe drought conditions.

The Applicant believes that water licences from the affected water sources are likely to be available through the trading market. The Applicant holds 125 units from the Hunter Regulated River Alluvial Water source and 1423 units of surface water from the Hunter Regulated River, which on current estimates is adequate. They still require 1347 units in the Sydney Basin- North Coast Groundwater Source and 45 units in the Jerrys Management zone. Competition for water licences in these water sources is high.

The Gateway Panel believes that an updated assessment of the potential accumulation of salts in the East Void and the assessment of potential travel time of seepage to the Hunter River and its tributaries is needed. This work has been identified in the Gateway application and will be undertaken as part of an EIS.

Little or no information has been provided on the project's mine water management measures such as whether controlled releases to surface watercourses will be required. Controlled and uncontrolled (spills) releases have not been discussed. Provision of site-specific surface water, geochemical and risk assessments supported by a site-specific water balance is required in an EIS.

Groundwater Dependent Ecosystems (GDEs)

The AIP requires applicants to consider impacts on 'high priority' groundwater dependent ecosystems. These are sometimes listed in NSW Government Water Sharing Plans, when they are known to occur. The definition of 'high priority' is not clear but is interpreted here to be equivalent

to threatened species under the EPBC Act or NSW Biodiversity Conservation Act 2016, and where there is a dependence on groundwater for at least part of the year.

The applicant has provided an assessment based on published information, contained within Water Sharing Plans and Bureau of Meteorology National Atlas of Groundwater Dependent Ecosystems. The first data source indicates there are no 'high Priority' GDEs within 20km of the project. The second data source indicates that areas of moderate or high GDE potential is restricted to reaches along the Hunter River.

The Applicant also reported earlier work that detected Stygofauna (i.e. fauna that live within the aquifer framework) in both the Hunter and Saddlers Creek alluvium. It is claimed that none of the Stygofauna found to date are endemic to the study area and are widespread in aquifers associated with the Hunter River and associated tributaries. The panel is not able to comment on this statement.

The Panel agrees with the IESC that a more detailed assessment of the indirect mining impacts on Groundwater Dependent Ecosystems is warranted. For further information see Table 1 in Appendix A for the Gateway Panel's assessment against all AIP requirements.

5 Panel Assessment of Impacts on Strategic Agricultural Land

The Gateway Panel has assessed and determined the potential impacts of the Project on BSAL as follows (findings are summarised in Table 1). The Project will subside 2,134 ha of the GCAA and cause direct impacts to 72 ha of presently verified BSAL due to subsidence effects. The effects are potentially significant

Table 1. Summary of Gateway Panel determination of impacts on BSAL

17H(4)(a) BSAL	**Determined Impact**
(i) any impacts on the land through surface area disturbance and subsidence,	Potentially significant
(ii) any impacts on soil fertility, effective rooting depth or soil drainage,	Potentially significant
(iii) increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH,	Potentially significant
(iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy),	Potentially significant
(v) any fragmentation of agricultural land uses,	Not significant
(vi) any reduction in the area of biophysical strategic agricultural land.	Cannot be determined

5.1 Significance of the project's potential impacts on BSAL

5.1.1 Any impacts on the land through surface area disturbance and subsidence

Subsidence has the potential to create issues with surface water flow, surface ponding and soil inundation and at the other extreme, access to soil water reserves. Any significant periods of inundation could affect the chemical and physical fertility of affected soil, thereby impacting the agricultural productivity of verified BSAL. Restriction of access to water in the soil profile may also impact the agricultural productivity of verified BSAL.

The Panel cannot determine the significance of any impacts on agricultural productivity from potential BSAL within the GCAA where it deems the BSAL verification protocol (OEH & OASFS, 2013) requires further application.

5.1.2 Any impacts on soil fertility, effective rooting depth or soil drainage

The potential for surface-water ponding and soil compaction in subsidence depressions, and subsoil inundation of BSAL means that the fertility, effective rooting depth and soil drainage may be significantly impacted in localised areas of presently verified BSAL soils.

The Panel cannot determine the significance of any impacts on agricultural productivity from potential BSAL within the GCAA where it deems the BSAL verification protocol (OEH & OASFS, 2013) requires further application.

5.1.3 Any increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH

The proposed Project should not significantly reduce the agricultural productivity of BSAL due to increases in micro-relief, rock outcrop or significant changes to soil pH providing thorough subsidence rehabilitation procedures are followed. However, changes in slope due to subsidence may affect the erosion potential of identified BSAL soils.

The Panel cannot determine the significance of any impacts on agricultural productivity from potential BSAL within the GCAA where it deems the BSAL verification protocol (OEH & OASFS, 2013) requires further application.

5.1.4 Any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)

The 'highly productive' groundwater, in this vicinity, is the unconsolidated alluvial aquifers associated with the Hunter River and its tributary - Saddlers Creek. The alluvium consisting of silts, sands, gravels and clays to a depth of about 10 to 20m. The Hunter alluvium is capable of yielding water supplies of 10 - 20 L/s to a well or bore. The water is low in salinity and suitable for irrigation and most other uses. The Hunter River is the main source of recharge to the alluvium. The Saddlers Creek alluvium contains brackish water, at least in part, and water yields are smaller.

The edge of the Hunter alluvium is located approximately 525 m south of the Project at its closest point. The alluvium is outside the angle of draw for fractures caused by mine subsidence, but possibly could be affected by far field fractures that extend to below the alluvium. This is a concern

of the IESC and should be further investigated. There is a similar concern for Saddlers Creek alluvium.

Dewatering during mining will cause depressurisation of the Permian strata, the effects of which will last beyond the life of the mine and also impact outside of the mine foot print. This impact, which is highlighted in the IESC report (IESC, 2018), occurs largely on the 'less productive' Permian aquifers.

The depressurised Permian strata will also cause some movement of water from the Hunter River/alluvium and Saddlers Creek/alluvium towards the mine.

The groundwater modelling predicts the loss of water from the Hunter River via the alluvium to be relatively small (max 50 ML/year). The modelling also predicts water impacts on the 'highly productive' Hunter alluvial aquifer meet the Level 1 minimal impact considerations in the AIP. The Panel accepts these predictions but requires more geological detail and data acquisition in any upgraded model that is to be used in an EIS. Also, any future groundwater flow modelling should be independently peer reviewed.

The groundwater modelling predicts the loss of water from the Saddlers Creek via the alluvium to also be relatively small (max 45 ML/year). The Applicant assesses the mining impacts on the Saddlers Creek alluvium to meet Level 1 minimal impacts. However, the Panel considers that impacts may be greater, i.e. at Level 2 in the AIP, and that more detailed cumulative impact studies are needed.

The Panel concludes that at this early staged of assessment, mine dewatering is unlikely to have a significant indirect impact on groundwater resources of the Hunter alluvium but may have a significant impact on the Saddlers Creek alluvial aquifer, when cumulative impacts from other mines are fully considered and groundwater dependent ecosystem studies are completed.

5.1.5 Any fragmentation of agricultural land uses

The Panel finds the Project will cause only short-term fragmentation of agricultural land use on any verified BSAL during the period of active subsidence and subsidence rehabilitation. The potential for longer-term fragmentation is low.

5.1.6 Any reduction in the area of BSAL

The potential success of local remediation and mitigation measures for the impacts of subsidence on verified BSAL including the potential for permanent inundation are difficult for the Gateway Panel to assess from the information supplied.

The Panel cannot determine the significance of any impacts on agricultural productivity from potential BSAL within the GCAA where it deems the BSAL verification protocol (OEH & OASFS, 2013) requires further application.

6 Conditional Gateway Certificate

The Gateway Application for the Maxwell Coal Project proposes underground coal mining within EL 5460. The Gateway Certificate Application Area (GCAA) of 3,215 hectares incorporates 72 hectares of applicant-verified BSAL.

It is the opinion of the Gateway Panel that;

- the Project could have direct and significant impacts on the agricultural productivity of verified BSAL within the Project Boundary area;
- the Project could have indirect and significant impacts on the agricultural productivity of verified BSAL within the Project Boundary area;
- The Project is unlikely to have significant impacts on the highly productive Hunter alluvial aquifer, within the meaning of the NSW Aquifer Interference Policy (DITRIS, 2012) but may have significant impacts on the highly productive Saddlers Creek alluvial aquifer.

Appendix A

Table 1. Gateway Panel Assessment for the Maxwell Project Against AIP Requirements for Highly Productive Aquifers

Requirement	Assessment	Recommendation
1. Estimates of all quantities of water that are likely to be taken from any water source on an annual basis during and following cessation of the activity.	The results are from a preliminary model calibrated in steady state mode and run in transient mode. The Applicant has indicated that a more robust and detailed groundwater flow modelling that more accurately depicts transient groundwater flow conditions will occur for an EIS. The Panel accepts the results of the preliminary modelling.	Use a calibrated transient 3D groundwater flow model to re-calculate the volumes of water to be taken from each water source. Quantify any uncertainties in the groundwater modelling. Have the modelling results independently peer reviewed. Develop a plan for monitoring actual water take and how any changes from the predictions will be accounted for with water licences and update the model
2. A strategy for obtaining appropriate water licenses for the maximum predicted annual take.	The Applicant already holds some water entitlements and has indicated that all necessary water entitlements will be acquired through the trading market or from Government.	The Applicant should hold the necessary water licences before any mining is commenced. It is noted that most of the Applicant's surface water licences are General Security Licenses. High security Licences may be preferable. It is noted that there will be challenges for any available water for the Sydney Basin North Coast Groundwater Source with several other coal mines also seeking entitlement.

Requirement	Assessment	Recommendation
3. Establishment of baseline groundwater conditions including groundwater depth, quality, and flow based on sampling of all existing bores in the area, any existing monitoring bores and any new monitoring bores that may be required under an authorization issued under the Mining Act 1992 or Petroleum (onshore) Act 1991	Some baseline data exists, including long term water level monitoring at 15 monitoring bores. More work is required to establish baseline groundwater conditions. In particular the following is inadequately defined: • Potential effects of geological faulting and basalt flows on groundwater movement; • The interaction between surface and groundwater near the Hunter River and Saddlers Creek. • The water transmitting capacity of the weathered zone beneath the Hunter River alluvium.	Undertake more studies to establish baseline groundwater conditions. Including: • Determining the likely effects of local geology on groundwater flow. • Determine the interaction between surface water and groundwater • Determine the hydraulic conductivity of the weathered zone beneath the Hunter alluvium • Ensure that sufficient water level and water quality monitoring is undertaken in all major rock units affected by the impacts of mining.
4. A strategy for complying with any water access rules applying to relevant categories of water access licences, as specified in relevant water sharing plans	Other than holding the appropriate annual licence volumes in affected water sources, the Applicant has not demonstrated how they would abide by Water Sharing Plan rules.	The Applicant should provide: • A strategy for mitigating the impacts of water losses from the Hunter River and Saddlers Creek to the mine during periods of restricted access, such as droughts.
5. Estimates of potential water level, quality or pressure drawdown impacts on nearby water users who are exercising their right to take water under a basic landholder right.	Basic landholder rights include extracting water for stock and domestic uses. Water extraction for this purpose does not require a water licence. Assessed impacts are similar to 6 below.	• Same as in point 6. below.

Requirement	Assessment	Recommendation
6. Estimates of potential water level, quality or pressure drawdown impacts on nearby licenced water users in connected groundwater and surface water sources	Current estimates are based on a preliminary groundwater flow model that gives broad results only. The Gateway Panel recognises the limitations of the work to date but finds the current work adequate for a Gateway Panel assessment. Cumulative Impacts are likely to exceed the thresholds in the AIP for the Saddlers Creek alluvial aquifer. They will also be exceeded in the Permian rock aquifers at some locations. A groundwater management plan should be developed that includes a monitoring strategy, trigger levels for a response and the response action to be undertaken.	Using a calibrated transient 3D model re-quantify the impacts on nearby water assets (bores/wells and GDEs). This updated modelling and reporting should: • Capture the hydrogeological complexity of the site; • Use temporal input data; • Have distributed input parameters; • Quantify any uncertainties in the groundwater /surface water connection; • Undertake both sensitivity and uncertainty analysis in accordance with IESC advice (2018).
7. Estimates of potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems	The information supplied on GDEs is limited. There are no known high priority GDEs in the vicinity of the proposed mine.	Further assessment of ecological impacts is required..
8. Estimates of potential for increased saline or contaminated water inflows to aquifers and highly connected river systems	The Applicant has stated that there will be no change in beneficial use of any aquifer or surface streams as a consequence of mining. The Panel accepts this position but requests a detailed mine water management plan be developed to show how waste water will be handled.	Provide a detailed assessment of the potential accumulation of salts, metals and toxicants where the water is to be stored and estimate the potential travel times of seepage to the Hunter alluvium/River. Include an uncertainty analysis using a range of hydraulic conductivity and porosity values.

Requirement	Assessment	Recommendation
9. Estimates of potential to cause or enhance hydraulic connection between aquifers	Substantial land subsidence is predicted to occur. Fracturing associated with subsidence will enhanced the connection between the 'less productive' Permian rock aquifers in the vicinity of the mine. This is unlikely to reduce the value of these aquifers for stock, domestic and industrial purposes. The IESC (2018) report has identified as a risk the possibility of far field fractures extending below the Hunter River and Saddlers Creek alluvium, causing greater river losses than currently predicted.	Ongoing subsidence studies and measurements are required. See IESC (2018) for guidance. More drilling and geophysics in the alluvium is recommended to address the risk of rock fracturing affecting stream flow losses.
10. Estimates of the potential for river bank stability, or high wall instability or failure to occur.	NA	NA
11. Outline of the method for disposing of extracted water (in the case of coal seam gas activities.	NA	NA