



Hawes & Swan

Town Planning Consultants

**OBJECTION
HUME COAL PROJECT
SSD 15_7172**

On behalf of
180-182 Belanglo Road, Sutton Forest



Hawes & Swan

Town Planning Consultants

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1.0 Executive Summary

The Proposal

Hume Coal Pty Ltd is seeking approval to construct and operate a new underground coal mine, and associated infrastructure with an integrated rail system in the Southern Highlands of NSW (**Project**). Hawes and Swan Planning has been engaged by Colin Biggers & Paisley Lawyers on behalf of their clients Richard and Lynne Crookes (**Owners**) to review the development application for the Project.

The Subject Property

The Crookes own land at 180-182 Belanglo Road, Sutton Forest (**Property**). The eastern boundaries of the Property share a common boundary with the Hume Coal land which is identified for developing surface infrastructure. The common boundary extends over approximately 1800m. The Hume Coal processing plant (CPP), handling, storage and outloading areas are located to the north-east and east of the Property. The property is approximately 335 acres.

The Crookes residence at 180 Belanglo Road is orientated north and north east with both large covered and open outdoor entertaining areas which have specifically been designed to enjoy the outlook and best orientation for sunlight. This orientation is towards the proposed Hume Coal CPP. The Property has a number of improvements including a private five (5) hole golf course to the north, passive external recreation areas and provisions for a 200 plus head Red Angus Cattle stud which is currently being operated on the Property.

Situated on 182 Belanglo Road is another private residence which is currently undergoing alterations and additions which includes the expansion of outdoor entertaining area. This land is also used as part of the cattle stud operations.

There are three registered bores on the Property. All bores intersect the Hawkesbury Sandstone and extract groundwater from water bearing zones within the sandstone. One of the bores extends beyond the Hawkesbury Sandstone, through the underlying Wongawilli Seam and into Permian siltstone. The bores are an important element in the agricultural use of the Property.

In addition to the bores, the Property has developed extensive irrigation infrastructure of a commercial nature which is critical to the operation of the Red Angus Cattle Stud. This extensive irrigation infrastructure is made up of:

- Thirty-four (34) irrigation connections;
- Five (5) sprinklers;
- Eight (8) water troughs;
- Three (3) bores; and
- A number of large dams.

The Red Angus Cattle Stud is a prize-winning stud, having recently been awarded at the Sydney Royal Easter Show 2017 the Reserve Senior Champion. The continued operation of the stud relies heavily on access to water. Without access to water from the bores, the continued operation of the stud would be likely unsustainable.

The Property is zoned E3 Environmental Management pursuant to the Wingecarribee Local Environmental Plan 2010 (**LEP**). There are several relevant objectives within the zone including providing sustainable agriculture and protecting significant agricultural resources including soil, water and vegetation.

The Review

The review of the proposal was undertaken on behalf of the owners to understand the impacts and identify where the Project adversely impacts the Property.

Our client has engaged the following consultants to review the Environmental Impact Statement (EIS) and supporting studies prepared for the project:

- GHD Pty Ltd – Review of Groundwater Assessment (**Appendix A**)
- Larry Cook Consulting Pty Ltd (**Appendix B**)
- Atkins Acoustics and Associates Pty Ltd – Review Noise and Vibration Assessment (**Appendix C**)
- Northstar Air Quality Pty Ltd – Review of Air Quality Impact Assessment (**Appendix D**)
- Jim Colquhoun, Landmark – Pasture Improvement Letter (**Appendix E**)

In addition, Hawes and Swan Planning have reviewed the proposal from a town planning perspective.

Groundwater

The Review of the Groundwater Assessment has identified that the extent of impact to private landholder bores (particularly the bores on the Property) is significant. Whilst Hume Coal have indicated that efforts will be made to limit the impact, the impacts remain significant. GHD questions that should actual groundwater drawdown exceed predicted values, whether the process of implementing additional make good measures can be managed without interruption to groundwater supplies.

The range of predicted drawdown at each bore, based on the sensitivity analysis, has not been determined and/or reported. Under some model runs it is possible that groundwater supplies are lost completely.

Historical groundwater data for the coalfield is limited and therefore the assessment of potential impact of the Project is limited. When compared to all other coalfields in NSW, there are extensive current datasets on groundwater responses to underground mining which can be used to calibrate and/or validate hydrogeological models.

In addition, the EIS notes that if drawn down of landholder's bores is significantly larger than predicted, then Hume Coal will consider if additional make good measures should apply. This provides no certainty to the landowner since action is at the discretion of Hume Coal.

Larry Cook Consulting notes that the Property is a commercially viable and well managed cattle stud that has a reliance on water for their operations including an extensive property-wide irrigation scheme. The licensed bores are integral parts of the rural operations. Water security is crucial.

Groundwater supplies may be interrupted because there is uncertainty surrounding the modelled drawdown predictions and uncertainty how a commitment regarding additional "make good" measures would be managed. If the actual drawdown is greater than the predicted drawdown in the replacement bore and the "make good" measures proposed for the remaining two bores are not suitable, additional "make good" measures should be addressed by the proponent prior to any project approval."

There is a well-established planning principle of the NSW Land and Environment Court (**Court**) in respect of the Precautionary Principle handed down by the Chief Judge Preston *Telstra Corporation Limited v Hornsby Shire Council [2006] NSW LEC 133*. Given the limited historical groundwater data, the fact that

under some model runs groundwater supplies are lost completely, the precautionary principle should be adopted.

Noise and Vibration

The Noise and Vibration Assessment (NVA) submitted by Hume Coal is lacking in critical information that restricts a proper and comprehensive assessment of the potential impact of the Project. The NVA has also failed to identify or properly assess the cumulative impacts of mining and construction on the area and in particular the Property.

Air Quality

The review of the Air Quality Impact Assessment submitted by Hume Coal has raised issue with the assessment process, data used and proposed mitigation methods. A more thorough and comprehensive assessment is required to properly assess the potential impact of the project on the air quality of the area and the property.

2.0 The Proposal

The proposal is to construct and operate a new underground coal mine, and associated infrastructure with an integrated rail system in the Southern Highlands of NSW (**Project**).

The Project involves a construction phase of approximately 2 years, with 19 years of mining. However, it is noted in the NVA that some coal extraction could commence during the second year of construction and hence there could be an overlap between the construction and operating phases. The noise and air quality assessments do not include modelling for this overlay period.

It is estimated that approximately 50 million tonnes (Mt) of run-of-mine (**ROM**) coal would be extracted at a rate of up to 3.5 million tonnes per year. Following processing in the coal preparation plant (**CPP**), it is estimated that up to 3Mtpa of metallurgical and thermal coal could be produced.

Product coal will be transported by rail to Port Kembla for shipment to export markets and/or by rail to domestic customers. Rail works and rail use are covered by a separate development application for the Berrima Rail Project.

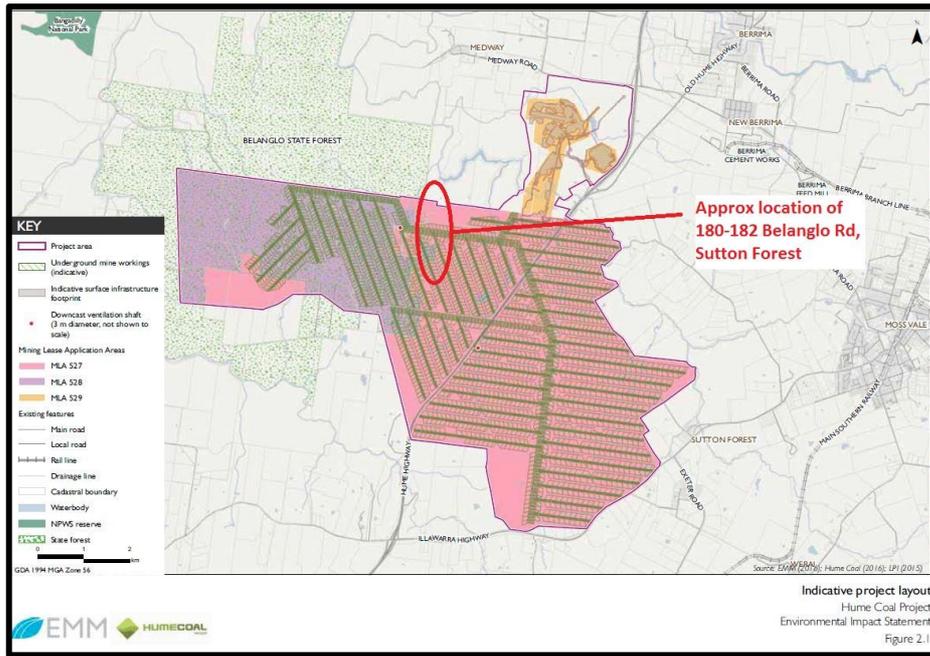


Figure 1 – Location of Project compared with 180 – 182 Belanglo Road, Sutton Forest (Source – Project EIS)

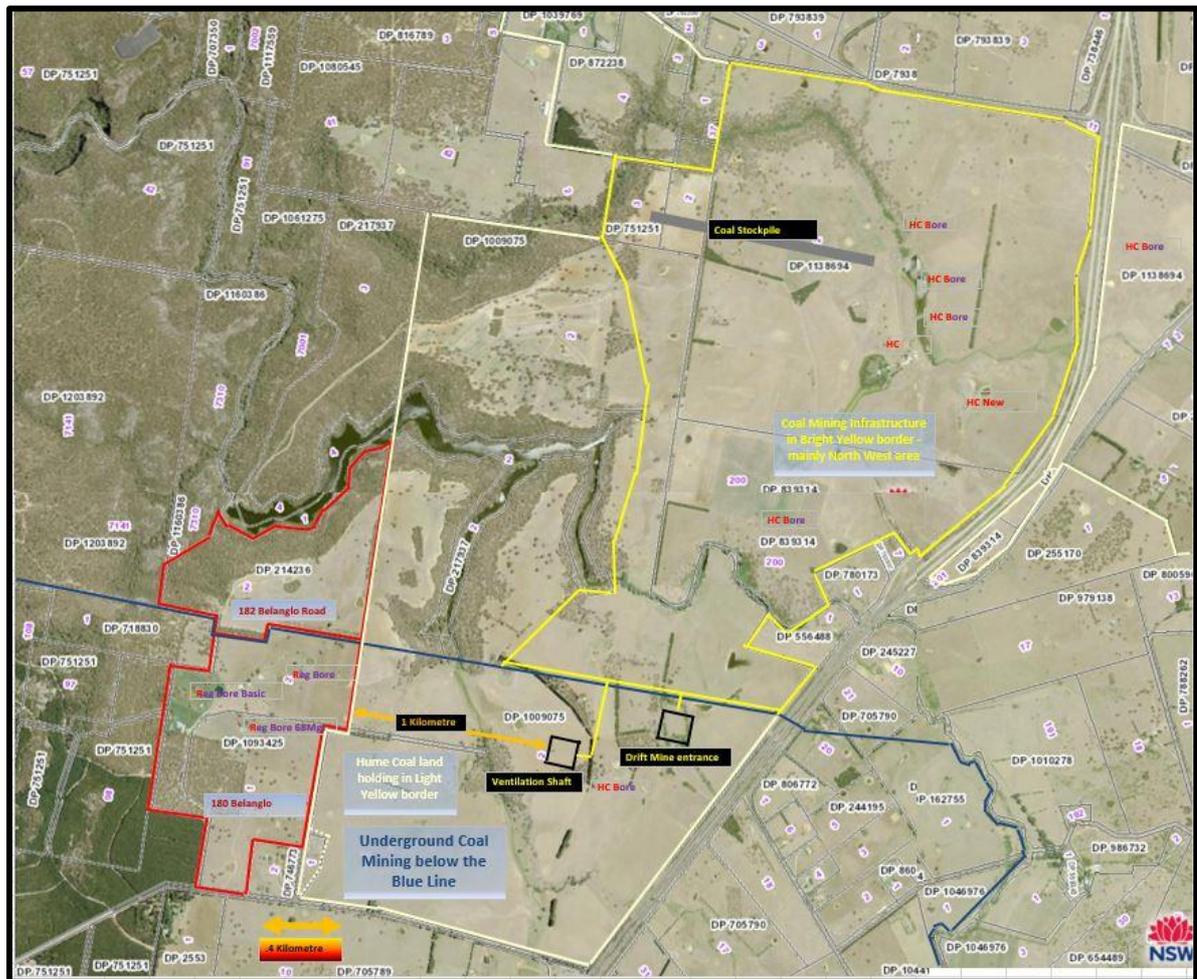


Figure 2 – Aerial Photo of 180 – 182 Belanglo Road, Sutton Forest in relation to The Project (Source – SixMaps)

3.0 The Property

The Crookes own land at 180-182 Belanglo Road, Sutton Forest. The eastern boundaries of the Property share a common boundary with the Hume Coal land which is identified for developing surface infrastructure. The common boundary extends over approximately 1800m. The Hume Coal processing plant (CPP), handling, storage and outloading areas are located to the north-east and east of the Property. The property is approximately 335 acres.

The Crookes residence at 180 Belanglo Road is orientated north and north east with both large covered and open outdoor entertaining areas which have been specifically designed to enjoy the outlook and best orientation for sunlight. This orientation will be towards the Hume Coal CPP if approval is granted. The Property has a number of improvements including a private five (5) hole golf course to the north, passive external recreation areas and provisions for a 200 plus head Red Angus Cattle stud.



Figure 3 – Aerial Photo of 180 – 182 Belanglo Road, Sutton Forest (Source – Nearmap)

The Crookes run a successful cattle stud known as Yallabee Red Angus (YRA). The stud was purchased by the Crookes in 2015, since then the Property has been transformed into a Stud Breeding Property, with bull pens, feed mixing mill, extensive irrigation, tractor for sowing fodder crops, fencing, cattle transport truck and other infrastructure.

The herd was carefully selected by the Stud Manager, with an aim for breeding structurally sound, easy care cattle that meet all market criteria.

YRA has a base herd of 100 stud breeding cows, with bloodlines from the Wollumbi, Waterfront, Trovone Park and BST herds, resulting in superior genetics from Australia, Canada and the United States. With the bulls and calves, the cattle currently number 196.

YRA offers the best genetics through the sale of bulls and breeding females. The stud topped the National Bull Sale and equal top prized female in NSW in 2016. This was a remarkable achievement in the first year of operation.

In addition, at the Sydney Royal Easter Shown in 2017, YRA was awarded the Reserve Senior Champion and all cattle exhibited were awarded ribbons.

The cattle are society registered, backed with group breed plan figures. The breed records are maintained by the Red Angus Society of Australia, operating out of the University of New England, Armidale.

A sample of the Breeding Stock records is shown below.

Name	Image	Information
WOLLUMBI HI STAR H53 (ET) (AI) (AMF) (MAF) (NHF) (OSF) PWWH53		http://abri.une.edu.au/online/cgi-bin/i4.dll?1=31213329&2=2420&3=56&5=2B3C2B3C3A&6=5C265B595923202F24&9=515E5B5B
RED NORTHLINE FAT TONY 605U (AMF) (MAF) (OSF) CANM1462961		http://abri.une.edu.au/online/cgi-bin/i4.dll?1=31213329&2=2420&3=56&5=2B3C2B3C3A&6=5C265B595A27222621&9=515E5B59

Figure 4 – Sample of Breeding Stock – Sirs (Source: Crookes)

The Property has developed extensive irrigation infrastructure of a commercial nature which is critical to the operation of the Red Angus Cattle Stud. Figure 4 below is an aerial photo of the site identifying key water and irrigation infrastructure across the Property.

This extensive irrigation infrastructure is made up of:

- Thirty-four (34) irrigation connections;
- Five (5) sprinklers;
- Eight (8) water troughs;
- Three (3) bores; and
- A number of large dams.

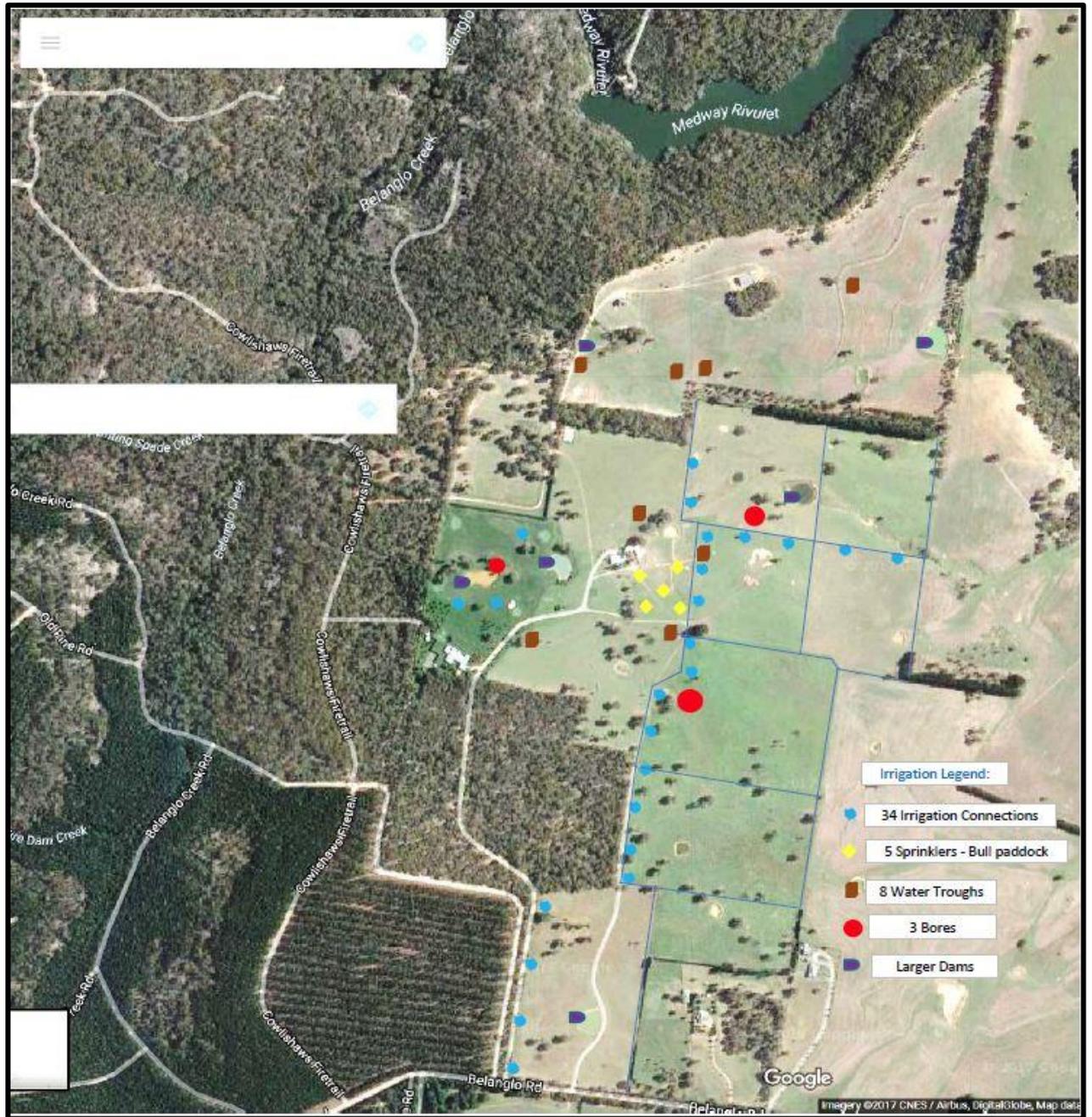


Figure 5 – Location of Irrigation Infrastructure (Source: Google Maps & Crookes)

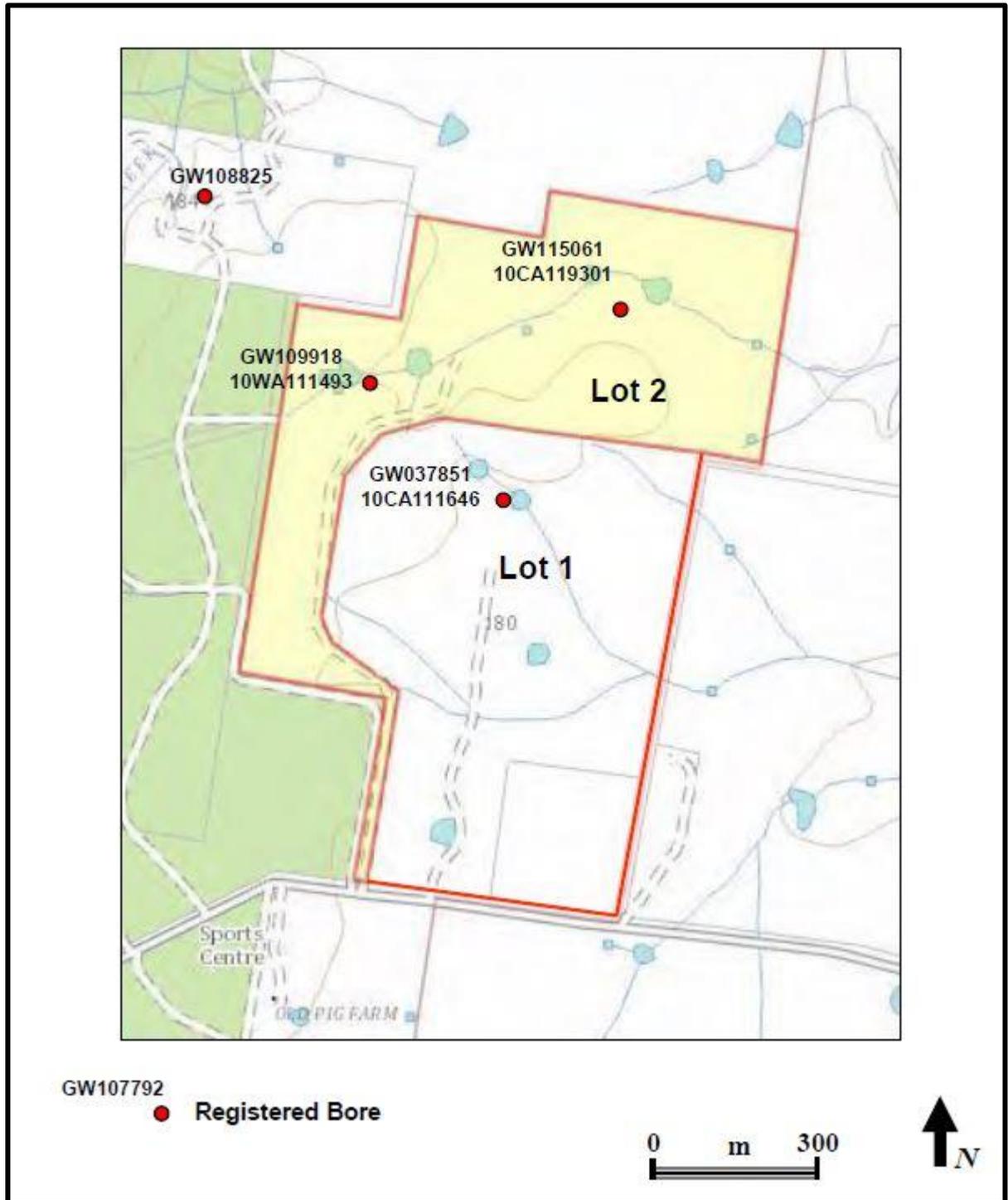


Figure 6 – Location of Registered Bores (Source: Larry Cook Consulting)



Figure 7 – Photo of Irrigator on Wheels
(Source: Crookes)



Figure 8 – Photo of Pump Shed (Source: Crookes)



Figure 9 – Photo of Sprinkler Socket (Source: Crookes)



Figure 10 – Photo of Sprinkler in Operation
(Source: Crookes)

Situated on 182 Belanglo Road is another private residence which is currently undergoing alterations and additions which includes the expansion of outdoor entertaining area. This land is also used as part of the cattle stud operations.

There are three registered bores on the Property. All bores intersect the Hawkesbury Sandstone and extract groundwater from water bearing zones within the sandstone. One of the bores (GW115061) extends beyond the Hawkesbury Sandstone, through the underlying Wongawilli Seam and into Permian siltstone. As set out above, the bores are an important element in the agricultural use of the land. Table 1 below provides further details of the registered bores at the Property.

Bore name	Depth (m)	Screen interval (m bgl)	SWL ^(a) (m bgl)	Registered use	Installation date	WAL ^(b) shares
GW115061	128.7	Open hole from 5.2 m	28.4	Irrigation	July 2015	30
GW109918	102	Open hole from 24 m	27	Stock and domestic	Feb 2009	Basic rights
GW037851	78.6	Open hole from 2.4 m	22.8	Stock, domestic and irrigation	May 1973	68

(a) Standing water level at date of installation
 (b) Water access licence

Table 1 – Registered bores at the property (Source: GHD)

Water is an important resource for the Property, and the bores are an important water resource to ensure the maintenance of the golf course, retention of the carefully cultivated pastures and the ongoing viability of the cattle stud business which has been established on the property. The bores play an important role in the ongoing use of the land and are used for not only stock and domestic purposes but also for irrigation purposes.

4.0 Assessment of Environmental Impacts

4.1 Groundwater

A review of the Groundwater Assessment submitted by Hume Coal was undertaken by GHD Pty Ltd, and is provided in **Appendix A**. In addition, a further review was undertaken by Larry Cook Consulting Pty Ltd, and is provided in **Appendix B**. Their review focuses on the potential groundwater impacts on the Property.

Whilst they note the assessment methodology is considered to be sound and in accordance with the NSW Aquifer Interference Policy (AIP) they identify a number of key issues with regards to the impact predictions, they are:

- *“The extent of impact to private landholder bores is considered to be significant when benchmarked against coal mining operations in other coalfields of NSW. This is due to the large number of private bores in the vicinity of proposed underground mining operations as well as the geological and hydrogeological conditions in the area. Efforts have been made to limit this impact, however it remains significant. Should actual groundwater drawdown exceed predicted values, the author questions whether the process of implementing additional make good measures can be managed without interruption to groundwater supplies. The EIS does not detail specific measures to be implemented to avoid interruption to groundwater supplies in the event that actual drawdown exceeds predictions and proposed ‘make good’ measures are inadequate.*
- *The groundwater impact assessment prepared by EMM (2017b) predicts that the water table in 93 private landholder bores will experience a drawdown greater than 2m which exceeds the maximum acceptable impact documented in the NSW Aquifer Interference Policy (AIP). The average predicted duration of drawdown greater than 2m for these affected landholder bores is 36 years.*
- *The three registered bores on the Property will be significantly impacted by the proposed coal extraction.*
- *The predicted time for the water table in the three bores to drop more than 2m is approximately 1 year reaching maximum impact in 11 years. The magnitude of these impacts significantly exceeds the maximum acceptable impact documented in the AIP.*
- *The range of predicted drawdown at each bore, based on sensitivity analysis, has not been determined and/or reported. Under some model runs it is possible that groundwater supplies are lost completely however this has not been reported.*
- *There is some uncertainty in model predictions due to the lack of historical data on groundwater responses to mining in the region. In all other coalfields in NSW, there are extensive current datasets on groundwater responses to underground mining which can be used to calibrate and/or validate hydrogeological models.”*

In our opinion, the review undertaken by GHD of the Groundwater Assessment identifies a number of key issues that question whether it is appropriate to approve the Project.

The review undertaken by Larry Cook Consulting at **Appendix B** can be summarised as follows:

“In summary, it is apparent that Watson Park is a commercially viable and well managed cattle stud that has a reliance on water for their operations including an extensive property-wide irrigation scheme. The licensed bores, especially Bore GW GW037851 (Approval 10CA111646) and storage dams are integral parts of the rural operations. Water security is crucial.

Groundwater supplies may be interrupted because there is uncertainty surrounding the modelled drawdown predictions and uncertainty how a commitment regarding additional “make good” measures would be managed. In this regard, if the actual drawdown is greater than the predicted drawdown in the replacement bore and the “make good” measures proposed for the remaining two bores are not suitable, additional “make good” measures should be addressed by the proponent prior to any project approval.”

There is a well-established planning principle of the NSW Land and Environment Court (**Court**) in respect of the Precautionary Principle handed down by the Chief Judge Preston *Telstra Corporation Limited v Hornsby Shire Council [2006] NSW LEC 133*.

At para 128 he states:

“The application of the precautionary principle and the concomitant need to take precautionary measures is triggered by the satisfaction of two conditions precedent or thresholds: a threat of serious or irreversible environmental damage and scientific uncertainty as to the environmental damage. These conditions or thresholds are cumulative.”

At para 129 he states:

“First, it is not necessary that serious or irreversible environmental damage has actually occurred – it is the threat of such damage that is required. Secondly, the environmental damage threatened must attain the threshold of being serious or irreversible.”

At para 140:

“The second condition precedent required to trigger the application of the precautionary principle and the necessity to take precautionary measures is that there be “a lack of full scientific certainty”. The uncertainty is at the nature and scope of the threat of environmental damage.”

Finally, at para 150:

“If each of the two conditions precedent or thresholds are satisfied – that is, there is a threat of serious or irreversible environmental damage and there is the requisite degree of scientific uncertainty – the precautionary principle will be activated. At this point, there is a shifting of an evidentiary burden of proof. A decision-maker must assume that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that this threat does not in fact exist or is negligible effectively reverts to the proponent of the economic or other development plan, programme or project.”

In our view given the issues raised by GHD and Larry Cook Consulting in their review of the Groundwater Assessment, focussing on the uncertainty of impacts on groundwater, the application cannot be supported in its current form. The precautionary principle should be applied as identified by the Chief Judge because:

- The range of predicted drawdown at each bore, based on sensitivity analysis, has not been determined and/or reported. Under some model runs it is possible that groundwater supplies are lost completely.
- Uncertainty in model predictions because of a lack of historical data on groundwater responses to mining in the region.

4.2 Noise

A review of the NVA submitted by Hume Coal was undertaken by Atkins Acoustics and Associates Pty Ltd, and is provided in **Appendix C**.

In their view, the NVA does not contain the following critical information to enable a proper and comprehensive assessment of the project:

- *Actual measured background noise levels for the property.*

As the background levels are reported as being 22 to 26 dBA (day/evening/night) an industrial noise source of 35 dBA would be clearly audible at the Property.

- *Noise contour plots and assessment locations for the Property.*

The NVA refers to noise contours as shown in Figures 5.1 to 5.3. No noise contour plots or assessment locations are provided in Figures 5.1 to 5.3 or for the Property. As a minimum, noise contour plots should have been provided that encompass the Property.

- *Discussion or explanation to support the claim that noise mitigation measures will satisfy the evening and night noise management levels at all locations.*

The construction noise modelling reported in the NVA shows that NML's would be exceeded at the Property during day and night time hours. The NVA concludes that noise levels from proposed out-of hours works (shaft drilling) satisfy the evening and night noise management levels (NML's) at all locations however the NVA provides no discussion or details (including the noise mitigation and management measures that will be employed during these periods) to support this claim, and

- *An assessment of the impacts associated with the construction of the downcast shafts and the associated construction traffic.*

In addition, the Project documentation appears to indicate that coal extraction may occur during the second year of construction. If that is to occur, then the Applicant should provide further acoustical testing and data in relation to the following matters:

- *Noise modelling to consider the coal handling/processing and the planned construction works happening at the same time;*
- *The relevant noise criteria which is to apply when both extraction and construction are occurring;*
- *The hours that will apply to the simultaneous operations; and*
- *What is the cumulative noise impact for coal handling/processing and construction, acknowledging that the construction noise modelling does not consider meteorological effects.*

As noted by Atkins Acoustics and Associates, the NVA is insufficient in its current form, and the consent authority cannot be satisfied based on the information currently supplied that there will not be an adverse environmental impact on the Property.

4.3 Air Quality

A review of the Air Quality Impact Assessment (AQIA) submitted by Hume Coal was undertaken by Northstar Air Quality Pty Ltd, and is provided in **Appendix D**.

The review raised many issues with the AQIA, ranging in significance. With observations being categorised as 'medium' and 'high' significance, both of which have potential to change the conclusion of the AQIA.

The following observations were identified as being of high significance and having potential to alter the conclusions of the AQIA:

- The AQIA does not present cumulative impacts for particulates at the identified receptor locations, as it is required to do following guidance provided in the NSW EPA Approved Methods. Without the predicted cumulative particulate impacts, the level of risk from particulates at the surrounding properties is not determinable.
- The selection and use of ‘background’ air quality data is questioned. In some instances, the 5-year average concentrations are used in lieu of the contemporaneous values, which potentially distorts the assessment. This data forms an important component of the assessed cumulative impacts, and is a metric to determine the relative receiving capacity and sensitivity of the environment to increased pollutant loads.
- The potential impacts from the construction phase should be assessed at locations on the Hume Highway, as this is proximate to the proposed development site.
- The use of veneering on product stockpiles is questioned, as the additional and removal of material on the stockpile would disrupt the containment and control that might be generated through veneering technologies.

The following observations were identified as being of medium significance and having potential to change the conclusions of the AQIA.

- The data set for the representation of ambient concentrations in the local area is not clear and this approach is inadequately justified.
- The concentration phase air quality assessment has been performed on a qualitative (modelling) basis, and presents incremental impacts only. The AQIA does not present results quantifying or illustrating the resultant cumulative impacts and therefore the resultant impacts on the receiving environment cannot be determined.
- Section 10 of the AQIA does not present any recommendations for control of particulates associated with construction.

A more extensive assessment would be required to better identify the potential risk of the Project on the air quality of the area and in particular of the Property.

4.4 Impact on the Property

As noted the property shares a common boundary with the proposed site for the project and is therefore susceptible to the potential impacts associated with the Project. The Property and parts of the project area are zoned E3 Environmental Management pursuant to the *Wingecarribee Local Environmental Plan 2010 (LEP)*.

The objectives of the E3 Environmental Management Zone are as follows:

- *To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.*
- *To provide for a limited range of development that does not have an adverse effect on those values.*

- *To encourage the retention of the remaining evidence of significant historic and social values expressed in existing landscape and land use patterns.*
- *To minimise the proliferation of buildings and other structures in these sensitive landscape areas.*
- *To provide for a restricted range of development and land use activities that provide for rural settlement, sustainable agriculture, other types of economic and employment development, recreation and community amenity in identified drinking water catchment areas.*
- *To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Wingecarribee's longer term economic sustainability.*

The Property includes a prize winning Red Angus cattle stud and private golf course, both of which are permissible within the E3 Environmental Management zone.

The land use and activities of the Property are consistent with the objectives of the zone in the sense that it provides for rural settlement, sustainable agriculture and recreation whilst protecting the significant resources and values associated with the land.

The Project, if it proceeds in its current form, will prevent the Property from meeting the objectives of the zone as it has the potential to impact on the sustainable agriculture, recreation and natural resources such as groundwater on site.

Amenity Impact

The objectives of the zone outline that the protection and preservation of the resources and values of the land are important to retain amenity. The Property satisfies these objectives whilst also including improvements such as a private golf course. The Project has the potential to significantly impact on the amenity of the area through factors such as the impact on groundwater. Groundwater is necessary for the area to retain its amenity and for the Property to retain amenity improvements such as the golf course and the operation of the prize winning Red Angus Cattle Stud.

Make Good Guidelines

Currently the New South Wales Department of Primary Industries and Water are drafting make good guidelines in order to outline what strategies and approaches are acceptable for making good on impacts that greater the minimal impact criteria. The Groundwater Assessment submitted by Hume Coal references the Queensland Department of Environment and Heritage Protection's make good provisions for coal and petroleum activities (**Guidelines**) in the absence of New South Wales having any operational guidelines.

The Guidelines require proponents to carry out the following four steps:

1. Undertake individual bore assessments (in accordance with the bore assessment guideline and the baseline assessment guideline);
2. Enter into a legally binding make good agreement;
3. Comply with the agreement; and
4. Negotiate any requested variations to the make good agreement.

The groundwater assessment prepared in support of the Project has identified three private bores on the Property that will experience significant drawdown impacts as a result of the Project. Table 3 in GHD's assessment review at Appendix A indicates is likely to be greater than 46.2m. The groundwater assessment outlines make good provisions for the three bores located on the property which consist of financial compensation for increased pumping costs, repositioning of the pump and/or installation of a new bore. These make good provisions are considered reasonable if the modelling is accurate and a new location for a bore can be located.

Due to the lack of historical groundwater data for the area the current modelling is limited and therefore the risk is more significant. Further assessment of the bores and potential impact of the Project would be required to properly identify the extent of the risk and appropriate make good measures. As previously discussed in our view the precautionary principle is a relevant consideration and the Project has not satisfied this test.

5.0 Site Suitability

The area surrounding the site for the Project relies on primary production that is made possible by the significant agricultural resources. The project has the potential to significantly impact on the resources such as groundwater which will have an adverse effect both socially and economically.

The cattle stud and private golf course rely on groundwater supply to remain viable both financially and socially.

As noted the Project also reduces the ability of the Property to satisfy the objectives of the E3 Environmental Management due to the potential impact on the agricultural resources.

The Project, when compared to other Coalfields in New South Wales, is located in the vicinity of a substantial number of private bores and has an increases potential to adversely impact these bores, potentially resulting in the loss of groundwater completely. Therefore, the Project is not considered suitable in its current location as the potential for environmental impact is too significant.

6.0 Public Interest

The potential environmental impact of the Project is substantial and will have an adverse impact on the area and community whilst the EIS identifies that there will be an economic benefit to the region. In our view, these do not outweigh the long term significant environmental impact the Project will have. Therefore, it is considered that the Project is not in the public's interest.

7.0 Conclusion

The project in its current form is high risk and has the potential to have an adverse impact on groundwater, air quality, acoustics and there is uncertainty about some of these impacts based on the information supplied in the application.

Section 79C of the *Environmental Planning and Assessment Act 1979* provides that in determining a development application, a consent authority is to take into consideration any submissions made in

accordance with the EP & A Act or the regulations. This submission by way of objection sets out below the significant impacts of the Project on our Client's Property at 180-182 Belanglo Road, Sutton Forest.

The Project, if approved, will result in significant impacts for our client which are summarised as follows:

1. The Groundwater Assessment is insufficient as follows

- *“The extent of impact to private landholder bores (including the Crookes property) is considered to be significant when benchmarked against coal mining operations in other coalfields of NSW. This is due to the large number of private bores in the vicinity of proposed underground mining operations as well as the geological and hydrogeological conditions in the area. Efforts have been made to limit this impact, however it remains significant. Should actual groundwater drawdown exceed predicted values, the author questions whether the process of implementing additional make good measures can be managed without interruption to groundwater supplies. The EIS does not detail specific measures to be implemented to avoid interruption to groundwater supplies in the event that actual drawdown exceeds predictions and proposed ‘make good’ measures are inadequate.*
- *The range of predicted drawdown at each bore, based on sensitivity analysis, has not been determined and/or reported. Under some model runs it is possible that groundwater supplies are lost completely.*
- *There is some uncertainty in model predictions due to the lack of historical data on groundwater responses to mining in the region. In all other coalfields in NSW, there are extensive current datasets on groundwater responses to underground mining which can be used to calibrate and/or validate hydrogeological models.”*
- *Watson Park is a commercially viable and well managed cattle stud that has a reliance on water for their operations including an extensive property-wide irrigation scheme. The licensed bores, especially Bore GW GW037851 (Approval 10CA111646) and storage dams are integral parts of the rural operations. Water security is crucial.*
- *Groundwater supplies may be interrupted because there is uncertainty surrounding the modelled drawdown predictions and uncertainty how a commitment regarding additional “make good” measures would be managed. In this regard, if the actual drawdown is greater than the predicted drawdown in the replacement bore and the “make good” measures proposed for the remaining two bores are not suitable, additional “make good” measures should be addressed by the proponent prior to any project approval.”*

2. The Noise and Vibration Assessment is insufficient and lacks critical information to enable a proper and comprehensive assessment. The following is insufficient:

- *Actual measured background noise levels for the property.*
- *Noise contour plots and assessment locations for the Property.*
- *Discussion or explanation to support the claim that noise mitigation measures will satisfy the evening and night noise management levels at all locations.*
- *An assessment of the impacts associated with the construction of the downcast shafts and the associated construction traffic.*

In addition, the Project documentation appears to indicate that coal extraction may occur during the second year of construction. If that is to occur, then the Applicant should provide further acoustical testing and data in relation to the following matters:

- *Noise modelling to consider the coal handling/processing and the construction works happening at the same time;*
 - *The relevant noise criteria which is to apply when both extraction and construction are occurring;*
 - *The hours that will apply to the simultaneous operations; and*
 - *What is the cumulative noise impact for coal handling/processing and construction, acknowledging that the construction noise modelling does not consider meteorological effects.*
3. The Air Quality Impact Assessment identifies a number of observations that are of high significance and have the potential to alter the conclusions as follows:
- *The AQIA does not present cumulative impacts for particulates at the identified receptor locations, as it is required to do following guidance provided in the NSW EPA Approved Methods. Without the predicted cumulative particulate impacts, the level of risk from particulates at the surrounding properties is not determinable.*
 - *The selection and use of 'background' air quality data is questioned. In some instances, the 5-year average concentrations are used in lieu of the contemporaneous values, which potentially distorts the assessment. This data forms an important component of the assessed cumulative impacts, and is a metric to determine the relative receiving capacity and sensitivity of the environment to increased pollutant loads.*
 - *The potential impacts from the construction phase should be assessed at locations on the Hume Highway, as this is proximate to the proposed development site.*
 - *The use of veneering on product stockpiles is questioned, as the additional and removal of material on the stockpile would disrupt the containment and control that might be generated through veneering technologies*

A more extensive assessment would be required to better identify the potential risk of the project on the air quality of the area and in particular of the property.

4. The impact of the proposed development on the Crookes Property in its current form hinders the property's abilities to meet the objectives of the zone as it has the potential to impact on the sustainable agriculture, recreation and natural resources such as groundwater on site.
5. The groundwater assessment has identified three private bores on the property that will experience significant drawdown as a result of the project. The groundwater assessment outlines make good provisions for the three bores located on the property which consist of financial compensation for increased pumping costs, repositioning of the pump and/or installation of a new bore. These make good provisions are considered reasonable if the modelling is accurate and a new location for a bore can be located.

However, due to the lack of historical groundwater data for the area the current modelling is limited and therefore the risk is more significant. Further assessment of the bores and potential impact of the Project would be required to properly identify the risk and inform appropriate make good measures. In our view, the precautionary principle is a relevant consideration and the Project has not satisfied this test.

Thank you for providing the opportunity to comment on the proposed development. Should you wish to discuss any of the details of this submission please do not hesitate to contact me on 0438 398 079 or jeremy@hawesandswan.com.au.

Yours sincerely



Jeremy Swan (B.Ec; Grad Dip Urban & Regional Planning (UNE))
DIRECTOR
Hawes and Swan Planning Pty Ltd



HSI

Hawes & Swan

Town Planning Consultants

Appendix A – Review of Groundwater Assessment

GHD Pty Ltd



26 June 2017

Richard Crookes
Watson Park Pty Ltd
180 Belanglo Road
BELANGLO NSW 2577

Our ref: 2218953-75277
Your ref:

Dear Richard

Hume Coal Project EIS Review of Groundwater Assessment

GHD Pty Ltd (GHD) has undertaken a technical review of the groundwater impact assessment within the Hume Coal Project Environmental Impact Statement (EIS), with a focus on potential groundwater impacts at 180 and 182 Belanglo Road.

1 Background

According to EMM (2017a), Hume Coal Pty Ltd (Hume Coal) is seeking approval for the construction and operation of the Hume Coal Project (the Project). The Project includes an underground coal mine and associated mine infrastructure, located within the Southern Coalfield of NSW. Extraction of Run of Mine (ROM) coal from the Wongawilli Seam at a rate of up to 3.5 million tonnes per annum (Mtpa) is proposed. The proposed project life is 23 years, including approximately two years' construction, 19 years' mining operations and two years' closure and rehabilitation.

Hume Coal has prepared an EIS, which includes an assessment of potential groundwater impacts associated with the Project.

The following documents have been reviewed as part of this review:

- EMM Consulting Pty Ltd (2017a). Hume Coal Project Environmental Impact Statement. Main Report.
- EMM Consulting Pty Ltd (2017b). Hume Coal Project Environmental Impact Statement. Water Impact Assessment Report.
- Coffey (2016a). Hume Coal Project Groundwater Assessment Volume 1: Data Analysis.
- Coffey (2016b). Hume Coal Project Groundwater Assessment Volume 2: Numerical Modelling and Impact Assessment.
- HydroAlgorithmics (2016). Hume Coal Project – Groundwater Impact Assessment Peer Review.
- Mine Advice Pty Ltd (2016). Hume Coal Project Environmental Impact Statement. Subsidence Assessment.
- Larry Cook Consulting Pty Ltd (2015). Aquifer Testing Proposed Production Bore Work Licence No. 10CA119301, Lot 2 in DP1093425 "Yallambee", 180 Belanglo Road Belanglo.

2 Site description

The property at 180 and 182 Belanglo Road (the property) is located within the Belanglo Creek and Wells Creek sub catchments of the Medway Rivulet, which is a tributary of the Wingecarribee River. Medway Dam is located to the north of the property. Site elevations at the property are within the range 650 – 700 m AHD. The property has been developed into a successful Red Angus cattle stud of approximately 200 head.

The property is underlain by Triassic-aged Hawkesbury Sandstone, which extends to a depth of approximately 113 m below ground level (bgl) at the property. The Triassic-aged Narrabeen Group, which occurs extensively throughout the Sydney Basin, including the eastern area of the Southern Coalfield, is absent throughout the Project area and therefore the Hawkesbury Sandstone directly overlies the Permian-aged Illawarra Coal Measures at this location (Larry Cook Consulting, 2015). Borehole logs reported by Larry Cook Consulting (2015) show sandstone in direct contact with coal of the Wongawilli Seam. The Illawarra Coal Measures is underlain by the early Permian-aged Shoalhaven Group.

The Hawkesbury Sandstone is considered to be a highly productive porous and fractured rock groundwater source. In the vicinity of the property, the Hawkesbury Sandstone groundwater source is recharged directly by rainfall throughout outcrop areas and discharges to surface watercourses associated with the Medway Rivulet catchment. Depth to the water table in the vicinity of the property is understood to be approximately 20 – 30 m.

There are three registered bores on the property. Details are provided below in Table 1. All bores intersect the Hawkesbury Sandstone and extract groundwater from water bearing zones within the sandstone. Bore GW115061 extends beyond the Hawkesbury Sandstone, through the underlying Wongawilli Seam and into Permian siltstone. The cattle stud at the property depends on groundwater supplied by these bores.

Table 1 Registered bores at the property

Bore name	Depth (m)	Screen interval (m bgl)	SWL ^(a) (m bgl)	Registered use	Installation date	WAL ^(b) shares
GW115061	128.7	Open hole from 5.2 m	28.4	Irrigation	July 2015	30
GW109918	102	Open hole from 24 m	27	Stock and domestic	Feb 2009	Basic rights
GW037851	78.6	Open hole from 2.4 m	22.8	Stock, domestic and irrigation	May 1973	68

(a) Standing water level at date of installation

(b) Water access licence

3 Review of methodology

The groundwater impact assessment, as reported in EMM (2017b), Coffey (2016a) and Coffey (2016b), provides detail on the hydrogeological data utilised in the assessment and the assessment methodology. Overall the methodology is sound and conforms to standard practice. A groundwater monitoring network has been progressively established by Hume Coal since September 2011. Available hydrogeological data have been used to develop a conceptual hydrogeological model of the region. A three-dimensional numerical hydrogeological model has been developed using MODFLOW-SURFACT Version 3 to predict impacts of the Project on groundwater receptors. The impact assessment has been undertaken in accordance with the NSW Aquifer Interference Policy (AIP).

3.1 Data limitations

Although Hume Coal has undertaken hydrogeological monitoring and testing since 2011, historical groundwater monitoring in this area of the Southern Coalfield is limited. Since there are no active mines in the area, and the majority of previous mining operations have been small and/or commenced many years ago, there is a lack of data regarding the hydrogeological responses to mining. In all other coalfields in NSW, there are extensive current datasets on groundwater responses to underground mining which can be used to calibrate and/or validate hydrogeological models.

It is understood that mining was undertaken at Berrima Colliery to the north of the Project area between 1926 and 2013, however the available groundwater level data, as reported in Coffey (2016a), only covers the last few years of mining between 2008 and 2013. No monitoring of groundwater drawdown was undertaken during the majority of coal extraction at Berrima, including the first workings. The available data indicate that there has been drawdown of the groundwater source above the Berrima Colliery workings, however provides no indication of the magnitude of drawdown and the relative contributions of first workings and secondary extraction to the drawdown.

Overall, this lack of historical data is considered to increase uncertainty in model predictions.

4 Discussion of potential impacts

The most significant groundwater impact identified in the EIS is drawdown of private landholder bores. Impacts to groundwater quality and Groundwater Dependent Ecosystems (GDEs) are assessed in the EIS to be minimal and are not discussed further in this review.

4.1 Overall impacts to private bores

According to EMM (2017b), it is predicted that 93 private landholder bores (excluding bores owned by Hume Coal) will experience a groundwater drawdown of greater than 2 m due to the Project. A total of 109 bores (excluding bores owned by Hume Coal) are predicted to experience a drawdown of greater than 2 m due to the cumulative impacts of the Project combined with landholder pumping and Berrima Colliery. It is predicted that the average duration of drawdown (greater than 2 m) due to the Project in the 93 affected bores is 36 years, with a maximum duration predicted to be 65 years.

In comparison to mining operations in other coalfields of NSW, the predicted impact of the Project on private landholder bores is significant. Table 2 provides details on predicted impacts on private

landholder bores from a selection of other current (and future) mining operations in NSW. From the author's experience, this is considered to be representative of the typical impacts from other operations.

Table 2 Predicted impacts on private bores from other coal mines in NSW

Mine	Coalfield	Type / Method	Private bores identified ^(a)	Private bore drawdown (m)	Source
Airly	Western	Underground (first and second workings)	35	Nil	GHD (2014) ^(b)
Bylong	Western	Open cut and underground	84	< 2 m	AGE (2015) ^(c)
Bengalla	Hunter	Open cut	76	< 2 m	AGE (2013) ^(d)
Mandalong	Newcastle	Underground (longwall)	28	< 2 m	GHD (2013) ^(e)
Chain Valley	Newcastle	Underground (first and second workings)	15	< 1 m	GeoTerra (2013) ^(f)

(a) Private bores identified typically within a 3-5 km radius from mine workings. Excluding monitoring bores

(b) GHD (2014) Airly Mine Extension Project Groundwater Impact Assessment

(c) AGE (2015) Bylong Coal Project Groundwater Impact Assessment

(d) AGE (2013) Continuation of Bengalla Mine Groundwater Impact Assessment

(e) GHD (2013) Mandalong Southern Extension Project Groundwater Impact Assessment

(f) GeoTerra (2013) Chain Valley Colliery Mining Extension 1: Groundwater Assessment

It is acknowledged that effort has been made by Hume Coal to limit the groundwater impact, including designing the mine workings to avoid deformation of the overburden and proposing to reinject mine water into sealed voids to reduce the groundwater recovery time. However, two factors that distinguish the Project from many other current underground coal mining operations throughout NSW, and hence result in this high level of impact, are:

- Large number of private landholder bores in the vicinity of the Project area (considerably more than the sites included in Table 2).
- Geological and hydrogeological environment, such that there is direct connection between the primary groundwater source and the mine workings. Consequently the drawdown impacts on landholder bores are larger for the Project compared to the sites shown in Table 2.

4.2 Impacts on bores at the property

Coffey (2016b) provides drawdown predictions for the three registered bores at the property. Drawdown predictions for the bores at the property are outlined in Table 3. It is noted that bore GW037851 will be directly undermined by mine workings whereas the other two bores are located slightly to the north of the underground mine working footprint.

As shown in Table 3, drawdown of up to 46.2 m due to the Project is predicted. Additional drawdown of approximately 1 m is predicted when considering cumulative impacts due to landholder pumping and Berrima Colliery. Drawdown at each bore is predicted to exceed the AIP threshold of 2 m within 1 year.

Table 3 Predicted impacts on registered bores at the property^(a)

Bore name	Maximum drawdown (m)	Time to maximum (yrs)	Time to 2 m drawdown (yrs)	Time to recovery to < 2 m (yrs)	'Make good' provision
GW115061	21.1	11.0	1.1	37.1	Lower pump
GW109918	27.3	11.0	1.1	39.3	Lower pump
GW037851	46.2	11.0	1.0	41.1	Replace bore

(a) Predicted impacts due to the Project only. Cumulative impacts are not included in this table, although Coffey (2016b) notes that 97% of drawdown at these locations is due to the Project

Coffey (2016b) indicates that some sensitivity analysis was undertaken on modelled drawdown predictions. However the results of this sensitivity analysis has not been reported. It is common practice to report a range of values for model predictions based on the results of the sensitivity analysis. This issue was also raised by Dr Noel Merrick in his independent peer review of the hydrogeological model (HydroAlgorithmics, 2016). It is possible that some modelled predictions may show a complete loss of water from the bores on the property as well as from many other private landholder bores.

The 'make good' actions proposed by Hume Coal include financial compensation for increased pumping costs, repositioning of the pump and/or installation of a new bore. It is understood that the actions proposed by Hume Coal for the bores at the property are yet to be verified through a site investigation and, in the case of GW037851, it is not yet know whether a suitable alternative site can be found. Overall, considering the limited historical data (as reported earlier) and the limited sensitivity analysis on groundwater drawdown predictions, it is considered that there is uncertainty with regards to the reported model predictions and it is possible that the drawdown may be greater than predicted.

EMM (2017b) notes that if drawdown in landholder bores is significantly larger than predicted, then Hume Coal will consider if additional make good measures should apply. It is acknowledged that the detail of this process would be included in a Groundwater Management Plan (GMP) rather than in the EIS, however the author is uncertain how such a commitment will be managed so that groundwater supplies are not interrupted. Considering the number of affected bores and the time to undertake investigations

and then develop additional supplies, it is highly likely that groundwater supplies will be interrupted should drawdown be greater than predicted and the proposed 'make good' measures are shown to be inadequate.

5 Conclusion

The groundwater impact assessment of the Hume Coal Project has been reviewed, with particular focus on potential impacts at the property (180 and 182 Belanglo Road, Belanglo). The property has been developed into a successful Red Angus cattle stud of approximately 200 head and depends on the groundwater supplied by the existing bores. The assessment methodology is considered to be sound and in accordance with the AIP.

A number of key issues have been identified with regards to the impact predictions:

- The extent of impact to private landholder bores is considered to be significant when benchmarked against coal mining operations in other coalfields of NSW. This is due to the large number of private bores in the vicinity of proposed underground mining operations as well as the geological and hydrogeological conditions in the area. Efforts have been made to limit this impact, through mine design and proposed injection of mine water into voids, however it remains significant. Should actual groundwater drawdown exceed predicted values, the author questions whether the process of implementing additional make good measures can be managed without interruption to groundwater supplies. The EIS does not detail specific measures to be implemented to avoid interruption to groundwater supplies in the event that actual drawdown exceeds predictions and proposed 'make good' measures are inadequate.
- The range of predicted drawdown at each bore, based on the sensitivity analysis, has not been determined and/or reported. Under some model runs it is possible that groundwater supplies are lost completely however this has not been reported.
- There is some uncertainty in model predictions due to the lack of historical data on groundwater responses to mining in the region. In all other coalfields in NSW, there are extensive current datasets on groundwater responses to underground mining which can be used to calibrate and/or validate hydrogeological models.

Sincerely
GHD Pty Ltd



Stuart Gray
Principal Hydrogeologist
+61 2 4979 9017

Appendix B – Review of Groundwater Assessment

Larry Cook Consulting Pty Ltd

Larry Cook Consulting Pty Ltd

(ABN 27 159 132 055)

PO Box 8146 Tumby Umbi NSW 2261

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15th June 2017

Ref:15134-B

Watson Park Pty Ltd
180 Belanglo Road
BELANGLO NSW 2577

Re: **Review of EMM Groundwater Assessment Relevant to Lots 1 and 2 DP1093425 180-182 Belanglo Road Belanglo (Watson Park) Environmental Impact Assessment - Hume Coal Project**

1. INTRODUCTION AND BACKGROUND

Hume Coal Pty Ltd (**Hume Coal**) proposes to construct and operate an underground coal mine within the Southern Coalfield. The target resource is the Wongawilli Seam which extends under a large part of Watson Park. Hume Coal is seeking approval from the state government for a proposed project life of 23 years with a maximum annual extraction rate of 3.5 million tonnes. In this regard, EMM Consulting has prepared an Environmental Impact Assessment (**EIS**) for Hume Coal. The EIS incorporates a detailed Groundwater Impact Assessment which addresses potential groundwater impacts associated with the proposed underground extraction of coal. The Wongawilli Seam beneath Watson Park is at an average depth of approximately 111 m below ground level. Watson Park comprises two adjoining parcels of rural land; Lots 1 and Lot 2 in DP1093425. The locations of Lots 1 and 2 are shown in **Figure 1**.

Stuart Gray, principle hydrogeologist with GHD Pty Ltd (**GHD**) was recently commissioned by Watson Park Pty Ltd to carry out a detailed review of the Groundwater Impact Assessment in the EIS relevant to Watson Park.

Larry Cook, principle hydrogeologist with Larry Cook Consulting carried out groundwater exploration over Watson Park in 2015 incorporating test drilling and aquifer testing in a newly constructed bore on Lot 2 in 2015. A description of the geology and hydrogeological setting including details of registered bores on Watson Park and immediately surrounding area, and results of aquifer testing are documented in the aquifer testing report dated 10th November 2015 (Rep. 15134-A).

Larry Cook Consulting has been engaged to prepare a report addressing the following:

- (a) geological and hydrogeological conditions beneath Watson Park,
- (b) details of the property bores on Watson Park, drawdown impacts predicted from the computer groundwater model developed for Hume Coal by Coffey, and
- (c) assessment of "make good" provisions presented by Hume Coal.

A resume for Larry Cook is provided in **Appendix B**.

2. DOCUMENTS REVIEWED

The following documents were reviewed:

- EMM Consulting Pty Ltd (2017a). Hume Coal Project Environmental Impact Statement. Main Report.
- EMM Consulting Pty Ltd (2017b). Hume Coal Project Environmental Impact Statement. Water Impact Assessment Report.
- GHD Pty Ltd (2017). Hume Coal Project EIS Review of Groundwater Assessment. Ref. 2218953-89591. 22 June 2017.

3. GEOLOGY

The district is largely underlain by Triassic Hawkesbury Sandstone which consists of a moderately thick sequence of flat lying interbedded massive and cross-bedded (sheeted) medium to coarse grained quartz sandstone with occasional interbeds and lenses of shale. (Geological Survey New South Wales (1966), Mason (1995), NSW Department of Mineral Resources (1999), McKibben, D. and Smith, P. (2000), Lee J. and Cook L. (2005), Larry Cook & Associates & Groundwater Data Collection Services (2008), Geological Survey New South Wales (2010), Larry Cook Consulting (2015). The average thickness of the Hawkesbury Sandstone beneath Watson Park determined by drilling is approximately 111 m. The sandstone directly and unconformably overlies the Permian Illawarra Coal Measures, in particular the Wongawilli Seam. A schematic geological cross section is presented in **Figure 2**.

4. HYDROGEOLOGY

Water-bearing zones (aquifers) are commonly developed within the Hawkesbury Sandstone in the Southern Highlands at different elevations down to the base of the unit. The aquifers are generally highly productive and recharged directly from local rainfall. The depth to the water table beneath Watson Park is between 20 and 30 m below ground level.

Published and unpublished results of groundwater studies and investigations in the Hawkesbury Sandstone in the Southern Highlands area (McKibben, D. and Smith, P. (2000), Lee J. and Cook L. (2005), indicate that aquifers hosted by the Hawkesbury Sandstone are found in two main occurrences.

- Sub-horizontal relatively porous and stacked layers (beds) of sheeted sandstone with increased primary permeability (in contrast to less permeable interbedded massive "tight" sandstone units, and shale) (**Figure 2**). These primary aquifers are considered to be "semi confined" and "leaky". These aquifers provide the main aquifer storage and are characterised by variable yields.
- Pervasive sub-vertical, semi-continuous to continuous, rock defects such as fractures and joints with secondary „enhanced“ permeabilities (**Figure 2**). Fracture controlled sandstone aquifers provide relatively moderate to occasionally high yields which, in some areas, can be up to between 5 and 20 times the average yield for the regional system.

5. REGISTERED BORES ON WATSON PARK

Three registered bores are located on Watson Park, the locations of which are shown in **Figures 3 and 4**.

A summary of the bore and licensing details and the information for each registered work is presented in **Table 1**. The location of Bore GW109918 (shown in the state government (DPI Water) charting) has been changed to reflect the actual position in Lot 2.

Table 1 Summary Details of Registered Bores									
Bore, Approval, License	Authorised Purpose	Coordinates (m MGA)		Depth (m)	Date Drilled	Aquifers/ Yield	Water Level (m)	Water Quality	Bore Geology
		E	N						
GW037851 10CA111646 'Werona' Lot 1 DP746773	I 68 ML	248939	6176253	78.6	May 1973	29.2 – 29.8 (0.03 L/s) 32.6 – 32.9 (0.04 L/s) 35.9 – 36.5 (2.2 L/s) 50.5 – 52.6 (6.57 L/s) 72.8 – 52.6 (2.53 L/s)	22.8	nil	0.0 – 1.5 Soil/clay 1.5 – 6.7 S/S 6.7 – 9.1 Sh 9.1 – 10.7 S/S 10.7 – 15.2 Sh 15.2 – 72.5 S/S 72.5 – 72.9 Sh 72.9 – 78.6 S/S
GW115061 10BL164774 'Yallambee' Lot 2 DP1093425	I 30 ML	249123	6176619	128.7	Jul 2015	45.0 – 46.0 (3.20 L/s) 67.5-68.5 (1.5 L/s) 85.3-86.3 (1.55 L/s) 108.0-109.0 (0.4 L/s)	23.0	nil	0.0 – 2.0 Soil 2.0 – 4.0 Sh 4.0.0 – 113.0 S/S 113.0 – 123.0 C/Sh 123.0 – 128.7 Silt
GW109918 10WA111493 'Yallambee' Lot 2 DP1093425	Basic Rights (S & D)	248655	6176488	102.0	Feb 2009	30.0 – 31.0 (0.08 L/s) 83.0 – 84.0 (0.25 L/s) 95.0 – 96.0 (2.45 L/s)	27.0	nil	0.0 – 4.0 Soil/clay 4.0 – 33.0 S/S 33.0 – 34.0 Bas 34.0 – 39.0 Sh 939.0 – 96.0 S/S 96.0 – 99.0 Sh 99.0 – 102.0 S/S

Kind of Approval for Production Bores:
Work Type:
Groundwater Management Zone:

Water Supply Works and Water Use
Extraction Works Groundwater
Nepean Management Zone 1

6.
Notes:

S	Stock	µS/cm	microsiemens per centimetre
D	Domestic	L/s	Litres per second
I	Irrigation	N/A to WSP	Not subject to Water Sharing Plan
S/S	Sandstone	mg/L	Milligrams per litre
Sh	Shale		
C	Coal		
Silt	Siltstone		

It is noted that a fourth bore is located on Watson Park. This bore is an historic "wind mill" located in Lot 1, the location of which is shown in **Figures 3 and 4**.

Production water extracted from Bore GW037851 is approved for irrigation purposes (10CA111646 - 68 ML/annum) and used to operate an extensive irrigation scheme across both lots 1 and 2. The existing operational irrigation network is annotated in **Figure 5**. The principle components are listed in **Table 2**.

Table 2 Summary Irrigation Elements	
Irrigation Element	Number
Irrigation Connections	34
Sprinkler Heads	5
Cattle Troughs	8
Dams	Several

6. WATER SHARING PLAN

Watson Park is located within the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources. The groundwater source hosting the Site is the Sydney Basin Nepean Groundwater Source within Nepean Management Zone 1.

7. AQUIFER INTERFERENCE POLICY

Introduction

The NSW Aquifer Interference Policy (AIP) was released in September 2012. The AIP provides an explanation of the water licensing and impact assessment processes for aquifer interference activities under the *Water Management Act 2000* and other relevant legislation.

Minimal Impact Considerations

The groundwater source in the area centred on the proposed coal extraction, as determined from Section 3.2.1 of the AIP for the Greater Metropolitan Region Groundwater Sources - Management Zone 1 is "**Porous and Fractured Rock Groundwater Sources (general)**". The category of the groundwater sources documented in the Greater Metropolitan Region Groundwater Sources- Management Zone 1 is "**Highly Productive**".

The maximum impact on the water table in Management Zone 1 is considered acceptable in the AIP if it is less than 2 m cumulative water level decline. The AIP indicates that water decline levels greater than 2 metres require "make good" provisions.

8. PREDICTED IMPACTS ON WATSON PARK BORES

The most significant potential impact from coal extraction in the district, identified in the EIS, is on private landholder bores. The groundwater impact assessment prepared by EMM (2017b) predicts that the water table in 93 private landholder bores will experience a drawdown greater than 2 m which exceeds the maximum acceptable impact documented in the NSW Aquifer Interference Policy (AIP). The average predicted duration of drawdown greater than 2 m for these affected landholder bores is 36 years.

The three registered bores on Watson Park will be significantly impacted by the proposed coal extraction. The groundwater computer model predicts a maximum drawdown of the water table of 46.2 m in Bore GW037851 located on Lot 1. Bores GW115061 and GW109918 on Lot 2 will experience maximum drawdowns of between 21.1 and 27.3 m. It is noted that Bore GW037851 will be directly undermined by the

proposed coal extraction operations.

The predicted time for the water table in the three bores to drop more than 2 m is approximately 1 year reaching maximum impact in 11 years. The magnitude of these impacts significantly exceeds the maximum acceptable impact documented in the AIP.

9. MITIGATION OF ANY IMPACTS TO ON-SITE BORES

In accordance with accepted practice in past projects of this nature, the following "Make Good" provisions are available to Hume Coal (the proponent):

- Supply groundwater supplies to the property/s with a minimum flow equivalent to the measured and documented losses with water quality commensurate with the present bore supply, or better.
- Deepen the affected bore, if feasible.
- Drill a new test bore for the owner in order to replace or improve the bore yield of the existing registered bore. The water quality must be similar to the existing bore water quality or suitable for the intended purpose.
- Lower the pump, if suitable.
- Agree to another arrangement mutually acceptable to the property owner and the Applicant.

It is noted that the proponent has assessed the magnitude of the drawdown in the three registered property bores on Lots 1 and 2 and proposed the following "Make Good" provisions listed in **Table 3**.

Table 3 "Make Good" Provisions			
Bore	Location	Maximum Drawdown (m bgl)	"Make Good" Provision
GW037851	Lot 1 DP1093425	46.2	Replace bore
GW109918	Lot 2 DP1093425	27.3	Lower pump
GW115061	Lot 2 DP1093425	21.1	Lower pump

bgl: below ground level

A review of the groundwater impact assessment in the EIS (EMM Consulting Pty Ltd (2017b)), review of the results of the computer groundwater model documented in the EIS and a review of the results documented in the GHD report (GHD, 2017) was undertaken. The reviews reveal the following:

- Historical groundwater monitoring in this part of the Southern Coalfield is considered limited. Although Hume Coal commenced dedicated in-house hydrogeological monitoring and testing in the region in 2011, there is considered to be a lack of historic data, in particular any regional data on

hydrogeological responses to coal extraction.

- Drawdown of the water table in each of the three bores is predicted to exceed the AIP threshold of 2 m in one year following commencement of coal extraction.
- The computer groundwater model developed by Coffey (Coffey, 2016b) indicates that some sensitivity analysis was carried out on the modelled drawdown predictions. However, the results of the analysis are not fully documented.
- An independent peer review of the computer groundwater model by Dr. Noel Merrick (HydroAlgorithmics, 2016) also noted the limited sensitivity analysis.
- GHD report that the implication of the limited sensitivity analysis and considered lack of historic hydrogeological data is that 'it is possible that some modelled predictions may show a complete loss of water from the bores on the property...'. Larry Cook Consulting concurs with this assessment.

There remains uncertainty regarding predictions of drawdown. It is therefore possible that the actual drawdown may be greater than predicted. A review of the distribution of water table drawdown in Figure 7.9 (page 174) in Volume 1 of the EIS entitled The Extent of Project Impact Water Table Drawdown – Year 17 suggests that anisotropic hydrogeological conditions may exist. The apparent heterogeneity supports the thesis that the actual drawdown could be greater than predicted.

EMM (2017b) state that if drawdown in landholder bores is significantly greater than predicted, then Hume Coal will consider if additional "make good" measures should apply. It is considered that such additional measures would be incorporated in a Groundwater Management Plan.

GHD (2017) note that groundwater supplies may be interrupted because there is uncertainty how such a commitment regarding additional "make good" measures would be managed. The implication is that developing additional supplies for such a large number of potentially affected bores in the district will likely result in the interruption of water supplies.

10. "MAKE GOOD" PROVISIONS

The "make good" provisions proposed by EMM for each of the three affected property bores are discussed in the following sections.

10.1 BORE GW037851 (10CA111646)

The "make good" measure proposed by EMM is "**Replace Bore**". A profile of Bore GW037851 (10CA111646) with annotated geological, groundwater and drawdown information is shown in **Appendix A**.

The following information and comments are provided:

- The bore was terminated at a depth of 78.64 m below ground level.

- The water table was measured at 22.80 m below ground level in 1973 following completion of drilling.
- Five aquifers were intersected between 29.2 m and 78.5 m depth. The aggregate yield from indicative "air lift" testing following drilling was estimated at 13.7 L/s.
- The maximum predicted drawdown of the water table is 46.2 m.
- The predicted maximum impact from proposed coal extraction will dewater four of the five aquifers which accounts for 64% of the bore yield. The maximum drawdown level is approximately 3 m above the lowermost aquifer.
- As previously documented in this report, water extracted from this bore is used to operate an extensive irrigation scheme across both lots 1 and 2.
- Although the base of the bore is approximately 41.40 m above the predicted depth of the Wongawilli Seam and, according to the model, the lowermost aquifer remains saturated, the uncertainty of the drawdown predictions indicates that this bore may be effectively dewatered as a consequence of the proposed coal extraction operations.
- In this regard, the predicted significant reduction in hydraulic head and bore yield will effectively negate its use as an effective irrigation bore and will not be suitable to "drive" the existing irrigation scheme that is presently connected to it.
- EMM proposes the replacement of this bore. Presumably this implies the sinking and construction of a new bore elsewhere on Watson Park.
- Although this proposal is considered reasonable and plausible, a new location would likely be in an area that minimises drawdown from the proposed coal extraction. The long term and safe yield of a successful new bore should be equal to, or greater than, the aggregate yield in the existing bore (13.7 L/s) taking into account the predicted drawdown at the new location.

Consideration must be also given to the on-going operation of the existing irrigation scheme and the infrastructure required to connect any new water supply from a successful new bore.

A new bore would be subject to an *Application for Approval for Water Supply Works and/or Water Use* under Section 92 of the Water Management Act 2000. If the groundwater exploration is successful, subject to aquifer testing, the water entitlement attached to the existing bore can be transferred to the license (WAL) created for the new bore.

The implications of the success of a new bore are considered to be:

- the uncertainty associated with the predicted maximum drawdown at the new bore location. That is, if the actual drawdown is significantly greater than the predicted maximum drawdown at this location, what will be the additional "make

good" measures; and

- the "lead in" time likely required to replace the water supply that is presently connected to the irrigation scheme. The implication is that developing additional supplies for such a large number of potentially affected bores in the district will likely result in the interruption of the water supply in this bore.

It is considered that, due to the uncertainty of the model predictions for the reasons documented in Section 10, such measures need to be addressed by the proponent prior to any project approval.

10.2 BORE GW109918 (10WA111493)

The "make good" measure proposed by EMM is "**Lower Pump**". A profile of Bore GW109918 (10WA111493) with annotated geological, groundwater and drawdown information is shown in **Appendix A**.

The following information and comments are provided:

- The bore was terminated at a depth of 102.0 m below ground level.
- The water table was measured at 27.00 m below ground level in 2009 following completion of drilling.
- Three aquifers were intersected between 30.0 m and 96.0 m depth. The aggregate yield from indicative "air lift" testing following drilling was estimated at 2.5 L/s.
- The maximum predicted drawdown of the water table is 27.3 m.
- The predicted maximum impact from proposed coal extraction will dewater the uppermost aquifer of the three aquifers.
- The bore is licensed Basic Rights.
- The base of the bore is approximately 20.0 m above the predicted depth of the Wongawilli Seam and, according to the model, the two lower aquifers that constitute almost 100% of the available water remain saturated.
- EMM proposes the lowering of the pump. Presumably this implies the lowering of the electro-submersible pump in the bore so that suitable available drawdown and bore yield is maintained. The long term and safe yield of this Basic Rights bore should be equal to, or greater than, the aggregate yield in the existing bore (2.5 L/s).
- Although lowering the pump is considered reasonable and plausible, the uncertainty of the previously discussed drawdown predictions indicates that the actual drawdown may be greater than the predicted maximum drawdown.
- It may be feasible to deepen the bore by approximately 18.0 m, 2 m above the Wongawilli Seam. However, prospects for additional aquifers

are unknown. The prospects for additional groundwater supplies in the underlying Permian sedimentary sequence are considered to be poor, based on historic water well drilling elsewhere in the district.

- It is understood that the pump currently installed in the bore is positioned above the lowermost, most productive, aquifer close to the base of the bore to maximise the available drawdown.
- It is considered that, due to the uncertainty of the model predictions for the reasons documented in Section 10, additional "make good" measures need to be addressed by the proponent prior to any project approval.

10.3 BORE GW115061 (10CA119301)

The "make good" measure proposed by EMM is "**Lower Pump**". A profile of Bore GW115061 (10CA119301) with annotated geological, groundwater and drawdown information is shown in **Appendix A**.

The following information and comments are provided:

- The bore was terminated at a depth of 128.70 m below ground level.
- The water table was measured at 28.42 m below ground level in 2015 following completion of drilling.
- Four aquifers were intersected between 45.0 m and 109.0 m depth. The aggregate yield from indicative "air lift" testing following drilling was estimated at 6.7 L/s.
- The maximum predicted drawdown of the water table is 21.1 m.
- The predicted maximum impact from proposed coal extraction will dewater the uppermost aquifer of the four aquifers.
- The bore is licensed Irrigation.
- The base of the bore is approximately 16.0 m below the Wongawilli Seam with backfill placed to above the seam following drilling. According to the model, the uppermost aquifer that constitutes approximately 48% of the bore yield will be lost as a consequence of proposal coal extraction.
- EMM proposes the lowering of the pump. Presumably this implies the lowering of the electro-submersible pump in the bore so that suitable available drawdown and bore yield is maintained. The long term and safe yield of this licensed irrigation bore should be equal to, or greater than, the aggregate yield in the existing bore (6.7 L/s).
- Lowering any bore pump is not considered feasible for the following reasons:
 - The main aquifer is the uppermost aquifer that will be dewatered.

- The aggregate bore yield (6.7 L/s) cannot be achieved.
- There are no prospects of deepening the subject bore because the base of the bore is below the Wongawilli Seam and prospects for additional groundwater supplies in the underlying Permian sedimentary sequence are considered to be poor, based on historic water well drilling elsewhere in the district.

It is considered that other "make good" measures need to be addressed by the proponent prior to any project approval to supply this volume.

11. CONCLUSIONS

- Watson Park is directly underlain by Triassic Hawkesbury Sandstone which in this area directly overlies the Wongawilli Seam. The depth to the Wongawilli Seam is approximately 111 m.
- Water-bearing zones (aquifers) are commonly developed within the Hawkesbury Sandstone at different elevations. The aquifers are generally highly productive. The depth to the water table beneath Watson Park is between 20 and 30 m below ground level.
- Three registered bores are located on Watson Park. Two of the bores are licensed for irrigation and one is a Basic Rights bore. A wind mill is also located on the property.
- Production water extracted from Bore GW037851 (10CA111646 - 68 ML/annum) is used to operate an extensive irrigation scheme across Watson Park.
- The most significant potential impact from proposed coal extraction in this area, identified in the EIS, is on private landholder bores. The maximum impact on the water table considered acceptable in the AIP is less than 2 m cumulative water level decline unless "make good" provisions.
- The three registered bores on Watson Park will be significantly impacted by the proposed coal extraction. The groundwater computer model predicts that maximum drawdown of the water table of 46.2 m will occur in Bore GW037851 located on Lot 1. Bores GW115061 and GW109918 on Lot 2 will experience maximum drawdowns of between 21.1 and 27.3 m. Irrigation bore GW037851 (68 ML) will be directly undermined by the proposed coal extraction operations.
- The predicted time for the water table in the three bores to drop more than 2 m is approximately 1 year reaching maximum impact in 11 years. The magnitude of these impacts significantly exceeds the maximum acceptable impact documented in the AIP.
- There is considered to be a lack of historic groundwater monitoring data in particular any regional data on hydrogeological responses to coal extraction. There is also considered to be limited sensitivity analysis. There remains uncertainty regarding predictions of drawdown with the

possibility that the actual drawdown may be greater than predicted. It is therefore possible that there may be a complete loss of water from one or more bores on Watson Park.

- A review of the drawdown extents suggests that anisotropic hydrogeological conditions may exist. The apparent heterogeneity supports the thesis that the actual drawdown could be greater than predicted
- The proponent proposes "Make Good" provisions as follows:
 - Replace irrigation bore GW037851
 - Lower the pump in bores GW115061 and GW109918

In summary, it is apparent that Watson Park is a commercially viable and well managed cattle stud that has a reliance on water for their operations including an extensive property-wide irrigation scheme. The licensed bores, especially Bore GW GW037851 (Approval 10CA111646) and storage dams are integral parts of the rural operations. Water security is crucial.

Groundwater supplies may be interrupted because there is uncertainty surrounding the modelled drawdown predictions and uncertainty how a commitment regarding additional "make good" measures would be managed. In this regard, if the actual drawdown is greater than the predicted drawdown in the replacement bore and the "make good" measures proposed for the remaining two bores are not suitable, additional "make good" measures should be addressed by the proponent prior to any project approval.

12. CLOSURE

Please do not hesitate to contact Larry Cook on 0428 884645 if you have any questions or you require further information.

For and on Behalf of
Larry Cook Consulting

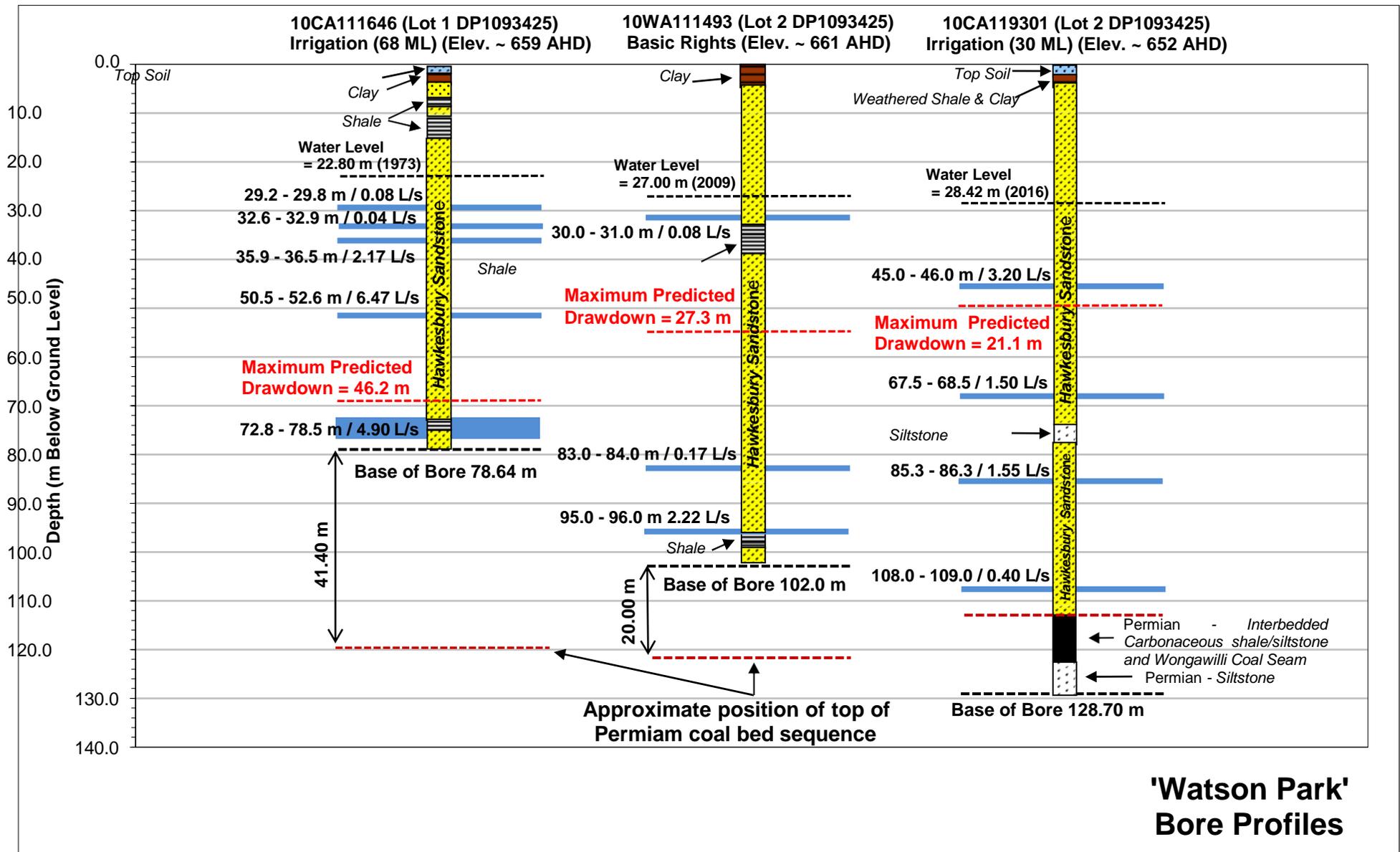


Larry Cook
Hydrogeologist

Attachments: Appendix A - Bore Figures
Appendix B - Resume
Figures 1 to 5
References

APPENDIX A

BORE PROFILES



APPENDIX B

Resume - Larry Cook

Larry Cook

PO Box 8146 Tumbi Umbi NSW 2261

SUMMARY RESUME

LARRY LESLIE COOK

SUMMARY CAREER DESCRIPTION

Larry's early career enjoyed a continuous working life as a professional geoscientist in the Australasian mineral exploration industry culminating in senior exploration management positions for several Australian and multinational exploration and mining companies and later as a geological consultant up until 1995.

Since the mid 1990s Larry has, and continues to work as a hydrogeological, environmental and geological consultant. The hydrogeological consultancy is largely in groundwater exploration and field and office-based hydrogeological assessment and management in a diverse range of hydrogeological settings. The hydrogeological consultancy also includes preparation of independent expert hydrogeological reviews for private organisations and state government agencies, and expert witness services.

Geological consultancies include several resource assessments for the mineral industry and extractive industry. Many of these are linked with hydrogeological investigations and assessments, and assessments of water quality, and any potential environmental impacts from water contamination.

Environmental consultancies including soil, surface water and groundwater contamination investigations and assessments were undertaken during my two-year senior staff position as Manager for Groundwater and Environmental Services for *Brink & Associates*, carried out as part of contractual work for leading NSW hydrogeological consultancies *C.M. Jewell & Associates* and *Hydroilex*, and numerous contractual engagements through *Larry Cook Consulting*.

CONTACT DETAILS

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QUALIFICATIONS

- Master of Applied Science Degree in Hydrogeology and Groundwater Management, University of Technology, Sydney. Conferred in 1998.
- Master of Science Degree in Mining and Exploration Geology, James Cook University of North Queensland (to be conferred).
- Bachelor of Science Degree (Geology) with Honours N.S.W.I.T. 1977.

SPECIAL EXPERTISE

- Groundwater Exploration and Management
- Groundwater Impact Assessments
- Bore Development Design
- Groundwater Computer Modelling
- Conceptual Hydrogeological Modelling and Borefield Assessment
- Soil and Water Environmental Assessments and Groundwater Environmental Impact Assessments
- Groundwater Sampling, Water Quality (environmental) Testing and Hydrogeochemical Classification
- Pump Test Design and Implementation, Aquifer Testing and Assessment, Assessment of Safe & Sustainable Bore Yields, Bore and Pump Design, Monitoring Bore Design and Installation, Production Pumping Schedule Design, Assessment of Potential Interference Effects, Water Bore Licensing.
- Independent Expert Hydrogeological reviews for private organisations and state government agencies
- Expert Witness services relating to hydrogeology and geology
- Ground Geophysical Surveys for Environmental Assessments (contamination plume mapping) and Groundwater Exploration including data processing and interpretation
- Bore Geophysical logging and interpretation including Gamma, Self Potential, Single Point Resistance, Electrical Conductivity, Temperature and Caliper
- Mineral Exploration Design, Implementation and Management.
- Wastewater Management
- Conceptual Geological Modelling.

SUMMARY EMPLOYMENT HISTORY

- 2004-current Consulting Hydrogeologist, Environmental Scientist and Geologist.
Larry Cook & Associates Pty Ltd and since 2012, **Larry Cook Consulting Pty Ltd**
- Environmental assessments and detailed hydrogeological, environmental and geological investigations, groundwater environmental impact assessments, groundwater resource assessments, groundwater monitoring network design and installations for private organisations and government departments. Independent hydrogeological reviews. Mineral exploration, extractive and mineral industry assessments, private and commercial wastewater management investigations and management plans,

environmental assessments.

Includes:

Major ongoing long-term hydrogeological consultancy for *Dubbo Shire Council. Baseline* and quarterly water level monitoring, groundwater sampling, water quality (environmental) testing and assessment, on-going comparison with published current guideline values for indicator analytes – Large-scale Council owned Wastewater Irrigation Projects near Dubbo, NSW.

Numerous environmental site assessments at different levels of investigation for mainly small-scale sites for assessment of potential hydrocarbon, heavy metal, pesticide and asbestos contamination in soils. Includes Phase I Preliminary and Phase II detailed environmental site assessments for proposed land sub-divisions in NSW, commercial businesses in Gosford and Mangrove Mountain and rural contamination projects.

Numerous water quality (environmental) testing and environmental monitoring for groundwater impact assessments associated with many hydrogeological assessments. Comparison with published current guideline values for indicator analytes

Major ongoing consultancy incorporating multi-level monitoring bore design, piezometer installation, water level and water quality monitoring and reporting for *Wyang Areas Coal Joint Venture* near Wyong NSW (Wallahah II). Comparison with published current guideline values for indicator analytes

Major ongoing hydrogeological consultancy for town water supply exploration and assessment project for *Gosford-Wyong Councils Water Authority*, central coast NSW. Involves groundwater exploration and target selection, test drilling, geophysical bore logging and interpretation, conceptual hydrogeological modelling, borefield design, borefield assessment and regular liaison with local government and state government agencies. Incorporates test drilling, pump test design and implementation, aquifer testing and assessment, determination of long-term safe & sustainable bore yields, bore and pump design, monitoring bore design and installation of monitoring network, production pumping schedule design, assessment of potential interference effects, groundwater sampling, water quality (environmental) testing with comparison with published current guideline values for indicator analytes and hydrogeochemical classification.

Collaborative hydrogeological investigations and reporting for *Wyang Areas Coal Joint Venture* re preparation of an EA for a proposed major underground coal mining development near Wyong NSW (Wallahah II).

Baseline regional hydrogeological assessment, reporting and ongoing water level monitoring in a network of monitoring bores for *Centennial Coal* and *Blue Circle* at Berrima Collier near Medway, Southern Highlands, NSW.

Major industrial groundwater supply assessment for *Airly Coal Project* at Capertee in Western Coalfields near Mudgee NSW for *Centennial Coal*.

Aquifer Testing for Ulan Coal. Formal pump testing and drawdown analysis for groundwater dewatering investigations. Formal reporting.

Hydrogeological Investigations and Groundwater Sampling at Ellalong Colliery, Hunter Valley, NSW. Strategic groundwater sampling, testing and analysis in coal beds in underground workings. Major rural groundwater supply scheme assessment for *DWE* near Moree, NSW.

Numerous groundwater assessments for irrigation water supply throughout NSW and QLD including Northern Coalfields.

Detailed independent review of groundwater impact assessment and plans for proposed (underground) Cadia East Project for *Cadia Holdings Pty Limited* (Newcrest) as part of an Environmental Assessment (EA) near Orange NSW for NSW Department of Planning and several independent reviews of formal third party groundwater impact assessments for extractive industry projects including *Rindean*, *Somersby Fields* and *Rocla - Calga* projects.

Ground geophysical surveys for groundwater investigations in Southern Highlands NSW for Sydney Catchment Authority (SCA) as part of drought water supply contingency measures.

Collaborative town water supply exploration and borefield development project for *Nambucca Shire Council*, north coast NSW.

Town water supply exploration, drilling, monitoring, testing and borefield assessment and development for major proposed subdivision development at *Cherrabah Resort*, south-eastern QLD.

Town water supply exploration and borefield development project for *Eurobodalla Shire Council*, south coast NSW.

Detailed hydrogeological investigations and groundwater impact assessment and reporting for EIS and EA relating to several proposed major extractive industry developments in NSW.

Ground geophysical surveys with processing and interpretation, reporting for several groundwater exploration projects.

2002-2004 Consulting Hydrogeologist, Environmental Scientist and Geologist.

Larry Cook & Associates

Numerous consultancies to Government, semi-government and private clients: Included regional and district groundwater exploration, town water supplies, environmental assessments, ground geophysical surveys with processing and interpretation, pumping tests and yield analyses, mineral water projects, viticulture projects, irrigation and commercial supplies, mine supplies, colliery pumping tests, subdivision water supplies, chicken growing developments, long-term groundwater monitoring, sewerage scheme monitoring, effluent irrigation monitoring, dairy supplies, borefield design, monitoring bore network design and installation, groundwater sampling design and implementation, water quality (environmental) testing, bore design, liaison with government agencies.

2000-2002 Manager Groundwater and Environmental Services. **Brink & Associates.**

Environmental and groundwater consultancy. Included hands-on field work and management of contaminated soil and water investigations and assessments. Management of, and field remediation of, contaminated sites. Included remediation of major hydrocarbon contaminated industrial sites, liaison with site auditors on large scale soil remediation site/s and design and implementation of large-scale

- water quality testing and long-term monitoring of potential heavy metal and biological contaminated aquifer systems, baseline commercial effluent monitoring. Numerous pumping tests, large scale water quality monitoring in monitoring bore networks, contaminated site hydrogeology, dewatering schemes, flood studies, acid sulphate soil assessments, stormwater management, soil & water management plans, effluent disposal schemes. Ground geophysical surveys with processing and interpretation
- 1997-2000 Consulting Hydrogeologist. **Larry Cook & Associates** and **Hydroilex**.
Various consultancies to Government and private clients: Water quality testing, water quality (contamination) monitoring and assessment. Reporting. Town water supplies, groundwater exploration, irrigation groundwater supplies, mineral water projects and viticulture projects. Ground geophysical surveys with processing and interpretation
- 1995-1997 Consulting Hydrogeologist. **C.M.Jewell & Associates** and **Larry Cook & Associates**.
Various hydrogeological consultancies to Government and private clients: Water quality testing, water quality monitoring. Reporting. Town water supplies, groundwater exploration, mineral water projects, feedlot pump testing, viticulture projects. Ground geophysical surveys for several groundwater exploration projects
- 1993-1995 Consulting Geologist. **Wantok Mining (PNG)**.
Conceptual geology, exploration, project design and management for projects in Papua New Guinea.
- 1990-1993 Senior Office Geologist. **Kennecott Explorations (Australia) Ltd**.
Exploration management, conceptual geology, third party property assessment, report writing.
- 1989-1990 Consulting Geologist. **Self Employed Contractor**
Various exploration and geological projects in Australia and Papua New Guinea.
Contract Geologist. **Kennecott Explorations (Aust.) Ltd**.
Geological modelling and verification drilling, Lihir Gold Project, Lihir Island, Papua New Guinea.
- 1988-1989 Principal Geologist, **BP Minerals Australia**.
Exploration design, management and implementation in northern Australia.
- 1987-1988 Project Geologist, **Kennecott Explorations (Australia) Ltd**.
Exploration design, management and implementation in Queensland and the Northern Territory.
- 1985-1987 Geologist, **Great Northern Mining**.
Exploration management, design and implementation in Queensland.
- 1976-1985 Project Geologist, **St Joe Australia**. Exploration in eastern Australia.

CURRENT AND RECENT CONSULTANCIES

Groundwater Investigations, Impact Assessments and Monitoring Programs

- **Hydrogeological Investigation and Assessment – Mangoola Coal Project for Xstrata Muswellbrook, Hunter Valley New South Wales.** Commenced mid 2011. Installation of a network of nested piezometers with water quality and water level monitoring. Installation of automated water level data loggers and vibrating wire pore pressure sensors.
- **Current Hydrogeological Investigation and Assessment – Sutton Forest Quarry Project for Tulla Group, Southern Highlands New South Wales.** Installation of a network of nested piezometers with water quality and water level monitoring. Installation of automated water level data loggers. Developed Conceptual Geological Model and Groundwater Impact Assessment for an EIS.
- **Current Hydrogeological Investigation and Assessment – Hillview Quarry Project for Tricone Mining, Booral New South Wales.** Installation of a network of nested piezometers with water quality and water level monitoring. Installation of automated water level data loggers. Developed Conceptual Hydrogeological Model and Groundwater Impact Assessment for an EIS.
- **Hydrogeological Investigations on Regional Scale for Berrima Colliery (Centennial Coal).** Baseline regional hydrogeological assessment, reporting and ongoing water level monitoring in a network of monitoring bores for *Centennial Coal* and *Blue Circle* at Berrima Colliery near Medway, Southern Highlands, NSW. Baseline hydrogeological investigations and assessments, aquifer testing, monitoring bore design and impact assessment, determination of long-term safe & sustainable bore yields, regular formal reporting.
- **Hydrogeological Investigations for Wallarah II Coal Project (Wyang Areas Coal Joint Venture)** Collaborative office and field hydrogeological investigations, and reporting for *Wyang Areas Coal Joint Venture* for input into preparation of an EA for a proposed major underground coal mining development near Wyong NSW.
- **Hydrogeological Investigations for Wallarah II Coal Project (Wyang Areas Coal Joint Venture).** Major ongoing consultancy incorporating multi-level monitoring bore design, piezometer installation, automated water level monitoring, water quality monitoring and reporting for *Wyang Areas Coal Joint Venture* near Wyong NSW.
- **Hydrogeological Investigations for Liddell Coal (Glencore).**
- **Hydrogeological Investigations, Aquifer Testing and Assessment for Airly Coal Project (Centennial Coal).** Major industrial groundwater supply assessment for *Airly Coal Project* at Capertee in Western Coalfields near Mudgee NSW for *Centennial Coal*. Includes groundwater licensing reports and submissions.
- **Aquifer Testing and Assessment – Ulan Coal Mines limited (UCML).** Aquifer Testing for Ulan Coal in Western Coalfields near Mudgee, NSW. Formal pump testing and drawdown analysis for groundwater dewatering investigations. Formal reporting.
- **Hydrogeological Investigations and Groundwater Sampling – Ellalong Colliery (Austar Coal Mine), Hunter Valley, NSW.** Collaborative strategic groundwater sampling, water quality testing, pressure testing and analysis in coal

beds in underground workings at Ellalong. Collaborative research with University of Technology (UTS). Formal reporting.

- ***Aquifer Testing and Assessment for Rural Water Supply – Department Water and Energy (DWE)***. Major industrial groundwater supply assessment for near Moree NSW for DWE. Included aquifer testing, water quality testing and assessment, groundwater impact assessment and formal reporting.
- ***Independent Review of Groundwater Impact Assessment - Cadia East Project for Cadia Holdings Pty Limited (Newcrest)***. Detailed independent review of groundwater impact assessment and plans for proposed (underground) extension of *Cadia East Gold Mine* near Orange NSW for NSW Department of Planning (DoP).
- ***Hydrogeological and Geophysical Investigations – Drought Contingency Measures – Southern Highlands NSW for Sydney Catchment Authority (SCA)***. Major ground geophysical surveys for targeting test bore locations in Southern Highlands NSW for SCA as part of the state government’s drought water supply contingency measures. Resistivity imaging and soundings. Formal reporting.
- ***Several Independent Reviews of Groundwater Impact Assessments for Extractive Industry Projects***. Several independent reviews of formal third party groundwater impact assessments for extractive industry projects including *Rindean*, *Somersby Fields* and *Rocla - Calga* projects.
- ***Numerous Water Supply Investigations and Assessments in Various Coalfields*** across NSW for rural landowners, mainly irrigation bore investigations, design and assessments.
- ***Major Hydrogeological and Geophysical Investigations – Town Water Supply*** Gosford & Wyong Council areas, central coast NSW. Involves intensive and extensive groundwater exploration with target selection, test drilling, extensive geophysical bore logging and interpretation, conceptual hydrogeological modelling, borefield assessment and regular liaison with local government and state government agencies. Incorporates test drilling, pump test design and implementation, aquifer testing and assessment, determination of long-term safe & sustainable bore yields, bore and pump design, monitoring bore design and installation of monitoring network, production pumping schedule design, assessment of potential interference effects, groundwater sampling, water quality testing including salinity monitoring, hydrogeochemical classification and formal reporting.
- ***Hydrogeological Investigations and Assessments – Town Water Supply, QLD***. Town water supply exploration, drilling, monitoring, testing and borefield assessment and development for major proposed 400-lot subdivision development at *Cherrabah Resort*, near Warwick south-eastern QLD.
- ***Major Hydrogeological and Geophysical Investigations – Town Water Supply***. Eurobodalla Shire Council, south coast NSW. Intensive groundwater exploration with target selection, test drilling, geophysical bore logging and interpretation, ground geophysical surveys and interpretation, conceptual hydrogeological modelling, borefield assessment and regular liaison with local government and state government agencies. Incorporates test drilling, pump test design and implementation, aquifer testing and assessment, determination of long-term safe & sustainable bore yields, bore and pump design, monitoring bore design and installation of monitoring network, production pumping schedule design, assessment of potential interference effects, groundwater sampling, water quality testing, hydrogeochemical classification and formal reporting.

-
- **Hydrogeological Investigations – Extraction Industry Project** – for *Blue Sky Mining* near Luddenham, Penrith. Groundwater Impact Assessment, Monitoring Bore design and installation, data logging, DWE liaison, formal reporting – Groundwater Management Plan.
 - **Hydrogeological Investigations - Mineral Resource Project** - ‘*Gunlake*’ near Marulan. Groundwater Impact Assessment, Monitoring Bore design and installation, data logging, EA reporting, DWE liaison, formal reporting.
 - **Hydrogeological Investigations - Mineral Resource Project** - ‘*Jones Sand Quarry*’ near Somersby. Groundwater Impact Assessment, Monitoring Bore design and installation, data logging, groundwater modelling, EA reporting, NOW liaison, formal reporting.
 - **Hydrogeological and Geophysical Investigation at a Major Golf Course- Residential Project** near Wyong, Central coast NSW, Included geophysical ground surveying and data interpretation, drill target delineation, test drilling, pump testing, bore design, safe yield analysis, water quality assessment, bore licensing, application for allocation, liaison with DNR, formal reporting
 - **Hydrogeological and Geophysical Investigations for a Major Irrigation Water Supply** for large vegetable growing complex near Cooma. Included extensive geophysical ground surveys with data processing and interpretation, bore licensing, formal reporting.
 - **Hydrogeological and Geophysical Investigations for a Major Irrigation Water Supply** for large vineyard complex near Gundagai. Included geophysical ground surveys, test drilling, geophysical bore logging, bore design, pump testing, yield analysis, assessment of interference effects, bore licensing, formal reporting.
 - **Baseline and Quarterly Water Level Monitoring, Groundwater Sampling, Water Quality Testing and Assessment – Large-scale Council owned Wastewater Irrigation Projects** near Dubbo, NSW. Project commenced 2004 and incorporates a network of 28 monitoring bores monitoring salinity and nutrient levels with statistical analysis and assessment of any impacts.
 - **Design Monitoring Bore Network Including Bore Design and Sampling Program – Norske Skog Paper Mill Wastewater Irrigation Project** near Albury, NSW. Design salinity and nutrient monitoring program.
 - **Baseline Construction of a Monitoring Bore Network Surrounding Sewerage Treatment Works and Wastewater Application areas** for Cabonne Council, central NSW. Annual water level monitoring, groundwater sampling, salinity and nutrient monitoring, data analysis, statistical analysis and interpretation, liaison with local Council with formal reporting.
 - **Major Hydrogeological Investigation – School Water Supply** for Tuncurry Foster High School, Tuncurry. Groundwater Exploration, delineate targets, test drilling, production drilling, geophysical bore logging, bore design, pump testing, yield analysis, water quality assessment, bore licensing, application for allocation, liaison with DNR, formal reporting.
 - **Hydrogeological Investigation – Town Water Supply for an Aboriginal School** complex near Kempsey, Mid north coast NSW. Groundwater exploration, delineate targets, test drilling, pump testing, bore design, safe yield analysis, water quality assessment, alternative water supply options, infiltration gallery design, bore licensing, application for allocation, liaison with aboriginal elders and DNR, formal reporting.
 - **Hydrogeological Investigation and Development of a Model Groundwater Management Plan – Major Mineral Water Project** in Berrima Area, NSW Southern Highlands. Groundwater Exploration for mineral water project. Borefield

assessment and regular liaison with *Department of Natural Resources* (DNR), pump test design and implementation, aquifer testing and assessment, determination of long-term safe & sustainable bore yields, bore and pump design, monitoring bore design and installation of monitoring network, production pumping schedule design, assessment of potential interference effects, formal reporting.

- **Hydrogeological Investigation and Development of a Groundwater Management Plan – Significant Mineral Water Project** in Dorrigo Area, northern NSW. Groundwater Exploration, delineate targets, test drilling, pump testing, borefield design, safe yield analysis, monitoring bore network design and installation, water quality assessment, bore licensing, application for allocation, liaison with DNR, assessment of potential interference effects, formal reporting.
- **Long-Term Pump Testing for a Proposed Town Water Supply** bore at Kyogle in northern NSW. Pump testing, safe yield analysis, assessment of interference effects, water quality assessment, liaison with DNR, formal reporting.
- **Hydrogeological Investigation – Water Supply for NSW National Parks and Wildlife Service**, Munmorah State Recreation Area, Central coast NSW. Groundwater Exploration, delineate targets, test drilling, pump testing, bore design, safe yield analysis, water quality assessment, bore licensing, application for allocation, liaison with DNR, formal reporting.
- **Pump Testing - Mineral Water Project** at Paddys River, NSW Southern Highlands. With drawdown analysis, safe yield analysis, assessment of interference effects, liaison with DNR, formal reporting.
- **Groundwater exploration, Mine Treatment Water**. Drill target delineation for water supply to major proposed silver mine near Mudgee.
- **Long-Term Pump Testing** of a bore at Ulan Colliery for new mining extraction.
- **Major Hydrogeological Investigation – Water Supply for Dual Carriageway** near Lake George NSW. Groundwater Exploration, delineate targets, test drilling, pump testing, bore design, safe yield analysis, water quality assessment, bore licensing, application for allocation, liaison with Consultant and DNR, formal reporting.
- **Major Hydrogeological Investigation – Water Supply for a Large Rural Subdivision** near Pokolbin in Hunter Valley. Groundwater Exploration, delineate targets, test drilling, pump testing, bore design, safe yield analysis, water quality assessment, bore licensing, application for allocation, liaison with DNR, formal reporting. Pokolbin
- **Design of a Network of Monitoring Bores Adjacent to Three Landfills** in northern NSW, Richmond Valley Council.
- **Installation and Testing of a Large Scale Bore Monitoring Network** at the former *Woodlawn Base Metal Mine* near Tarago, southern NSW, now a state-significant mega-landfill and bioreactor project. For effluent contamination monitoring. Bore logging, bore design.

Environmental Assessments, Wastewater and Stormwater Management Investigations

- **Numerous Preliminary, Phase I and Phase II environmental assessments** (ESAs) including assessments of asbestos, hydrocarbon, pesticide and heavy metal contaminated sites and acid sulfate soil.
- **Current Environmental Assessments:** Asbestos contamination assessments at Maraylya and Mooney Mooney, general contamination assessments including

underground storage systems at commercial fuel sites in Gosford, Mount White and Mangrove Mountain. Remediation Action Plans. Rehabilitation.

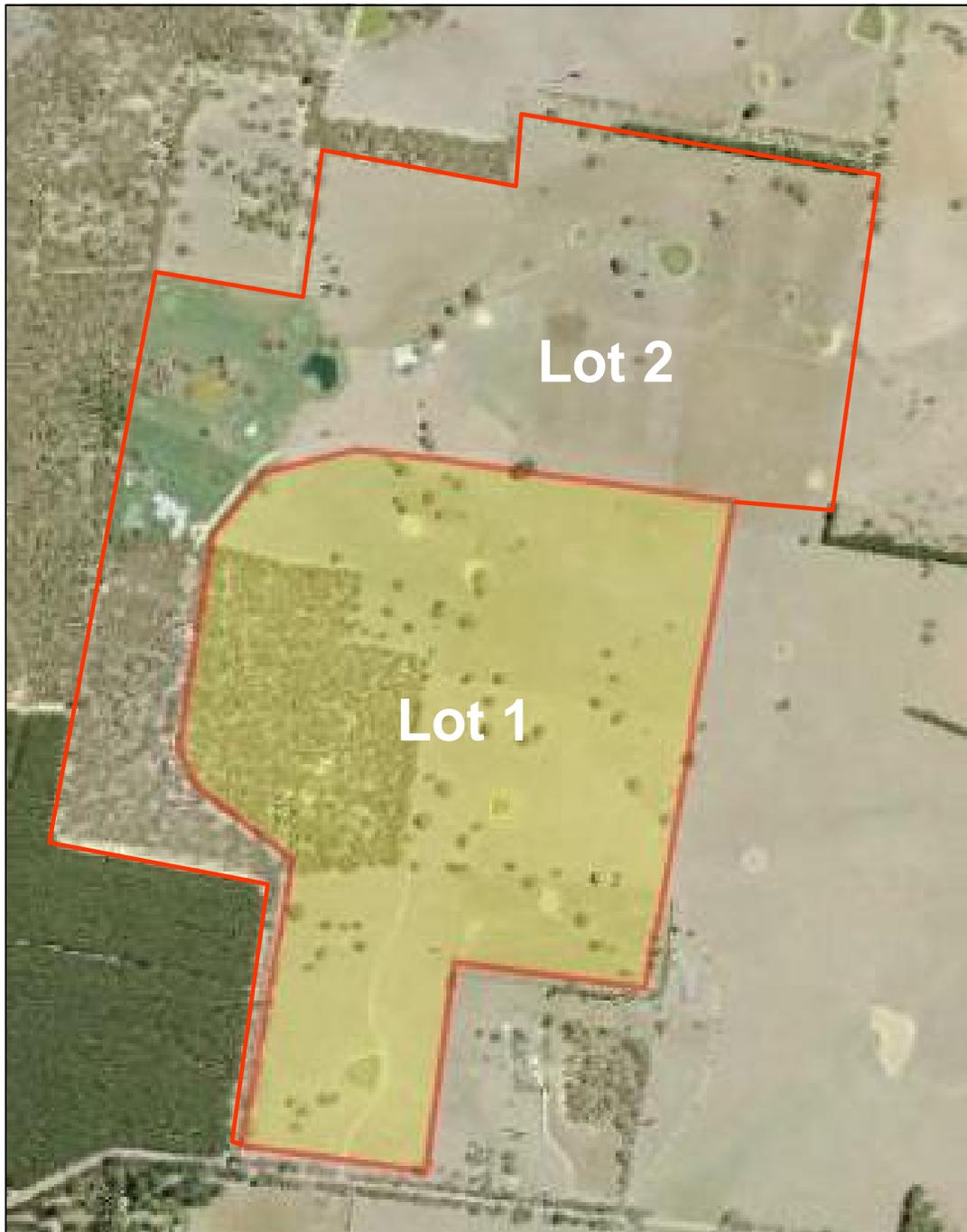
- **Major detailed Stage II contaminated site assessment** in industrial area in Rockdale. Proposed new industrial development. Required delineation of significant hydrocarbon contamination, major remedial earthworks and on-site remediation with ongoing monitoring, verification sampling and testing with comparison of soil test results with guidelines. Brink & Associates.
- **Major detailed Stage II contaminated site assessment** in Werrington for Multiplex. Site Auditor assigned. Required delineation of potential contamination, grid-controlled soil sampling, remedial earthworks with verification sampling and testing with comparison of soil test results with guidelines. Site Auditor 'sign off'. Brink & Associates.
- **Preliminary Environmental Site Assessment** for a proposed land sub-division on previously zoned rural land at Richmond NSW. Investigation of previous land usage with testing for hydrocarbons, heavy metals and pesticides/herbicides/PAHs with comparison of soil test results with guidelines.
- **Identification of asbestos minerals** in fibre cement sheeting.
- **Baseline and quarterly groundwater sampling, water quality testing and assessment** and water level monitoring – Large-scale Council owned Wastewater Irrigation Projects near Dubbo, NSW. Project commenced 2004 and incorporates a network of 28 monitoring bores monitoring salinity and nutrient levels with statistical analysis and assessment of any environmental impacts.
- **Quarterly sampling and testing of groundwater in 37 bores on Mangrove Mountain** for a comprehensive set of analytes including heavy metals, toxic chemicals and Newcastle disease virus. Network of monitoring bores developed following significant and serious outbreak of Newcastle disease in chickens. Brink & Associates. Statistical analysis of results and establishment of trends.
- **Hydrogeological and environmental investigations** for several coal and hard rock extractive industry projects, for example Wallarah II Coal Project (Wyang Areas Coal Joint Venture). Major ongoing consultancy incorporating multi-level monitoring bore design, piezometer installation, automated water level monitoring, water quality monitoring and reporting. Potential for rural contamination and natural hydrocarbon leaks.
- **Current Major Hydrogeological and Environmental – Town Water Supply** Gosford & Wyong Council areas, central coast NSW. Involves intensive and extensive groundwater exploration, borefield assessment, environmental testing and regular liaison with local government and state government agencies. Includes groundwater sampling, water quality environmental testing including salinity and contaminant monitoring, hydrogeochemical classification and formal reporting.
- **Numerous wastewater treatment and disposal investigations** and assessments, and preparation of Wastewater (effluent) Management Plans and Stormwater Management Plans in several local government areas.

Mineral Resource Exploration and Assessments

- **Major Geological and Geophysical Investigations - Mineral Resource Project** on 'Ardmore Park' near Bungonia. Groundwater exploration, target delineation, test drilling, pump testing, drawdown analyses, safe yield analysis, interference assessments, bore licensing. Mineral resource exploration and resource estimate drilling, resource estimation, EA reporting, formal reporting.

- **Geological Investigations - Mineral Resource Project near Karuah, NSW.** Mineral exploration, target delineation, resource estimate drilling, test drilling, resource assessment and formal reporting.
- **Geological Investigations and Resource Estimation - Mineral Resource Project near Kingaroy, QLD.** Resource mapping and assessment at *Maidenwell Diatomite Deposit* with resource estimation and valuation, and formal reporting.
- **Current Geological Investigations – Extractive Industry Project - ‘Jones Sand Quarry’** near Somersby, NSW. Resource estimation, mining plan and formal reporting for EA, in conjunction with groundwater investigations.

FIGURES



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Larry Cook Consulting
PO Box 8146
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Phone 02 4340 0193

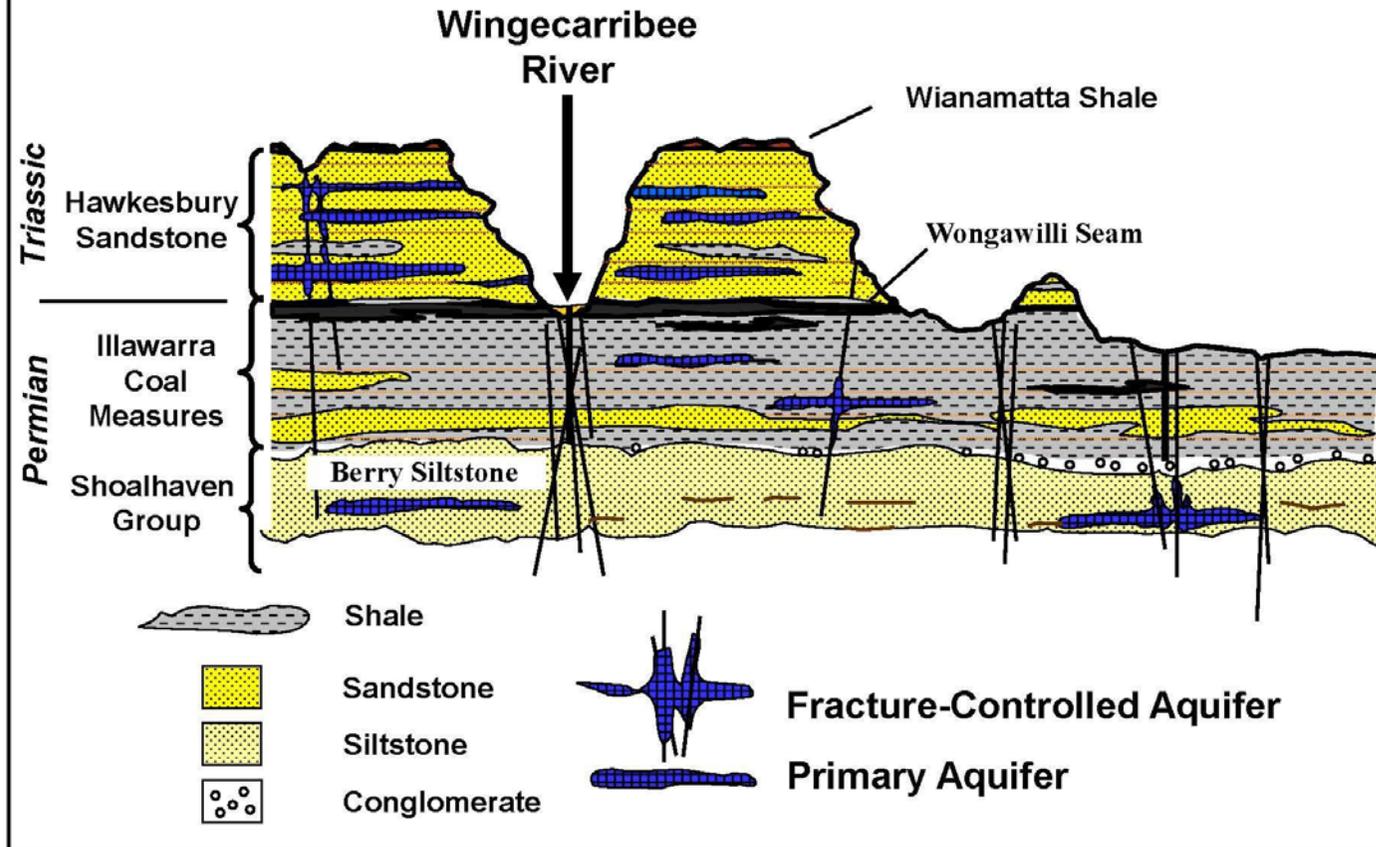
Groundwater Investigations

Lots 1 and 2 in DP1093425
180 Belanglo Road Sutton Forest
Lot Plan

Scale: As shown

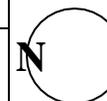
FIGURE 1

Geology Schematic



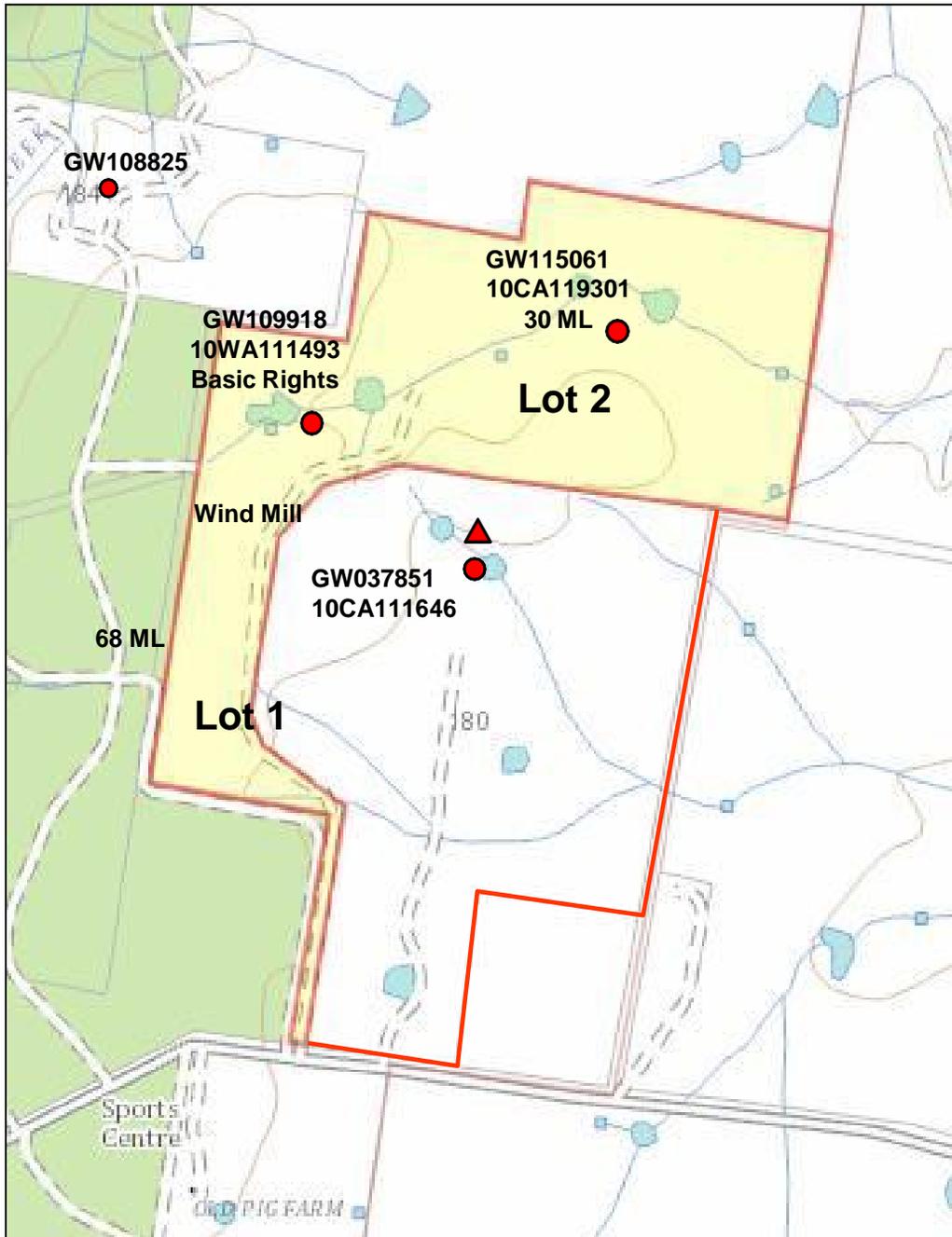
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Groundwater Investigations
 Lots 1 and 2 in DP1093425
 180 Belanglo Road Sutton Forest
 Geology Schematic



Scale: As shown

FIGURE 2



GW107792

● Registered Bore



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Groundwater Investigations

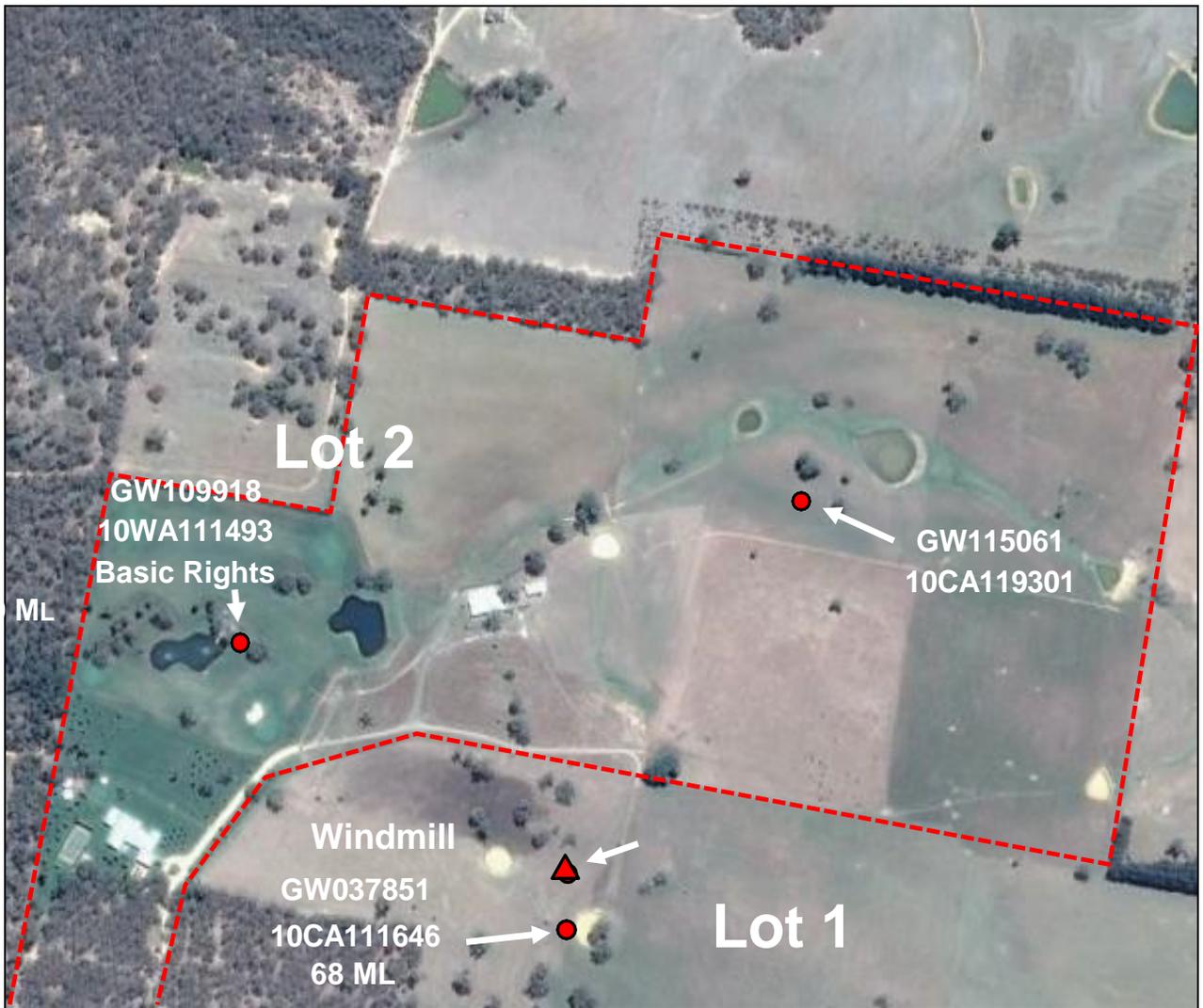
Lots 1 and 2 in DP1093425

180 Belanglo Road Sutton Forest

Locations of Registered Bores

Scale: As shown

FIGURE 3



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Groundwater Investigations

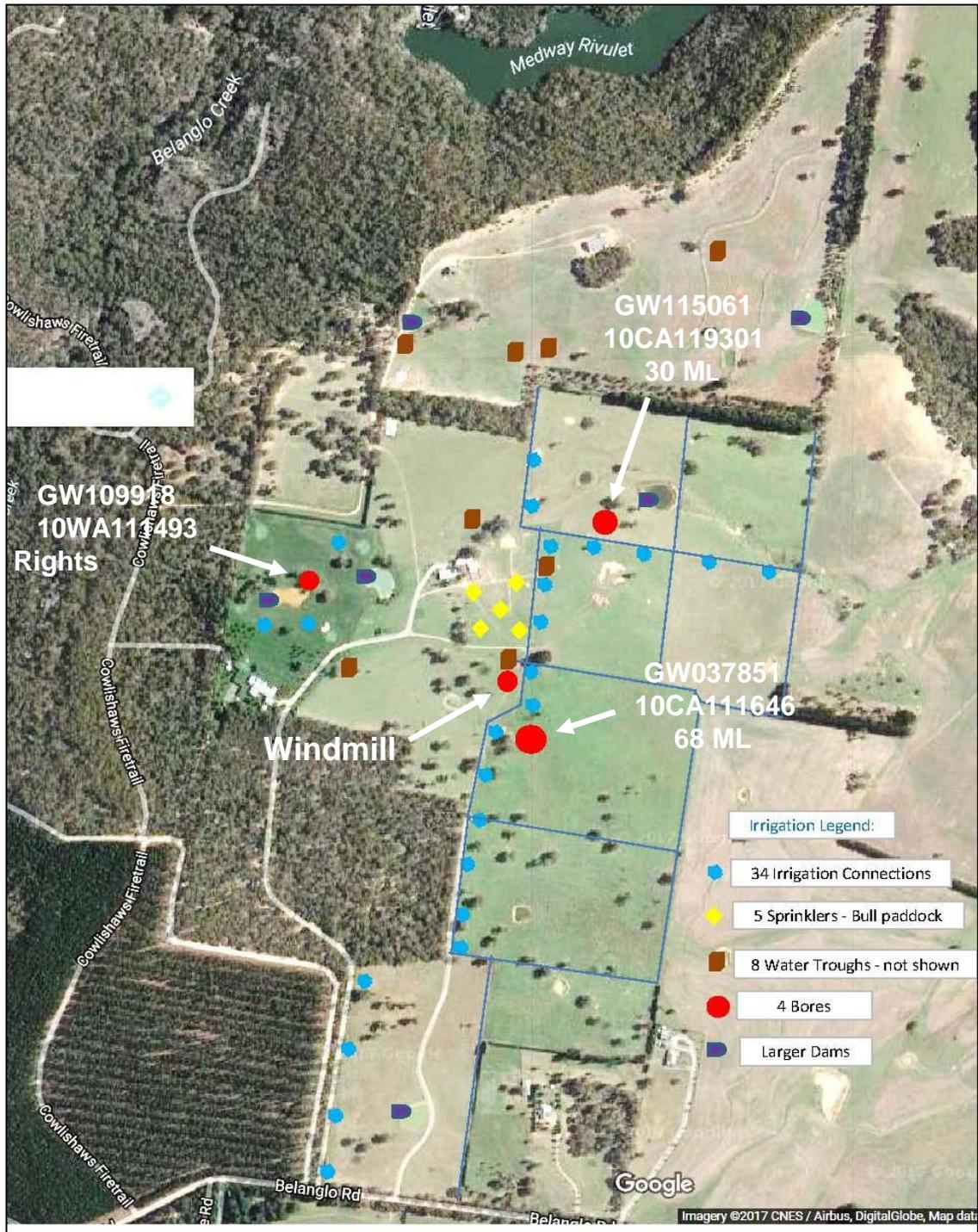
Lots 1 and 2 in DP1093425

180 Belanglo Road Sutton Forest

Aerial Photo Showing Locations of Registered Bores

Scale: As shown

FIGURE 4



Note: Irrigation scheme is connected to Bore GW037851

0
N
m 300



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Groundwater Investigations

Lots 1 and 2 in DP1093425

180 Belanglo Road Sutton Forest

Operational Irrigation Scheme

Scale: As shown

FIGURE 5

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Appendix C – Review of Noise and Vibration Assessment
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Atkins Acoustics and Associates Pty Ltd.

Consulting Acoustical & Vibration Engineers

Atkins Acoustics and Associates Pty Ltd.

Consulting Acoustical & Vibration Engineers

**REVIEW NOISE AND VIBRATION ASSESSMENT
HUME COAL PROJECT
SOUTHERN COALFIELD
NEW SOUTH WALES**

47.7085.R1:GA/DT/2017

2 June 2017

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Executive Summary

The Proposal

Hume Coal Pty Ltd is seeking approval to construct and operate a new underground coal mine, and associated infrastructure with an integrated rail system in the Southern Coalfields of NSW (**Project**). The application was supported with a Noise and Vibration Assessment (**NVA**) prepared by ENGA Mitchell McLennan (**EMM**).

Atkins Acoustics has been engaged by Colin Biggers & Paisley Lawyers on behalf of their clients Richard and Lynne Crookes to review the Project proposal, particularly in relation to potential acoustic and vibrational exposure and impacts which may be suffered by the Crookes at their residences from the Hume Proposal.

The Subject Property

The Crookes own land at 180-182 Belanglo Road, Sutton Forest (**Property**). The eastern boundaries of the Property share a common boundary with the Hume Coal land which is identified for developing surface infrastructure. The common boundary extends over approximately 1800m. The Hume Coal processing plant (CPP), handling, storage and unloading areas are located to the north-east and east of the Property.

The Crookes residence (at 180 Belanglo Road) provides for both covered and open outdoor entertaining areas with north and north-east orientations towards the Hume Coal CPP. The Property improvements include a private five hole golf course to the north of the residence, passive external recreation areas and provisions for a 200 plus head Red Angus cattle stud.

Situated on 182 Belanglo Road is another private residence which is currently undergoing additions, including the expansion of the outdoor entertaining area and carport. This land is also used as part of the cattle stud operations.

Ambient Noise Levels

The NVA describes the ambient noise environment for the area as typical of a quiet natural setting with insects, birds and rustling leaves when wind is present and there is no industrial noise. This has been confirmed by the Crookes and I have also observed this whilst in attendance at the Property in May 2017. The Property is located within the assessment area identified as BG1, with ambient background noise levels reported in the NVA for BG1 for day/evening/night assessment periods between the range of 23-26dBA.

With respect to the Property, noise exposure and impacts from the Hume proposal will be influenced by wind direction and temperature inversions. As a result of the distance from the proposed surface activities, it is likely that construction and operational noise associated with the Project would be audible on the Property, particularly with source to receptor wind conditions and/or temperature inversions.

Lack of Critical Information

As set out in more detail below, the NVA is deficient with respect to information to enable the Crookes (and therefore the Department) to assess the potential acoustic and vibrational impacts on the Property. In particular, the NVA does not include the following information to enable a thorough and proper assessment of the noise exposure and impacts of the Project on the Property:

1. Actual measured background noise levels for the Property.

As the background levels are reported as being 22 to 26dBA (day/evening/night) an industrial noise source of 35dBA would be clearly audible at the Property.

2. Noise contour plots and assessment locations for the Property.

The NVA refers to noise contours as shown in Figures 5.1 to 5.3. No noise contour plots or assessment locations are provided for the Property. As a minimum, noise contour plots should have been provided that encompass the Property.

3. Discussion or explanation to support the claim that noise mitigation measures will satisfy the evening and night noise management levels at all locations.

Construction noise modelling reported in the NVA show that NML's would be exceeded at the Property during day and night time hours. The NVA concludes that noise levels from proposed out-of-hours works (shaft drilling) satisfy the evening and night noise management levels (NML's) at all locations, however the NVA provides no discussion or details (including the noise mitigation and management measures that will be employed during these periods) to support this claim, and

4. An assessment of the impacts associated with the construction of the downcast shafts and the associated construction traffic.

In addition to this lack of supporting information, further questions arise from the potential for coal extraction to occur during the second year of construction. Whilst the Project indicates that construction is to be scheduled over a two year period, the documentation suggests that coal extraction could commence during the second year of construction and prior to the installation of the entire surface infrastructure. During this period it is understood that a dozer and other mobile plant could be engaged to handle ROM coal. No specific details are provided in the NVA in terms of schedules of plant/equipment, operating hours and noise exposure during this period. It follows that the Applicant should provide the following additional information in order for the Crookes and the Department to properly assess the potential impacts of the Project on the surrounding neighbours:

1. noise modelling to consider the coal handling/processing and the construction works happening at the same time;
2. the relevant noise criteria which is to apply when both extraction and construction are occurring;
3. the hours that will apply to the simultaneous operations; and
4. what is the cumulative noise impact for coal handling/processing and construction, acknowledging that the construction noise modelling does not consider meteorological effects.

Until such time as all supporting information (as set out above) is provided, in our opinion the Department would not be in a position to understand or fully assess impacts from the proposal.

1. The Proposal

Hume Coal Pty Ltd is seeking approval to construct and operate a new underground coal mine, and associated infrastructure with an integrated rail system in the Southern Coalfields of NSW (**Project**).

The project involves a construction phase of approximately 2 years, with 19 years of mining. However, it is noted in the NVA that some coal extraction could commence during the second year of construction and hence there could be an overlap between the construction and operating phases.

It is estimated that approximately 50 million tonnes (Mt) of run-of-mine (**ROM**) coal would be extracted at a rate of up to 3.5 million tonnes per year. Following processing in the coal preparation plant (**CPP**), it is estimated that up to 3Mtpa of metallurgical and thermal coal could be produced.

The primary surface infrastructure identified in the NVA includes:

- one personnel and material drift;
- one conveyor drift;
- one upcast ventilation shaft;
- up to two downcast ventilation shafts (depending on the ventilation requirements);
- overland conveyors;
- coal processing plant (CPP); and
- rail out load facilities.

As part of proposed noise management for the Project, the NVA reports that Hume Coal is committed to adopting leading practices in planning, construction, operation and closure of the project. Practices identified include:

- latest generation rail locomotives and wagons;
- low noise conveyor idlers;
- low frequency noise mitigation to the CPP; and
- automatic coal handling using stackers and reclaimers to minimise the reliance on mobile plant and equipment.

The NVA refers to the Secretary's Environmental Assessment Requirements (**SEARs**) and indicates that the assessment has been prepared to address the requirements of the NSW Department of Planning and Environment (DP&E) and the NSW Environmental Protection Authority (EPA). In addition the NVA indicates that it addresses vibration matters raised by the Roads and Maritime Services (RMS).

2. Review of Proposal

2.1 Review

Atkins Acoustics was engaged by Colin Biggers & Paisley on behalf of Mr and Mrs Crookes to review the NVA with respect to noise exposure and impacts relating to their two privately owned properties otherwise known as the Property.

For the preparation of this review detailed noise modelling has not been conducted by *Atkins Acoustics*. Therefore, it is not possible to verify the validity of the noise predictions presented in the NVA or the source noise data. The review, findings and recommendations rely on the modelling and source noise data which is provided in the NVA. As the review was a desktop exercise, independent noise measurements to verify the noise levels referenced in the NVA have not been undertaken.

This Review has focused on two issues:

- (i) the SEARs and the reporting methods in the NVA; and
- (ii) the noise and vibration exposure and impacts that are likely to be experienced on the Property from the Hume proposal..

The eastern boundaries of the Property share a common boundary with the Hume Coal land which is identified for developing surface infrastructure. The common boundary extends over approximately 1800m (see Figure 1 below). The CPP, handling, storage and outloading areas are located to the north-east and east of the Property.

The Crookes residence (180 Belanglo Road) was constructed in 2009 and provides for both covered and open outdoor entertaining areas with north and north-east orientations towards the Hume Coal CPP. We are advised that these areas form a prime design feature of the dwelling and are extensively used throughout the year, day and night. The Property improvements include a private five hole golf course to the north of the residence, passive external recreation areas and the housing and the operation of an approximately 200 head Red Angus cattle stud.

Situated on 182 Belanglo Road is another private residence which is currently undergoing additions, including the expansion of the outdoor entertaining area and carport. This land is also used as part of the cattle stud operations.

Figure 1. Aerial of Property Locations



From the NVA the approximate scaled distances to 180 Belanglo Road are:

- 3.5km south-west of the CPP;
- 1.85km west of the upcast ventilation shaft;
- 2.28km west of the drift conveyor; and
- 570m east of the western downcast ventilation shaft.

The approximate scaled distances for 182 Belanglo Road, are:

- 2.95km south-west of the CPP;
- 1.7km west-north-west of the upcast ventilation shaft;
- 2.3km west of the drift conveyor; and

- 1.1km north-east of the western downcast ventilation shaft.

2.2 Ambient Background Noise Levels

Referring to the NVA (Table 2.1) the Property is located within the assessment area and is identified as BG1. Ambient background noise levels reported for BG1 for day/evening/night assessment periods range between 23-26dBA.

The NVA describes the ambient noise environment for this area as typical of a natural setting with insects, birds and rustling leaves when wind is present and no industrial noise. I attended the Property in May 2017 and I confirm that this type of noise was typical on that day.

In accordance with Industrial Noise Policy (INP) assessment procedures, if the measured existing background level is less than 30dBA, then the rating background level for determining assessment criteria is considered to be 30dBA.

The aim of the INP is to help strike a feasible and reasonable balance between the establishment and operation of industrial activities and the protection of the community from noise levels that are intruding or unpleasant.

It is noted that the INP assessment procedures were developed to protect at least 90% of the population living in the vicinity of industrial noise sources from adverse effects of noise for at least 90% of the time. The INP recognises that there are people in the community who are very sensitive to noise and this sector of the population will react, often strongly, to intruding noises that are barely audible.

2.3 Operational Noise Modelling

The NVA reports that the assessment was prepared to assess noise and vibration impacts for the construction and operation phases of the Project. The results of noise modelling are referenced to dwellings identified in the study area, including the Property. Under INP assessment procedures, noise is assessed at the boundary of the property or 30m from a dwelling on the property, if the dwelling is more than 30m from the boundary.

The operational noise modelling referenced in the NVA refers to source noise levels and prevailing meteorological conditions. The meteorological data reported in the NVA at Table 2.3 confirms that during evening and night-time hours, the frequency of prevailing winds from the NNE, NE and ENE trigger the INP requirement to model and assess the wind effects. Further the meteorological data confirms that Pasquill Stability Category F conditions during night time hours occur for more than 30% of the time and therefore trigger the requirement to model the effects of these conditions with respect to noise propagation.

It is recognised that during certain wind and temperature gradient conditions source noise levels at a receptor may increase or decrease. With source to receiver wind conditions the source noise level at the receptor will increase. Conversely with a wind direction from a receptor to the source, the source noise level will decrease. Similar with temperature gradients present source noise levels at a receptor can increase. The NVA indicates that the noise modelling has considered worst case scenarios for both wind and temperature gradients.

With respect to the Property, noise exposure and impacts would be influenced by wind direction and temperature inversions. As a result of distance from the proposed

CPP surface activities, it is likely that operational noise associated with the Project would be audible at the Property, particularly with source to receptor wind conditions and/or temperature inversions.

The NVA operational noise modelling is referenced to the Bruel and Kjaer Version 11 software 'Predictor'. It assumes that a number of noise mitigation strategies are effectively implemented and therefore the NVA indicates that the referenced mitigated source sound power levels are achieved.

It is noted that the noise mitigation recommended for the overland conveyors include the enclosure of the roof and eastern side of the conveyor galleries. However, it is understood that the western side of the main overland drift conveyor gallery that faces towards the Property is open (not clad).

From the documentation reviewed it appears that coal extraction could commence during the second year of construction and prior to the installation of the entire surface infrastructure. During this period a dozer and other mobile plant could be engaged to handle ROM coal. However, no specific details are provided in the NVA in terms of schedules of plant/equipment, operating hours and noise exposure during this period.

The NVA (Table 5.1) presents a summary of the predicted noise levels at each of the referenced assessment locations and refers to noise contours which are reproduced in Figures 5.1 to 5.3. These figures do not include noise contour plots and assessment locations for the Property.

Operational noise predictions for the Property show the $L_{Aeq\ 15min}$ levels are less than 35dBA and according to the NVA satisfy the Project Specific Noise Levels $L_{Aeq\ 15min}$ 35/35/35. Although, it appears that the procedures adopted for modelling, assessment and reporting are generally in accordance with normally accepted assessment guidelines and procedures, no support information is presented in the NVA to allow the Crookes to understand or assess the likely noise exposure and impacts that would be experienced at the residences and/or across the Property.

To allow for any reasonable assessment of likely noise exposure and impacts, the actual predicted levels should have been reported, not an undisclosed level of <35dBA. Considering the reported background levels for the Property of between 22 and 26dBA (day/evening/night) an industrial noise contribution of 35dBA would be clearly audible. Without the predicted levels for the Property, an assessment of noise exposure and impacts cannot be assessed or at the very least properly understood. Further, without the noise contours NVA references to Figures 5.1 to 5.3, a review and assessment of operational noise impacts and exposure of the Property cannot be determined.

The NVA (Section 5.3) refers to noise modelling based on a 3dB correction factor to convert the $L_{Aeq\ 15min}$ levels to $L_{Aeq\ 15hour}$ and $L_{Aeq\ 9\ hour}$ levels. The NVA (Figure 5.4) presents limited $L_{Aeq\ 15hour}$ and $L_{Aeq\ 9\ hour}$ noise contours for day and night hours. The NVA indicates that the ventilation system source sound power level is 93dBA (Table 4.2), and therefore a predicted noise level (calm conditions, point source) of 65dBA would be expected at 10m from the ventilation system and 35dBA at approximately 350m. Similar for the open sided drift conveyor gallery with rated sound power level of 75dBA/m, a predicted noise level (calm conditions, line source) of 35dBA would be expected at 1700m from the conveyor. From the desktop noise modelling for the upcast ventilation fans and drift conveyor and the NVA results summarised in Table 5.1, the predicted noise contours presented in Figure 5.4 are questionable and should be justified. Additionally, the source of $L_{Aeq\ 9\ hour}$ 45dBA contour level shown

midway along the drift conveyor (Figure 5.4) is questioned and the source should be confirmed and quantified.

2.4 Construction Noise and Vibration

The Project documentation indicates that construction is to be scheduled over a two year period. However, it appears from the supporting documentation that during the second year of construction coal could be produced. This immediately raises the following questions which should be answered before the Department takes any further step in assessing the application:

- does the noise modelling considered the coal handling/processing and the construction scenario happening at the same time;
- what noise criteria applies,
- what hours apply to the simultaneous operations; and
- what is the cumulative noise impact for coal handling/processing and construction, acknowledging that the construction noise modelling does not consider meteorological effects.

The Project includes the construction of two downcast ventilation shafts and one upcast shaft. Construction of the upcast shaft is reported to occur 24 hours a day. The NVA (Table C.5) refers to an indicative construction period from December 20 to June 21 (6 months) for the drilling and construction of the upcast shaft.

The NVA provides no assessment of the impacts associated with the drilling and construction downcast shafts, including the potential impacts of construction traffic. The location of the western downcast shaft is approximately 570m west of 180 Belanglo Road and 1.1km from 182 Belanglo Road.

The noise modelling source data reported in the NVA (Table C.5) for drilling and construction refers to standard hours and out-of-hours total sound power levels of the following:

- $L_{Aeq\ 15min}$ day and night;
- $L_{Aeq\ 15min}$ 115dBA for shaft drilling/construction; and
- $L_{Aeq\ 15min}$ 109dBA ventilation fan construction.

From the NVA, the approximate scaled distance from the upcast ventilation shaft to 180 Belanglo Road is 1.85km, for 182 Belanglo Road the scaled distance is approximately 1.7km. From desktop noise modelling, considering noise attenuation for the scaled distances, the predicted $L_{Aeq\ 15min}$ contributions of 42/3dBA are 7-8dBA above the OOH evening and night assessment NML of 35dBA and marginally exceed the daytime NML 40dBA (2/3dBA).¹ In contrast, the NVA (Section 7 Conclusion) concludes that noise levels from proposed out-of-hours works satisfy the

¹ It is acknowledged that topographical effects have not been considered in the desktop modelling as the details are not provided in the NVA.

It is noted that when considering the effects of a north-east breeze and/or temperature inversion any excess attenuation claimed for ground or screening would be minimal.

evening and night noise management levels (NML's) at all locations with feasible and reasonable noise mitigation and management in place.

The NVA (Section 7 Conclusion) reports that construction noise during daytime hours will exceed the recommended noise management levels (NML's). At the Property noise levels during CPP construction are predicted to exceed the NML's (40dB) by up to 8dB (48dBA) and 6dB (46dBA), respectively. During the drilling and construction of the upcast ventilation shaft, the reported predicted levels exceed the NML's by up to 4dBA at 182 Belanglo Road and 3dBA at 180 Belanglo Road. Construction noise levels of up to 48dBA, when compared to background levels of 23-26dBA would be clearly audible at the Property. As a result of this more detail and information should be provided to the Crookes to allow for an assessment and understanding of noise exposure and impacts likely to be experienced at the Property during construction,.

In addition, the NVA provides no assessment of noise associated with the construction of the western downcast shaft. This data should also be provided.

2.5 Road Traffic Noise

Construction and operational offsite road traffic noise is addressed in the NVA at Section 3.4 and references the assessment procedures documented in the EPA, Road Noise Policy (RNP).

Considering the separation distance from the Hume Highway, traffic noise is not expected to be an issue at the Property. The NVA (Section 7 - Conclusion) states that road traffic noise has been assessed for all local roads potentially used for operation and construction phases of the Project and where adjacent assessment locations existing will experience zero to negligible (1-2dB) noise level increases.

The NVA fails to address or assess traffic noise impacts associated with the construction of the western downcast shaft. As indicated above this information/data should also be part of the NVA.

2.6 Rail Traffic Noise

Onsite rail traffic noise is addressed in Section 3.5 of the NVA, whilst offsite rail noise is dealt with in a separate noise and vibration report. The standard procedures for assessing rail associated noise and vibration are documented in the EPA, Rail Infrastructure Noise Guideline (RING) and the Industrial Noise Policy (INP).

Considering the separation distance between the onsite and offsite rail infrastructure, rail noise and vibration associated with the Project is not expected to be an issue at the Property.

3. Conclusion

Atkins Acoustics was engaged by Colin Biggers & Paisley on behalf of Mr and Mrs Crookes to review the NVA with respect to potential noise exposure and impacts of the Project on the Property. The Property contains two residential dwellings and a 200 plus head Red Angus cattle stud. The Property (including the residences) has been extensively improved to provide for external recreation and passive uses. The design of the residence at 180 Belanglo Road takes advantage of the outdoor amenity and provides for covered and uncovered entertaining areas.

The NVA does not contain the following critical information to enable a proper and comprehensive assessment of the Project:

1. Actual measured background levels for the Property.

As the background levels are reported as being 22 to 26dBA (day/evening/night) an industrial noise source of 35dBA would be clearly audible at the Property.

2. Noise contour plots and assessment locations for the Property.

The NVA refers to noise contours as shown in Figures 5.1 to 5.3. No noise contour plots or assessment locations are provided in Figures 5.1 to 5.3 or for the Property. As a minimum, noise contour plots should have been provided that encompass the Property.

3. Discussion or explanation to support the claim that noise mitigation measures will satisfy the evening and night noise management levels at all locations.

The construction noise modelling reported in the NVA show that NML's would be exceeded at the Property during day and night time hours. The NVA concludes that noise levels from proposed out-of-hours works (shaft drilling) satisfy the evening and night noise management levels (NML's) at all locations however the NVA provides no discussion or details (including the noise mitigation and management measures that will be employed during these periods) to support this claim, and

4. An assessment of the impacts associated with the construction of the downcast shafts and the associated construction traffic.

In addition the Project documentation appears to indicate that coal extraction may occur during the second year of construction. If that is to occur, then the Applicant should provide further acoustical testing and data in relation to the following matters:

5. noise modelling to consider the coal handling/processing and the construction works happening at the same time;
6. the relevant noise criteria which is to apply when both extraction and construction are occurring;
7. the hours that will apply to the simultaneous operations; and
8. what is the cumulative noise impact for coal handling/processing and construction, acknowledging that the construction noise modelling does not consider meteorological effects.

In order to assess the potential impacts on the Property the Applicant should, at a minimum, provide the information set out above so that a proper assessment can be undertaken by the Crookes and the Department in relation to the noise exposure and impacts of the Project on the Property. Based on the current information and data in the NVA the Project will have noise impacts on the Property, particularly when compared to the current and reported estimated background noise levels.

ATKINS ACOUSTICS & ASSOCIATES PTY LTD

Graham Atkins

Appendix D – Review of Air Quality Impact Assessment
Northstar Air Quality Pty Ltd

Letter Report



Date: Friday, 2 June 2017

Watson Park Pty Ltd

C/- Richard Crookes Constructions, 214 Willoughby Road, Naremburn, NSW

FAO: C/- Emma Whitney (Colin Biggers & Paisley Pty Ltd)

Project Name: Watson Park – Review of Hume Coal Air Quality Impact Assessment

Reference: 17.1063.DR1V2

CONFIDENTIAL | SUBJECT TO LEGAL PRIVILEGE

Northstar Air Quality Pty Ltd (Northstar) was commissioned by Watson Park Pty Ltd to provide an independent review of the Air Quality Impact Assessment (AQIA) prepared by Ramboll Environ on behalf of EMM Consulting Pty Ltd for the Hume Coal Project.

The document reviewed was accessed from the NSW Planning & Environment Major Projects portal at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172. The AQIA is presented as Appendix K of that Environmental Impact Statement (EIS).

For and on behalf of

Northstar Air Quality Pty Ltd

Peer review performed by:

Gary Graham
Director

Northstar QA/QC review performed by:

Martin Doyle
Director

1. QUALIFICATIONS

This peer review has been performed by Gary Graham, Director of Northstar Air Quality Pty Ltd (Northstar).

For the purposes of providing adequate QA/QC controls, this document has been reviewed by Martin Doyle, Director of Northstar Air Quality.

Copies of the relevant CV are presented in **Appendix A**.

Gary Graham

Gary is a Director with Northstar and has over 23 years' experience in environmental management and assessment with a specialism in air quality sciences.

He is a Certified Air Quality Professional (CAQP), Chartered Scientist (CSci), Chartered Environmentalist (CEnv), Chartered Water and Environmental Manager (C.WEM MCIWEM) and a PRINCE2 certified project manager with extensive experience in multi-disciplinary consultancy with an emphasis within the air quality, environmental permitting, compliance, environmental planning and waste management sectors. He has significant expertise in odour management.

He has provided technical and management advice to a broad cross-section of clients, including the World Bank, European Bank for Reconstruction and Development, central government agencies in Europe and Australia, (including Australian DOD, NSW DECCW/EPA, NSW OEH, INSW, UK DEFRA and Highways Agency), councils, development agencies, energy, industry, infrastructure, waste and urban renewal sectors.

His experience in air quality matters covers a wide range of services, and has fulfilled roles performing ambient and UKAS accredited process emissions monitoring, as a Local Site Operator for the management, data validation and reporting of a number of ambient air quality monitoring stations as part of the UK Automatic Urban and Rural Monitoring Networks on behalf of the UK DEFRA, the commercial construction and operation of a fleet of mobile ambient monitoring stations, and was previously (before starting Northstar Air Quality with Martin Doyle) the manager of an Australian NATA-accredited ambient and process emissions monitoring team, and was a NATA endorsed signatory for all monitoring reports.

He regularly provides peer review services on behalf of Councils and other stakeholders, and is regularly requested to provide expert witness, testimony and evidence across Australia on air quality, dust, odour and spray drift matters. He has been engaged as an expert witness on behalf of NSW EPA, NSW Department of Planning and Environment, WA State Solicitor's Office, UK Highways Agency, and direct appointed by the NSW Land and Environment Court.

Martin Doyle

Martin has over 18 years of experience in the field of air quality, from academic research to public and private environmental consultancy. He completed his doctorate in 2004 in the area of air pollution meteorology and was a Senior Research Associate at the University of East Anglia, which has the UK’s highest rating for the quality of environmental research undertaken. His work has been included in UK Department of the Environment, Food and Rural Affairs Air Quality Expert Group state-of-science reports on PM₁₀ and NO₂.

His major areas of expertise include air quality monitoring (including monitoring network design and data analysis), emissions inventory development, atmospheric dispersion modelling, greenhouse gas assessment and climate change impact assessment, independent peer review and performance of audits.

2. REVIEW METHODOLOGY

The aim of this peer review is not to provide a value judgement on the quality of the work performed, but identify matters that may be regarded as limitations or a risk to the conclusions drawn from the report(s).

The observations have been categorised as presented in **Table 1** below.

Table 1 Peer Review Significance Descriptors

Significance	Description
Observation	Observation / comment only
Low	Issues identified are not likely to change the conclusions of the report
Medium	Issues identified may have the potential to change the conclusions of the report
High	Issues identified have the potential to change the conclusions of the report

The categorisation relates to an opinion of the potential significance of the observation upon the conclusions of the reviewed document(s). For example, where an observation is made, but the relevance of that observation would not make a difference to the conclusions, that would be classified as ‘low’.

A tabulated summary of identified issues is provided below in **Table 2**. It is recommended that any commentary provided by Northstar as to the potential impact of issues identified should be considered by the relevant parties.

The following observations and comments were noted to be of ‘high’ significance:

- Cumulative impacts of particulates not adequately demonstrated:** The AQIA does not present cumulative impacts for particulates at the identified receptor locations, as it is required to do following guidance provided in the NSW EPA *Approved Methods*. Without the predicted cumulative particulate impacts, the level of risk from particulates at the surrounding properties is not determinable.
- Background air quality data selection:** The selection and use of ‘background’ air quality data is questioned. In some instances, the 5-year average concentrations are used in lieu of the contemporaneous values, which potentially distorts the assessment. This data forms an important

component of the assessed cumulative impacts, and is a metric to determine the relative receiving capacity and sensitivity of the environment to increased pollutant loads.

- **Construction impacts on the Hume Highway:** The potential impacts from the construction phase should be assessed at locations on the Hume Highway, as this is proximate to the proposed development site.
- **Validity of stockpile veneering:** The use of veneering on product stockpiles is questioned, as the additional and removal of material on the stockpile would disrupt the containment and control that might be generated through veneering technologies.

3. SUMMARY

The independent peer review performed by Northstar Air Quality has identified a number of issues which may require consideration.

Table 2 Peer Review Summary

Ref	Section	Comment	Significance
1.	2.3	The table of selected sensitive receptors would be significantly improved with a description of the receptor (type and address) or at least the receptor type. For example, R37: 180 'residential property at 180 Belanglo Road'.	Observation
2.	5.2.2	For clarity, the last line in paragraph 2 should read <i>"The 5-year average TSP concentration is 37.6 µg/m³."</i> Whilst the data is not provided numerically, the 2013 annual average TSP concentration (contemporaneous with the selected meteorology period) is estimated to be ~45 µg·m ⁻³ .	Low
3.	5.2.3	<i>"There is good agreement between the local stations (Hume TEOM1 and Boral Berrima) with stations located further afield (Bargo, Camden and Monash), indicating that the Hume TEOM1 PM₁₀ dataset is appropriate for the representation of ambient concentrations in the local area and regional influences area notable to ambient particulate matter concentrations."</i> The justification for this statement is not clear. Figure 5-2 is too small and 'cluttered' to support this statement and Figure 5-3 shows a frequency distribution across the various sites without a clearly defined trend that by itself does not support the statement. As this approach is used to justify the selection of background data used in the assessment it is considered to be inadequately justified.	Medium

Ref	Section	Comment	Significance
4.	5.2.3	<p><i>"The Boral Berrima station shows a higher occurrence of elevated PM₁₀ concentrations (>30 µg·m⁻³) and is considered reflective of the localised influence of the emissions of the cement works."</i></p> <p>Intuitively this would appear to be reasonable, and a pollution-rose demonstrating the directional bias at this location should be provided. It is noted that this approach has been used, although not shown, to justify the selection of TEOM1 PM_{2.5} data (see also 7).</p> <p>It is also noted that Figure 5-4 shows a lower annual average PM₁₀ concentration at Boral Berrima than Hume which would be incongruous with the above.</p>	Low
5.	5.2.3	<p>It is noted that the frequency distribution of 24-hour PM₁₀ concentrations for Boral Berrima (site consistent with that used for the TSP background) shows a higher distribution of PM₁₀ data in the ranges 40-50 µg·m⁻³ and > 50 µg·m⁻³ when compared to other distributions.</p>	Observation
6.	5.2.3	<p>For clarity, the last line on p39 should read <i>"The 5-year average PM₁₀ concentration across the Hume TEOM1 dataset is 14.3 µg/m³."</i></p> <p>Whilst the data is not provided numerically, the 2013 annual average PM₁₀ concentration (contemporaneous with the selected meteorology period) is estimated to be ~15 µg·m⁻³.</p>	Observation
7.	5.2.4, bullet 1	<p>The <i>"analysis of concurrent wind direction data from the Hume 1 station with recorded concentrations"</i> (a pollution rose) is discussed but is not presented in the AQIA report. This statement is therefore unsubstantiated.</p>	Observation
8.	5.2.4	<p>For clarity, the last line in the section should read <i>"The 2-year average PM_{2.5} concentration across the derived Hume PM_{2.5} dataset is 6.3 µg/m³."</i></p> <p>Whilst the data is not provided numerically, the 2013 annual average PM_{2.5} concentration (contemporaneous with the selected meteorology period) is estimated to be very similar, i.e. ~6.3 µg·m⁻³.</p>	Low
9.	5.2.5	<p>For clarity, the last line in paragraph 1 should read <i>"The 5-year average across all sites between 2012 and 2015 is 0.8 g/m²/month."</i></p> <p>Whilst the data is not provided numerically, the 2013 annual average dust deposition rate (contemporaneous with the selected meteorology period) is estimated to be between (approx.) 0.6 and 1.8 g·m⁻²·month⁻¹ (as an annual average of all site-DDG).</p>	Low

Ref	Section	Comment	Significance
10.	5.2.7	Further to comments at 2 to 9, the assumptions used for background estimations should be reviewed and justified. Whilst inter-year variability in background air quality conditions is required to be examined, the use of 5-year average data is not considered to be appropriate. The report should adopt local 2013 background data primarily, and discuss the sensitivity of the cumulative predictions to annual variability.	High
11.	5.2.7	Further to the comment at 10, the use of PM ₁₀ monitoring data at Bargo, Camden and Monash is not considered to be appropriate or adequately justified, given the availability of local data sources. Using these sites as data sources, and incorporating these data into the Monte Carlo analyses is considered to potentially distort the results.	High
12.	9	It is considered that construction phase impacts should be assessed at receptor locations on the Hume Highway. It is considered that short-term dust plumes may have a significant and unquantified risk to vehicles using the road. The report should address this risk.	High
13.	9.1.1	The construction-phase air quality assessment has been performed on a qualitative (modelling) basis, and presents incremental impacts only. The AQIA does not present results quantifying or illustrating the resultant cumulative impacts (inclusive of assumed background and neighbouring processes) and therefore the resultant impacts on the receiving environment cannot be determined.	Medium
14.	9.1.1 bullet point 3	The validity of the second mitigation scenario with product stockpile veneering is questioned. It would seem logical that the addition and removal of materials from that stockpile would disrupt the containment / control that might be generated through veneering techniques. It is considered that justification of this proposed mitigation measure as a realistic control is provided.	High
15.	9.1.3	It is a requirement in the NSW EPA <i>Approved Methods</i> that an AQIA is required to present predicted cumulative impacts at all receptors in a tabulated form (increment, background, cumulative). This has not been provided in the AQIA. Critically, as the particulate results have not been presented adopting the required approach, it cannot be determined from the AQIA if the PM ₁₀ / PM _{2.5} / TSP / deposited dust criteria are exceeded, under what circumstances and, whether (or not) there are predicted to be more exceedances of the criteria than resultant from background fluctuations alone.	High

Ref	Section	Comment	Significance
16.	9.1.3	Monte Carlo frequency analyses are presented in the report as Figure 9-7 and Figure 9-8 for PM ₁₀ and PM _{2.5} respectively. This type of analysis is often (and increasingly) used in this regard to add more clarity to exceedance analysis (see 15), but the AQIA does not present the required step of tabulating results as required under the NSW Approved Methods and therefore does not present a critical step in transparent reporting.	Observation
17.	9.1.3	The Monte Carlo frequency analyses should be revised after due consideration of the applicability of background air quality data (see 10).	High
18.	9.1.3	The Monte Carlo frequency distribution histograms show predicted exceedances of the respective PM ₁₀ and PM _{2.5} criteria. How the conditions leading to the predicted exceedances are to be managed are not discussed in the AQIA (here or in Section 10).	High
19.	10	Section 10 does not present any recommendations (mitigation measures) for control of particulates associated with construction. This should be provided in cognisance of the comment at 12 also.	Medium

Appendix A - CV

Gary Graham

Director

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qualifications

- Bachelor of Science with Honours BSc (hons), Environmental Science, 1992
- Master of Science (MSc), Wastes Management, 1994
- Certified Air Quality Professional (CAQP), CASANZ
- Chartered Scientist (CSci), Science Council
- Chartered Environmentalist (CEnv), Society of the Environment
- Chartered Water and Environmental Manager (C.WEM), CIWEM
- PRINCE2 Foundation and Practitioner

membership

- Elected Member of Clean Air Society of Australia and New Zealand (CASANZ) Committee for NSW, NSW Treasurer
- Member of the Chartered Institution of Water and Environmental Management (MCIWEM)
- Institute of Acoustics Certificate and Competence in Environmental Noise Measurement (IoA CoC)

special expertise

Gary provides a range of expertise including:

- Expert witness, testimony and evidence
- Peer review of technical reports
- Air quality impact assessment
- Air quality monitoring programs
- Odour and dust management
- Indoor air quality and occupational exposure
- Process due diligence and Industrial regulation
- Management of Environmental Impact Assessment studies and planning applications

background

Gary is a Director with Northstar and has over 23 years' experience in environmental management and assessment with a specialism in air quality sciences.

He is a Certified Air Quality Professional (CAQP), Chartered Scientist (CSci), Chartered Environmentalist (CEnv), Chartered Water and Environmental Manager (C.WEM MCIWEM) and a PRINCE2 certified project manager with extensive experience in multi-disciplinary consultancy with an emphasis within the air quality, environmental permitting, compliance, environmental planning and waste management sectors. He has significant expertise in odour management.

He has provided technical and management advice to a broad cross-section of clients, including the World Bank, European Bank for Reconstruction and Development, central government agencies in Europe and Australia, (including Australian DOD, NSW DECCW/EPA, NSW OEHL, INSW, UK DEFRA and Highways Agency), councils, development agencies, energy, industry, infrastructure, waste and urban renewal sectors.

He has substantial experience in advising clients through the environmental assessment process, and has directed and managed scores of multi-disciplinary Environmental Assessments for a wide range of developments, including being lead environmental advisor and co-ordinator for the master-planning of a £5.5 billion urban renewal development in NW England. He regularly provides peer review services on behalf of Councils and other stakeholders, and is regularly requested to provide expert witness, testimony and evidence across Australia on air quality, dust, odour and spray drift matters. He has been engaged as an expert witness on behalf of NSW EPA, NSW Department of Planning and Environment, WA State Solicitor's Office, UK Highways Agency, and direct appointed by the NSW Land and Environment Court.

selected project experience



Agribusiness

- Intensive Poultry Facility, Peer Review, NSW
- Intensive Poultry Facility, Peer Review, WA
- Intensive Poultry Facility, Peer Review and Expert Witness, VIC
- Equine Odour Risk Assessment, NSW
- Pig Rearing Facility Peer Review (1), WA
- Blayney Abattoir, NSW
- Broiler Farm Peer Review, Dungog, NSW
- Pig Rearing Facility Peer Review (2), WA
- Westmere Grains, VIC
- Walfertan Tannery Odour Assessment, Expert Witness, NSW
- Kurri Kurri Viniculture Spray Draft Assessment, NSW
- Carbon Foot-printing Tool, UK

Clients in this sector include: 360 Environmental, Australian Turf Club, Darley Estates, Shire of Serpentine Jerrahdale, Hunter Thoroughbred Breeders Association, Saines Lucas Solicitors, TFE Pastoral Company, UK Horticultural Association.



Resources & Waste

- Kewdale Waste Transfer Station, Expert Witness for WA Department of Planning, WA
- Tellus Holdings, Chandler Integrated Mining and Waste Facility, NT
- Tellus Holdings, East Arm Waste Transfer Station Risk Assessment, NT
- WA Limestone, Bayswater Concrete Batching Plant, Expert Witness, WA
- Cleanaway, Erskine Park Waste Transfer Station, NSW
- Genesis Landfill, Expert Witness for NSW EPA
- Boral Kooragang Concrete Batching Plant, NSW
- Bingo Waste Transfer Stations (St Marys, Mortdale), NSW

- Institute of Quarrying Australia Field Booklet – Dust Management
- Woodlawn Bioreactor Project, NSW
- Eastern Creek Organic Resource Recovery Facility, NSW
- Redhill Waste Management Facility, WA
- Tropicana Gold Mine, WA
- Area C Iron Ore Mine, WA
- Rockdale Waste Transfer Station, NSW
- Kemps Creek Alternative Waste Treatment Facility, NSW
- Carrow/Koppio Project, SA
- Chullora, Resource Recovery Park,
- North Ryde Resource Recovery Centre, NSW
- Wafi Golpu, PNG
- Metropolitan Colliery Independent Auditor NSW
- P'nyang Project, PNG
- Eastern Creek Landfill Odour Assessment, NSW
- Genesis Landfill, Expert Auditor, NSW
- Centennial Coal Company, PRP Assessments, NSW
- Roy Hill Iron Ore Project, WA
- Peabody Energy, PRP Assessments, NSW
- FMG Solomon, WA
- Tropicana Gold Project, WA
- Boral Scoresby, VIC
- Drayton South Peer Review, NSW
- Hidden Valley Mine Project, PNG
- Tamperkan Project, Philippines
- Woodsreef Mine Rehabilitation Project, NSW
- Waste Management Centre, Expert Opinion, NSW
- Cavehill Quarry, VIC
- Donald's Mineral Sands, VIC
- Wagga Wagga Sand and Gravel Extraction, NSW
- Bigryli Uranium Exploration Project, NT
- East Guyong Quarry, NSW
- UHG Phase II Mine Extension, Mongolia
- Pre-Acquisition Advice, UK
- Energy from Waste Plant PPC, UK
- Blue Circle Compliance Program, UK
- NEWS Loss of Amenity Study, UK
- Assessment of the Risks to Human Health of Waste Transfer Stations, UK

Clients in this sector include: Aggregates UK Energy Resources, Anglo Gold Ashanti, APP Corporation, BHP BIO, Blue Circle, Cleanaway, Coffey International, Eastern Metropolitan Regional Council, Energy Metals, Environmental Earth Sciences, Gamut Consulting, Hanson, Hunter Thoroughbred Breeders Association, Institute of Quarrying Australia, Mongolian Mining Corporation, Norfolk Environmental Waste Service, NSW DPE, NSW EPA, NSW Dept of Mines, NSW WAMC, Peabody Energy, Port Stephens Council, Roy Hill Iron Ore, SITA, SUEZ, Tellus Holdings, UK Environment Agency, Vallance, WA Department of Planning, WA Limestone, WA State Solicitors Office.



Property

- Residential Subdivision Tenambit, Expert Witness, NSW
- Childcare Centre, Expert Witness, NSW LEC
- Kitchen Exhaust Ventilation Assessment. Expert Witness, NSW DC,
- Beerwah Land Sterilisation Investigation, QLD
- Marsden Park North Development, NSW
- Leppington Precinct Development, NSW
- South Orange Urban Release Area, NSW
- Oakdale Central Development, NSW
- Warehouse and Distribution Facility, Chullora NSW
- Berry's Bay Marina Project, NSW
- Equine Development, Peer Review and s.34 Conferencing, NSW
- Wilton Junction Land Use Mapping, NSW
- Oakdale West Development, NSW
- Mercure Odour Audit, NSW
- Crowne Plaza Hunter Valley Brewery Odour Assessment, NSW
- Willoughby Council Compliance Assessment, NSW
- Crowne Plaza Newcastle Brewery Odour, NSW
- Hurricanes Bar & Grill Odour Management, Darling Harbour, Bondi, Brighton-le-Sands, NSW
- Bungarabee Estate Data Centre, NSW
- Ridges World Square Schwartz Brewery Odour Audit, NSW

- Residential Risk Assessment, Peer Review, NSW
- Odour Risk Assessment, Peer Review, NSW
- McDonalds Retained Odour Expert, Expert Witness LEC Multiple Sites, NSW
- Catherine Fields Part Precinct, NSW
- Smash Repair Facility Odour Peer Review, Peer Review, NSW
- Brooklyn Child Care Centre, NSW
- Countess of Chester Health Park Environmental Expert, UK
- Bacton Homes Background Environmental Studies, UK
- Environmental Auditing (Pre-acquisition), UK

Clients in this sector include: Bellway Homes, Camden Council, City of Sydney Council, Elton Consulting, English Partnerships, GAT & Associates, Geolyse, Goodman, Hosking Munro, Hurricanes, JBA Planning, Kamrani Estates, NSW DPE, NSW EPA, NSW Land and Environment Court (direct appointment), Port Stephens Council, Shine Pre-School, Valad Property Group, Worley Parsons, Willoughby Council.



Transport & Infrastructure

- NorthConnex Peer Review, NSW
- Lower Main North Quadruplication Lite, NSW
- Sydney Harbour Bridge Lead Paint Removal Compliance and Verification, NSW
- Capital Metro Stage 1 EIS, ACT
- WestConnex Peer Review, NSW
- NorthWest Rail Link, Baseline Program, NSW
- Kranji Marshes, Singapore
- Toowoomba Second Range Crossing, QLD
- Sentosa Gateway Junction Project, Singapore
- JSF Impact Assessment, NSW, NT, QLD, SA, WA
- Enfield Intermodal Logistics Centre, NSW
- North Ryde Transport Orientated Development, NSW
- Enfield to Chatswood Rail Line, NSW
- Mitchell's Transportation Efficiency Project, WA
- M1 Motorway Service Station, NSW

- Brisbane North Guided Busway, QLD
- RAAF Williamstown AQ Program Review, NSW
- New Raynesway Grade Separated Junction Expert Witness, UK
- Manchester Airport Freight Forwarding Unit EIA
- Farnworth Multi-Use Development UK
- Manchester Airport T3 Apron Extension EIA, UK
- Beverley Southern Relief Road EIA, UK
- A1 Dualling and Realignment Stage 2/3, UK
- Templeborough Estates EIA, UK
- Denbigh Multi-Use Development EIA, UK
- Liverpool Water Environmental Co-ordinator, UK
- Preston East Employment Park EIA, UK
- ForthQuarter Development EIA, UK
- Liverpool Garden Festival EIA, UK
- Merseytravel Mersey Rapid Transit EIA, UK
- Bishkek Public Transport Assessment, Ministry for Transport, Kyrgyzstan
- Woolston Riverside EIA, UK
- WWTW Odour Impact Assessment (multiple sites), UK
- Lower Liffey Crossing, Eire
- M60 Improvement Program J12-J18, UK
- Local Air Quality Management, AQRA, Local Authorities (numerous) UK

Clients in this sector include: Australian DoD, Bank of Ireland, Camden Council, Cathco Property Group, East Riding of Yorkshire Council, EG Property Group, ForthQuarter plc, Grampian Water, Hornsby Shire Council, Jaguar Estates, Kamrani Estates, Langree Housing, Lend Lease, Manchester Airport plc, Merseytravel plc, Mitchell's, NSW DPE, NSW EPA, NSW Land and Environment Court (direct appointment), NSW Ports, Peel Group, QLD DTMR, South East England Development Agency, Strathfield Council, Sydney Harbour Bridge Alliance, Sydney Water, Transport for NSW, UK Highways Agency, Urbis, Yorkshire Water, World Bank / EBRD.

Industry

- NSW OEH, Load-based Licensing (LBL) Review, NSW
- Department of Planning, Independent Auditor, Shoalhaven, NSW
- NSW OEH, Review of International Best Practice – Air Quality Monitoring Network Design and Operation, Australia
- NSW OEH, Review of NEPM Monitoring Networks, Australia
- Regulatory and Planning Advice, Licella, NSW, ACT & UK
- APC Performance Evaluation Insurance Advice, NSW
- Boral Kooragang Island Materials Recycling Facility, NSW
- Bayswater Concrete Batching Plant, Expert Witness, WA SAT
- NSW Fire and Rescue Compartmental Fire Behaviour Training Facility, NSW
- Frenchs Forest Bushland Crematorium, NSW
- Crash Repair Facility, Peer Review and s34 Conferencing, NSW
- Pentarch Munitions Disposal Project, NSW
- Orica Accidental Ammonia Discharge, Peer Review and Expert Opinion, NSW
- Boral Scoresby Opportunities and Constraints Assessment, VIC
- Port of Melbourne Peer Review, VIC
- Tuggeranong Crematorium, ACT
- VOC Exposure from Household Sources NSW EPA, NSW
- Boral Berrima Cement Works, NSW
- Nuplex POEO Review, NSW
- Boral Granville Concrete Batching Plant, NSW
- Givaudan Odour Management, NSW
- HCMC Bakery Odour Assessment, Vietnam
- Hunter River Remediation Project Compliance Program, NSW
- Walfertan Tannery Odour Assessment, Expert Witness, NSW

- Adelaide Desalination Plant Environmental Management Plans, SA
- Nestlé, Hayes Odour Management, UK
- Nestlé, Burton-on-Trent, Odour Management, UK
- Quinn Radiators, UK
- Ford Dagenham Compliance Program, UK
- Ford Halewood Compliance Program, UK
- Ardagh Glass, UK
- Humber Energy / Fibres Worldwide PPC, UK
- British Steel / Tata Compliance Program, UK
- UK HMIP / Environment Agency Clinical & Chemical Incineration Sector Compliance Program

Clients in this sector include: AB Mauri, Ardagh Glass, British Steel / Tata Steel, City of Sydney Council, Darley Stud, Environmental Property Services, Fibres Worldwide, Ford Motor Company, Givaudan, Ignite Architects, Moray & Agnew, Nestlé, NSW Fire and Rescue, Nuplex, Pentarch, Port of Melbourne Corporation, Quinn Radiators, SA Water, Theiss, WA Limestone, UK Environment Agency.



Energy

- Alinta Energy, Mallala Power Station, SA
- Alinta Energy, Fate of Emissions Study, WA
- Confidential, Expert Witness, QLD
- Port Hedland Power Station, WA
- Sydney Exhibition Centre at Glebe Island, NSW
- West Qurna II Gas Field Development, Iraq
- LGI Landfill Flare Assessments, NSW
- Geelong Refinery Semi-Quantitative Occupational Risk Assessment, VIC
- Solomon Project, WA
- Santos Fairview CS1&2 LNG, QLD
- Immingham Gas Terminal Compliance Program, UK
- Industrial Regulation Advice, UK
- PFI Hospital Site GHG Emissions Trading Scheme Applications, (multiple sites) UK
- Bioverda Energy EIA, PPC, COMAH Assessments, UK
- Isles of Scilly Waste from Energy Plant, UK
- Stockton Energy from Waste, UK

- Tees Valley Biofuels Seed Crushing Plant, UK

Clients in this sector include: Alinta Energy, Balfour Beatty Capital Projects, Bioflame, Bioverda Energy, Coffey International, FMG, Immingham Gas Terminal, INSW, Jersey States, Landfill Gas Industries, Lend Lease, Santos, Shell, SUEZ, Tees Valley Biofuels.

publications

- Balch A, Graham G & Knaggs B, *FIDOL Factors, Odour Nuisance and Risk: The Adaptation of Field Based Odour Assessments using a Field Olfactometer* Proceedings of the 22nd International Clean Air and Environment Conference, Melbourne 2015
- Graham G, *Dust Management Field Booklet* The Institute of Quarrying Australia 2014
- Rahaman F, Lawrence K, Starke G, Graham G & Doyle M, *Estimation of Odour Emissions from Broiler Farms – An Alternative Approach* Proceedings of the 21st Clean Air Society for Australia and New Zealand, Sydney 2013
- Graham G, Lawrence K & Doyle M, *Development of Odour Impact Assessment Methodologies Accounting for Odour 'Offensiveness' or Hedonic Tone* Proceedings of the 21st Clean Air Society for Australia and New Zealand, Sydney 2013
- Graham G, & Lawrence K, *Managing Emissions to Air* Monograph 28 - Australasian Mining and Metallurgical Operating Practices (AMMOP) - Third Edition, Published by The Australasian Institute of Mining and Metallurgy, 2013
- Graham G *Sensitivities in Assessing Cumulative Impacts from Extractive Processes* Proceedings of the 4th Annual Dust Management Strategies, Brisbane, Australia, 2010
- Bradbeer E, Clayton J, Graham G & Wood S, *Cost Effective Health Risk Assessments: An Occupational Health and Safety Approach* Proceedings of the 5th International Workshop on Chemical Bioavailability in the Environment, Adelaide, Australia 2009

Martin Doyle

Director

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qualifications

- PhD Air Quality Meteorology (University of East Anglia, UK, 2004)
- BSc (Hons) Environmental Science (University of East Anglia, UK, 1998)
- Certified Air Quality Professional (CAQP), Clean Air Society of Australia and New Zealand (CASANZ)

membership

- CASANZ NSW Branch Committee member 2007 - 2012
- CASANZ NSW Branch Training Activities Coordinator 2007 - 2012
- CASANZ Federal Deputy Chair Training Activities Executive 2008 - 2010

special expertise

Martin provides a range of expertise including:

- Air quality and greenhouse gas impact assessment
- Dispersion modelling studies including a range of specialist software
- Ambient air quality and meteorology studies
- Satellite remote sensing
- Geographical Information Systems (GIS)
- Indoor air quality and occupational exposure assessment
- Process & air pollution control due diligence and testing
- Odour impact assessment and audit
- Climate change impact assessment
- Expert testimony and witness
- Independent peer review and audit

background

Martin has over 18 years of experience in the field of air quality, from academic research to public and private environmental consultancy. He completed his doctorate in 2004 in the area of air pollution meteorology and was a Senior Research Associate at the University of East Anglia, which has the UK's highest rating for the quality of environmental research undertaken. His work has been included in UK Department of the Environment, Food and Rural Affairs Air Quality Expert Group state-of-science reports on PM₁₀ and NO₂.

His major areas of expertise include air quality monitoring (including monitoring network design and data analysis), emissions inventory development, atmospheric dispersion modelling (using TAPM, CALPUFF, AUSPLUME, CALINE and AERMOD), greenhouse gas assessment and climate change impact assessment, independent peer review and performance of audits.

Martin has significant experience across all sectors (see overleaf) and broad experience in assessment of air pollutants including odour.

Use of Geographical Information Systems (GIS) and other software to present data to non-specialists in easy to understand formats is one of Martin's key interests.

selected project experience



Agribusiness

- Intensive Poultry Facility, Peer Review, NSW
- Blayney Abattoir, NSW
- Bourke Small Stock Abattoir, NSW
- The Ranch Poultry Complex, NSW
- Abattoir and Rendering Plant, NSW
- Maylands Poultry Farm, NSW
- Milk Production Facility, NSW
- Serpentine Poultry Farm Expansion, WA
- Westmere Grains, VIC

Clients in this sector include: CAPRA Development, Dairy Farmers, Darmad, Saines Lucas Solicitors, Scolexia, Thomas Foods International Tamworth.



Resources & Waste

- Confidential, Integrated Mining and Waste Development, NT
- East Arm Waste Transfer Station Risk Assessment, NT
- Erskine Park Waste Transfer Station, NSW
- Bingo Waste Transfer Stations (St Marys, Mortdale), NSW
- Albion Park Quarry, NSW
- Glenfield Waste Services Materials Recycling Facility, NSW
- Kemps Creek Alternative Waste Treatment Facility, NSW
- Twinza Oil Project, PNG (GHG)
- Wafi Golpu Project, PNG (GHG)
- P'nyang Project, PNG (GHG)
- Mandalong Southern Extension Project, NSW
- Springvale Mine Extension Project, NSW
- Angus Place Mine Extension Project, NSW
- Lidsdale Siding Extension Project, NSW
- Airly Mine Extension Project, NSW
- Clarence Colliery REA V Project, NSW
- Northern Coal Logistics Project, NSW
- Neubeck Coal Project, NSW
- Karuah Quarry East Expansion Project, NSW
- Jandra Quarry Expansion Project, NSW
- Woodsreef Mine Rehabilitation Project, NSW
- Eastern Creek Organic Resource Recovery Facility, NSW
- Centennial Coal Company, PRP Assessments, NSW
- Peabody Energy, PRP Assessments, NSW
- Solomon Project, WA
- Carrow/Koppio Project, SA
- Area C Iron Ore Mine, WA
- Ace Landscapes Dust Management, NSW
- Redhill Waste Management Facility, WA
- Dromana Landfill, Mornington Peninsula, VIC
- Tropicana Gold Mine, WA
- Woodlawn Bioreactor Project, NSW
- Bigryli Uranium Exploration Project, NT
- Narrabri Coal Project, NSW
- Roy Hill Iron Ore Project, WA
- Glebe Island Bulk Sands Project, NSW
- Duralie Coal Mine Extension Project, NSW
- Cavehill Quarry, VIC
- Central Coast Sands, NSW
- Donalds Mineral Sands, VIC
- Brickworks (Client Confidential), VIC
- Sepon Gold and Copper Mine, Laos
- Werris Creek Coal Mine, NSW
- East Guyong Quarry, NSW
- Darling Downs Sand Extraction Project, QLD
- Belmont and Sunnyside Coal, NSW
- Whitehaven CHPP, NSW
- Wagga Wagga Sand and Gravel Extraction, NSW
- Roy Hill Iron Ore, WA
- Solomon Iron Ore Project, WA
- Leongatha Quarry Extension, VIC (GHG)
- Narrabri CSG Power Plant, NSW (GHG)
- Sunnyside Coal Project, NSW (GHG)

Clients in this sector include: Ace Landscapes, Anglo Gold Ashanti, APP Corporation, BHP BIO, Boral, Centennial Coal Company, Cleanaway, Cleary Bros, Coffey International, Energy Metals, Environmental Earth Sciences, Environmental Property Services, EMRC, Erias Group, ExxonMobil, Fortescue Metals Group, Hanson, Holcim, NSW Department of Mines, Peabody Energy, Roy Hill Iron Ore, SUEZ Australia, Tellus Holdings Ltd, Veolia, Whitehaven Coal, Xstrata.



Property

- Horsley Drive Business Park Warehouse and Distribution Facility, NSW
- Childcare Centre Air Quality Assessment, NSW
- Poultry Farm Odour Assessment, Austral NSW
- Marsden Park North Development, NSW
- Survitec Development Application, NSW
- Tyres4U Development Application, NSW
- Leppington Precinct Development, NSW
- Emerald Hills Development, NSW
- Trinity Point Marina Project, NSW
- South Orange Urban Release Area, NSW
- Warehouse and Distribution Facility, Chullora NSW
- Berrys Bay Marina Project, NSW
- Culburra STP, NSW
- Oakdale Central Development, NSW
- Oakdale West Development, NSW
- Acacia Ridge Campus AQ Investigation, QLD
- Wilton Junction Land Use Mapping, NSW
- Bungaribee Estate Data Centre, NSW
- Orange Pump Station No.1, NSW
- North Orange Pump Station, NSW
- Crowne Plaza Newcastle Brewery Odour, NSW
- Crowne Plaza Hunter Valley Brewery Odour Assessment, NSW
- P&N Beverages Odour Assessment, NSW
- Hurricanes Bar & Grill Odour Management, Darling Harbour, Bondi, Brighton-le-Sands, NSW
- Ridges World Square Schwartz Brewery Odour Audit, NSW

- Newtown Hotel Odour Audit, NSW
- Club Burwood, Smoking Balcony AQ Assessment, NSW
- Leppington Part Precinct, NSW
- Currarong Sewerage Scheme - CEMP audit, NSW
- Brooklyn Child Care Centre, NSW
- Emirates Wolgan Valley Resort - CEMP audit, NSW
- Fairfield RSL - Environmental Audit, NSW
- VOC Monitoring, Reserve Bank of Australia, NSW
- Great Barrier Reef Marine Park Authority, QLD (GHG)

Clients in this sector include: ADW Johnson, Cardno, City of Sydney Council, Commercial & Industrial Property Group, Elton Consulting, Frasers Property Group, Geolyse, Goodman, Hosking Munro, JBA Planning, Meriton, Mirvac, QLD DPW, Shine Pre-School, Urbis, Worley Parsons.



Transport & Infrastructure

- Sydney Metro EIS Peer Review, NSW
- WestConnex Peer Review, NSW
- NorthConnex Peer Review, NSW
- Lower Main North Quadruplication Lite, NSW
- Epping to Chatswood Rail Line, NSW
- Enfield Intermodal Logistics Centre, NSW
- Northern Coal Logistics, NSW
- Capital Metro Stage 1 EIS, ACT
- Solomon Project Road Transportation Study, WA
- Sydney Harbour Bridge Lead Paint Removal Compliance and Verification, NSW
- North Ryde Transport Orientated Development, NSW
- Enfield to Chatswood Rail Line, NSW
- M1 Motorway Service Station, NSW
- Mitchell's Transportation Efficiency Project, WA
- Enfield Intermodal Logistics Centre, NSW
- M2 Upgrade, Sydney NSW
- Majura Parkway, ACT
- Clarrie Hermes Drive Extension, ACT

Clients in this sector include: Centennial Coal, EG Property Group, Fortescue Metals Group, Goodman, Hornsby Shire Council, Leightons Contractors, McDonalds Australia, Mitchell's, NSW Ports, P&N Beverages, Parsons Brinkerhoff, SMEC, Strathfield Council, Sydney Harbour Bridge Alliance, Transport for NSW, Urbis.



Industry

- Boral Kooragang Island Materials Recycling Facility, NSW
- Frenchs Forest Bushland Crematorium, NSW
- Boral Scoresby Opportunities and Constraints assessment, VIC
- Bluescope Steel PRP Assessment, NSW
- Pentarch Munitions Disposal Project, NSW
- Shoalhaven Starches Odour Audit, NSW
- Boral Granville Concrete Batching Plant, NSW
- Tuggeranong Crematorium, ACT
- Vopak Terminals PRP Assessment, NSW
- Eastern Asphalt Plant, Bairnsdale VIC
- Givaudan Odour Management, NSW
- Allens Asphalt, QLD
- SIMS Metal, QLD
- Metals Recycling Facility, NSW

Clients in this sector include: Bluescope Steel, Boral, Canberra Cemeteries, Environmental Property Services, Givaudan, Ignite Architects, Pentarch, Shoalhaven Starches, Vopak.



Energy

- Port Hedland Power Station, WA
- Solomon Project, WA
- West Qurna II Gas Field Development, Iraq
- Munmorah & Bayswater B Independent Peer Review, NSW
- Santos Fairview CS1&2 LNG, QLD

- Bamarang Power Station, NSW (including Plume Rise Assessment)
- Powergen, UK
- TXU Energi, UK

Clients in this sector include: Alinta Energy, Coffey International, Fortescue Metals Group, GHD, NSW Department of Planning and Environment, Infratil Energy, Santos.

publications

Rahaman F, Lawrence K, Starke G, Graham G & Doyle M, *Estimation of Odour Emissions from Broiler Farms – An Alternative Approach* Proceedings of the 21st Clean Air Society for Australia and New Zealand, Sydney 2013

Graham G, Lawrence K & Doyle M, *Development of Odour Impact Assessment Methodologies Accounting for Odour 'Offensiveness' or Hedonic Tone* Proceedings of the 21st Clean Air Society for Australia and New Zealand, Sydney 2013

Doyle M & Dorling SR, *Particulate Pollution: New Perspectives on Measurement, Source Apportionment and Policy*, Proceedings of the 5th Urban Air Quality Conference, Valencia, Spain, 2005

Doyle M & and Dorling SR, *Meteorological Classification and Aggregation Approaches in Support of Models-3 Air Quality Simulations*, Proceedings of the 4th International Conference on Urban Air Quality. Prague, Czech Republic, pp424-427, 2003

Chatterton T, Dorling SR, Doyle M et al. *A Rigorous Inter-comparison of Ground-level Ozone Predictions*, Atmospheric Environment 37, 3237-3253, 2003

Doyle M & and Dorling SR, *Visibility Trends in the UK 1950 -1997*, Atmospheric Environment, 36, 3161-3172, 2002

Doyle M & and Dorling SR, *Satellite and Ground Based Monitoring of Aerosol Plumes*, Water, Air and Soil Pollution, Volume 2, Numbers 5-6, pp615-629, 2002

Appendix E – Pasture Improvement Letter

Jim Colquhoun, Landmark

LANDMARK

look to us

“Yallambee” Belangalo Road, Berrima

21/6/2017

To Whom it may concern

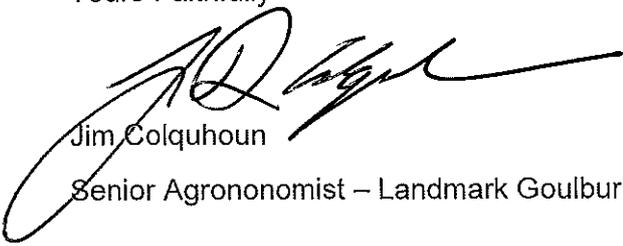
I have been asked by the principals of Watson Park Pty Ltd to report on the fertility status and quality of the pasture-base on “Yallambee”.

The current pasture base consists of deep rooted perennial specials, mainly Phalaris spp. and Cocksfoot. To compliment this perennial grass is a very strong legume base of Sub-clover with some white clover dispersed throughout the sward. The current management has been utilising over-sowing techniques to further enhance the pastures with productive cultivars of Italian and perennial rye-grass species. This has taken the winter carrying capacity of the farm to in excess of 18 D.S.E. per Ha.

Pre-establishment, all pastures have been limed, and large volumes of Poultry Manure have also been utilised the programme to lift soil organic matter levels and improve water holding capacity. Further to this, annual top-dressing applications of granular Nitrogen, Phosphorus, Potassium and Sulphur have been applied to the pastures to ensure that the target soil fertility is maintained. Liquid fertilisers and Gibberellic Acid are also applied to pastures to boost winter pasture growth rates.

Whilst the above comments provide a brief overview of the pasture-base on “Yallambee”, I can be contacted on the number below with any further queries.

Yours Faithfully



Jim Colquhoun

Senior Agronomist – Landmark Goulburn & Moss Vale - 0418 936 305