Senate Standing Committee on Environment and Communications
Legislation Committee
Answers to questions on notice
Environment portfolio

Question No: 60

Hearing: Additional Estimates

Outcome: Outcome 1

Programme: Environment Assessment and Compliance Division (EACD)

Topic: IESC advice

Hansard Page: 125

Question Date: 23 February 2015

Question Type: Spoken

Senator Heffernan, Bill asked:

Mr Knudson: If I can just, hopefully, clarify: we are very happy to provide you with the requests that went to the IESC for advice on this project and also the response from the IESC which gets to some of these issues.
Senator HEFFERNAN: Thank you for that. I am very grateful for that. But you already have advice from the IESC—
Mr Knudson: That is correct.
Senator HEFFERNAN: based on the national partnerships agreement. You say the new arrangement, based on the water trigger, will not be much different, so, if you could provide that information to us, we would know without having to ask you.
Mr Knudson: And we are very happy to provide that.

Answer:

On 12 March 2013, the delegate of the Minister requested advice from the Independent Expert Scientific Committee (IESC) under section 131AB the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the Watermark Coal Project (Attachment A).

Following the announcement that the Government intended to introduce amendments to the EPBC Act to establish a water trigger, this request was withdrawn and the former Minister submitted a new request for advice on 17 April 2013 (Attachment B). This request was cast so that the proposed water trigger could be reflected in the IESC's advice.

The IESC provided its advice in response to the 17 April 2013 request on the Watermark Coal Project on 27 May 2013 (Attachment C). This advice meets the requirement of section 131AB of the EPBC Act for the Minister to obtain IESC advice.

On 26 February 2015, the Minister requested further advice from IESC under section 132 of the EPBC Act (Attachment D).

On 23 March 2015, the Minister requested further advice from the IESC under section 132 to address specific questions raised by the community (Attachment E).

The IESC provided its advice in response to the 26 February 2015 and 23 March 2015 requests on the Watermark Coal Project on 27 April 2015 (Attachment F) and the Department is currently considering this advice.

This advice and the IESC requests are also available on the Department's website.

Request for Advice

Independent Expert Scientific Committee on CSG and Large Coal Mining

1. Summary Details

1.1 Project Title

Project name: Watermark coal project

1.2 Requesting Organisation

Requesting Organisation: Department of Sustainability, Environment, Water, Population and Communities

Regulator: n/a

Representative: James Tregurtha, Assistant Secretary, South Eastern Australia Assessments

Contact Details:

[redacted]

1.3 EPBC Act Referral

Reference: 2011/6201

Assessment / Secondary Officer:

[redacted]

1.4 Advice Stage

- Accredited Assessment, NSW Department of Planning and Infrastructure - Part 4, Division 4.1 of the NSW EP&A Act.
- NSW DP&I have released the Environmental Impact Statement for a period of public comment.
- The EIS documents for the project have been released for a period of public comment, which is open until Friday 26 April 2013.

1.5 Request Details

To inform the department's assessment of likely impacts on the quality and hydrological regimes of water systems that may support matters of national environmental significance (MNES) in and surrounding the project area, the department poses the following questions to the Committee:

- Is the assessment of the current condition of the ground and surface water environments in and surrounding the project area accurate?
- Are the various models used to assess the potential impacts of the project on ground and surface water in and outside the project area, appropriate for the purpose and acceptable as compared to known industry best practice? Are the data and assumptions, on which the models were based, valid and accurate? Have all reasonably foreseeable scenarios been modeled (e.g. low flow periods, climate change, simultaneous flooding events in surrounding water bodies etc.)?

- Are the model output data valid, accurate and representative of the systems they are modeling (including the ephemeral waterways)? Have the output data been presented and interpreted in an appropriate, relevant way, relative to the likely impacts of the proposal, including for the flow regimes of ephemeral waterways within and surrounding the project boundary? What level of confidence can be applied to the results and conclusions presented in the EIS?
- Has the EIS comprehensively identified, assessed and quantified all potential impacts of the proposal on water systems within and outside the project area? If not, what impacts have not been covered and/or what information is required?
- Is the assessment of the nature and extent of post-rehabilitation impacts on ground and surface waters accurate?
- Has the cost-benefit analysis (page 55) properly considered the potential negative impacts of the proposal on water-resources? If not, what would be required to address this?
- Does the Committee find the water management, mitigation and monitoring measures proposed to be appropriate, accurate, reasonable and effective? To what degree, if any, do the proposed mitigation and management measures reduce impacts? Also:
  - Are the water storages proposed during operation sufficient to ensure no contamination of downstream surface waters?
  - Is baseline water monitoring data sufficient to provide an accurate and representative baseline against which changes may be determined during and after mining operations?
  - Are the parameters to be measured in ground and surface water monitoring appropriate and sufficient to cover the likely water quality impacts?
  - Are there any other mitigation measures that could be implemented to further reduce any impacts?
- There are a number of other mines either existing or proposed in the area surrounding the proposed Watermark Coal project. The existence and operating management of these mines within this area raises the possibility of cumulative impacts. Does the Committee identify any particular concerns relating to cumulative impacts?

1.6 Proponent Details

Proponent Name: Shenhua Watermark Coal Pty Limited

Proponent Contact Details:

[redacted]

1.7 Website Links

EIS Documentation available on NSW DP&I website:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4975

Shenhua Watermark Coal Pty Limited website: (not available)

Please note: The specific references throughout this Request for Advice document to figures, page numbers, volumes, appendices and so forth refer to the above EIS documentation (Attachment A – available electronically).

1.8 Public Submissions

During EPBC Act referral: 32 comments

During assessment: The public comment period on the EIS is open until Friday 26 April 2013.

2. Project Description

2.1 Project Location

The project is located approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza within the Gunnedah Local Government Area. The project is located in the Gunnedah Basin which covers more than 15,000 square km in the north-western region of NSW. The Project is approximately 282 km by rail from the export Port of Newcastle.

Figure 1 of the EIS shows the general location of the project site, and Figure 2 (page 6, Chapter 2, Volume 1) indicates the project boundary, and 1st – 4th order and higher streams in the near vicinity, Figure 9 (page 26, Volume 1) shows the layout of the project.

2.2 Project Description

Development and operation of an open cut coal mine for a period of 30 years, extracting up to 268 Mtpa of ROM.

The EIS states a total of 4, 021 ha of woodland and grassland habitat will be removed. The proponent notes that indirect impacts on surrounding vegetation is also possible, but does not provide any information to quantify this.

The EIS states there are deeper coal resources present beyond the 30 year mining limit. Shenhua Watermark may, depending on market factors and resource confirmation, seek further relevant approvals for the extraction of these.

- The proponent does not indicate if they own any adjacent land or exploration licences for any such area. It is not clear where the additional resource (above) is located, how it overlaps with the current proposal or extends beyond it, nor likely timing for pursuing this additional resource.

2.3 Project Type

Development and operation of open cut coal mine.

2.4 Resource

The project will extract the open cut coal reserve from the **Hoskissons and Melvilles seams**.

2.5 Operation Area

- Conceptual detailed design is provided in Appendix B which will be revised and finalized upon seeking relevant additional building and construction approvals.
- The orientation of individual components of the Mine Infrastructure Area (MIA), location and sizing of water management structures and the location of other associated facilities within the Disturbance Boundary are yet to be confirmed. The MIA is anticipated to contain (at least) ... waste water treatment facility and water management infrastructure (see page 43 – 47).
- Total area of the lease does not appear to have been provided in the documentation, nor the depth of the pit.

2.6 Establishment Activities

The EIS indicates that works will be undertaken outside the outside the disturbance boundary (and quite possibly the project boundary) although no detailed information is provided on these proposed works.

The proponent has not included the size of the area within the project boundary. However, the disturbance area (not including indirect impacts) is described as **4, 084 ha** of land disturbance. Construction activities within the disturbance area will include:

- construction and operation of surface and groundwater management and reticulation infrastructure including pipelines, pumping stations/bore field and associated infrastructure for access to water from the groundwater aquifers in the vicinity of the Project, the Mooki River and private dams to the north-east of the project boundary
- construction and operation of a handling and preparation plant,
- waste disposal facilities,
- construction and operation of a rail spur, loop, overpass loading facility and connection to existing railway,
- As stated by the proponent: "Some of the infrastructure such as water, power and communications infrastructure will be located **outside the disturbance boundary (and quite possibly the project boundary).** Additional disturbance associated with ancillary works including fencing, firebreaks, **water diversion structures, pipelines, a bore field, minor contour banks,** access tracks, explosives storage facilities, power lines, **sediment and erosion control structures** will also be required and are part of the Project for which consent is sought."

Further detail on page 25, Section 3, Volume 1.

2.7 Operation Details

- The project seeks to recover approximately 268 Mt of ROM coal within the 30 year mining limit to produce approximately 159 Mt of product coal. Up to 1,629 Million bank cubic metres (Mbcm) of overburden material will be moved and approx. 108 Mt of coal reject and tailings will be produced during processing of ROM coal during the life of the project
- Topsoil will be stripped by scrapers, overburden blasted and removed by shovel or excavator and trucks before proceeding with coal extraction. The fleet will then progress through the sequence to uncover each coal seam to be extracted. Infrastructure supporting day to day activities will be constructed as required. Likely to include, among other things: erosion and sediment control structures, water reticulation systems, in-pit fuelling areas, and storage areas. An equipment list provided on page 37 (Table 7).
- Mine planning predicts approximately 240 blast events per year, or up to an average of 5 blast events per week will be required once mining rates raach a steady state.
- Placement and shaping of overburden and placement of rejects or tailings is described on page 36. Coal handling and preparation, tailings and reject management, page 37–40.
- Tailings and reject management (Volume 1, Chapter 3) – The CHPP will generate coarse rock and fine tailings rejects representing the waste products of the coal preparation process. The indicative volument of coarse rejects and fine tailings to be produced by the Project is in Table 6 (page 36).Coarse rejects and fine tailings will be dewatered as part of the CHPP process and directed to a rejects bin via a conveyor system from the CHPP.

This material will then be loaded onto haul trucks for co-disposal within the OEAs.

- Volume 1 (Chapter 3) – the project will require an ongoing and reliable water source to enable processing of coal and also for dust suppression. The water management system will be designed and operated to minimize the impacts of the Project on downstream water quality. The system will be operated to fully contain mine water on the mine site and to preferentially reuse this water. The project also proposes to draw water from adjoining water sources pursuant to water access licences already held or to be purchased from within the water market. One or more electric pump stations and a pipeline will be constructed to the Mooki River (see Figure 9). The main components of the water-related infrastructure for the project include: Sediment dams to collect and treat runoff from the OEAs; Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams; Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining; A dirty water storage system to store water pumped out of the mining areas and to collect runoff from the CCHPP and coal stockpile area. The mine water dams will be the first priority water sources for read watering and CHPP water demands; and Raw water storage (the Main Dam) from the water supply pipeline.
- Further details provided in Section 7.3

2.8 Lifetime

- The Project will facilitate the extraction of up to 10 Million tonnes per annum ROM coal via open cut mining methods over a 30 year period.
- The project is proposed to be undertaken as expeditiously as possible. No dates are provided by the proponent, only a breakdown of actions referencing year 0 (year to commence) to year 30 of the proposed mine-life.
- Mining operations will commence in the north-west of the Eastern mining Area and by Year 17 active mining will be completed in this area. (see Figure 9); mining operations will then commence in the northern end of the Southern Mining Area – overburden from the SMA will initially be utilized to backfill the EMA void. By approx. year 21, the EMA will be completely backfilled and rehabilitated up to RL 380m. By year 24, active mining will be completed in the SMA. It will then commence in the eastern edge of the Western Mining Area and overburden from this area will but used to backfill the SMA void (completed by year 26). By Year 30 active mining in this area is completed leaving a final void in the WMA.
- There are deeper coal resources present beyond the 30 year mining limit. Shenhua Watermark may, depending on market factors and resource confirmation, seek further relevant approvals for the extraction of these. In this instance the WMA will be ideally placed for underground access to this coal resource.
    - No information is provided on the location of this additional resource, how it overlaps with the current project proposal or when it would be pursued.
- EIS states that should mining operations not continue beyond the 30 year mine plan, the orderly closure of the mine at the time could be achieved.
- See chapter 3 (volume 1) for more detail.

2.9 Residual Site Condition

See mine closure and rehabilitation information, below and in Volume 10, Appendix AA. Permanent changes to ground and surface waters as a result of the project are modeled and discussed in further detail in Volume 8 and Volume 7, respectively and are outlined below.

2.10 Site Rehabilitation

- Volume 1, Chapter 3: Rehabilitation activities will be undertaken progressively and as early as practicable to ensure that the total area of disturbance at any one time is minimized. This will be conducted in conjunction with the open cut mining process. Prior to the re-establishment of vegetation cover, temporary control measures will be utilized for erosion and sediment control. These measures *may* include sediment fences, sand bag sediment traps and rip rap scour protection (see Section 7.21.3). Consideration will be given to erosion and sediment control measures during the construction and operational phases such as restricting access or modifying activities during wet weather, establishing exclusion zones around areas undergoing rehabilitation, reporting erosion and sediment hazards and regular inspections and maintenance of structures.
- Volume 5, Appendix M, Chapter 10.6.3 – Approx. 2,386 ha is proposed to be rehabilitated within the Disturbance Area. Conservation has been given to the retention of land for agricultural purposes. The principle objective will be to recreate and establish, as best as possible, a self-sustaining post-mining landscape that resembles the original vegetation communities. The Biodiversity Management Plan (BMP) will contain further information on the staged rehabilitation of all open cut mining areas and will specify how the Project Boundary will be closed to mining and returned to other land uses. The rehabilitation of portions of the Disturbance Area would be a staged process.
- A final void will remain in the western portion of the disturbance area. The size and depth of this void is not described in the EIS.
- The EIS states a rehabilitation Management Plan (RMP) "will be developed".
- See Volume 10, Appendix AA for further detail.

3 Water Resources

3.1 Regional Water Balance Model

3.1.1 Regional Overview

- The surrounding area is primarily agriculture – pastoral activities and irrigated cropping. Within the project boundary, land use consists of grazing with limited cropping.
- The project is located approx. 25km south-east of the township of Gunnedah. The Gunnedah LGA is located approximately 320m above sea level (m AHD) on the Liverpool Plains of the Namoi River Valley. The region is generally flat. Topography is variable across the project boundary, ranging from Mt Watermark (512 m AHD) and Smokey Point (447m AHD) through to the black soil plains;
- Geological features are described on p29-33, Volume 8, Appendix T.
- A simulation of rainfall runoff for the Mooki River catchment is presented (page 51 of Appendix S) and the EIS also presents flood modeling conducted separately for Watermark Gully and Mooki River waterways.
- It is not clear if flood modeling has been conducted to incorporate a scenario of simultaneous flooding in more than one waterway or to incorporate the potential impacts of climate change.

- It is not clear if the EIS has adequately identified and quantified potential connectivity between relevant ground and surface waters within and surrounding the site, and assessed possible impacts of the proposal on this connectivity.

3.1.2 Regional Groundwater

- The Gunnedah Formation does not exist within the project boundary. The closest occurrence being 900m from the NE corner of the Eastern Mining Area and 1.3k in the south; The Narrabri formation is generally represented by the quaternary alluvium soil boundary of Banks (1995). Accordingly, the Eastern and Southern Mining Areas are set back by a minimum of 150m from the Narrabri Formation.
- A large region of Tertiary volcanic known as the Liverpool Ranges occur some 45km to the south of the project boundary and cover an area of 5, 600 km^2. In a regional context, these tertiary aquifers are important to groundwater flow and constitute a significant recharge source for the alluvium. Flow is dominantly secondary through fracture networks as well as primary flow through weathered and porous vesicular zones within the unit. Fresh groundwater can be associated with the shallow tertiary basalts.
- The upper section of the alluvial groundwater system is characterized by clays, silts and discontinuous lenses of sand. The lower zones are comprised of coarser grained alluvial sands and gravels, semi confined by the overlying clays. Previous investigators have split the Upper Namoi alluvium into two major formations, the Narrabri Formation and the Gunnedah Formation. The Narrabri Formation is typically a brown clay dominated aquitard, which becomes darker near the surface with minor sands and gravels, whereas the Gunnedah Formation is typically a sand and gravel aquifer with minor clay lenses. The sand and gravel channel deposits range in thickness from 5m to 30m. The Narrabri Formation conformably overlies the Gunnedah Formation. The alluvial sequence has been divided in this way to allow the geological complexity that exists to be simplified and represented in models and groundwater flow.
- The Eastern and Southern Mining Areas are set back a minimum of approx. 1 km and 1.3km from the Gunnedah Formation, respectively. They are set back from the Upper Namoi alluvium by a minimum distance of 150m and at least 0.9km from the Gunnedah Formation aquifer. This means a significant zone of bedrock, with a minimum width of 150m will remain between the proposed Eastern and Southern Mining Areas and the black soil plains. If the mining area face in these Mining Areas adjacent to the buffer zone is sloped back for geotechnical reasons at an angle of about 45 degrees, this will increase the buffer distance to approx. 260m at the toe of the SMA and 230m at the toe of the EMA.
- Research in the district indicates recharge to the alluvial aquifers occurs via: surface water seepage through beds of major watercourses (significant), stream flow, seepage at the toe of ridge areas, diffuse rainfall infiltration, irrigation returns, flooding and bedrock up-flow.
- Figure 7.1 indicates the project boundary and the alluvium catchment boundary.
- EIS states "Measurable subsidence has occurred in the Lower Namoi Valley, host to over 30 years of irrigated agriculture. Similar to the Upper Namoi Valley, large quantities of water are extracted to irrigate predominantly cotton crops".

3.1.3 Regional Surface Water

- The project is located within the catchment of the Mooki River, a tributary of the Namoi River.
- Surface runoff from the Disturbance Area drains in one of three general directions:
  - North to the Mooki River floodplain, either via Watermark Gully or other smaller unnamed flow paths;
  - South to Native Dog Gully, a tributary of the Mooki River; or
  - West towards Lake Goran, a large ephemeral lake.

  The catchment boundary and directions of surface drainage are shown in Figure 3.2 (page 13, Appendix S).
- Historical water quality data provided in Appendix S.
- Volume 7, Appendix S, Figure 1.1 – project locality and surrounding waterways.
- Surface water balance model for the site operations – Appendix S, Volume 7, page 68.

3.1.4 Data Uncertainties / Data Integrity Issues

- Refer to Volumes 7 and 8.
- Refer also to the comment made in 2.5 (above).

3.2 Local Water Balance Model incorporating the Site

3.2.1 Site Overview

As above and below.

3.2.2 Local and Site Groundwater Overview

- The main aquifer unit identified within the project boundary is the Clare Sandstone, a relatively coarse and porous unit, particularly where subjected to weathering.
- Numerical simulation of groundwater flow in the aquifers was undertaken using the MODFLOW and SURFACT code.
- The EIS concludes that bores adjacent to the project boundary will not be significantly impacted by predicted reduction in groundwater levels of between 0.5m and 1.5m. Also, when mining is complete in the Southern and Eastern Mining Areas, there will be no net impact on the alluvial aquifer system water supplies due to the Project. Further, predictions from the modeling work indicate negligible effect on alluvial aquifer systems outside the project boundary.
- For further detail see: Chapter 8.

3.2.3 Local and Site Surface Water Overview

- Geomorpohology (Section 7.5, p 150) - Three primary watercourses were identified within the project boundary, including Watermark Gully, Native Dog Gully and the Mooki River. These watercourses are classified as first and second order streams, with the exception of the d/stream reach of NDG and the Mooki River which are third and fourth order streams, respectively. See figure 2. Further detail see pages 150 – 151
- The project is located in the Gunnedah Basin which covers more than 15,000 square km in the north-western region of NSW. The project is located within the catchment of the Mooki River, a tributary of the Namoi River. The headwaters of the Mooki River originate

on the northern slopes of the Liverpool Ranges and Coolah Tops, flowing in a northerly direction to the Namoi River north-east of Gunnedah. Several ephemeral first and second order streams traverse and drain the land within the Project Boundary, including Watermark Gully, Native Dog Gully and a series of smaller unnamed watercourses. Water bodies within the project boundary are primarily represented by farm dams. Further to the west is Lake Goran , which is a naturally occurring ephemeral lake. During periods of intense rainfall the lake overflows to the east via Native Dog Gully. The catchment of Lake Goran is drained by Coomoo Coomoo Creek, Moreduval Hut Gully and Lever Gully from the south and some unnamed watercourses from the north and west. Flooding in the project boundary largely occurs during high rainfall events along Watermark Gully. This regime is typically influenced by surface water runoff from Mt Watermark and the western ridges. Under similar conditions, Native Dog Gully is affected by backwater from the Mooki River. The floodplain area outside the project boundary between Native Dog Gully and Lake Goran is very flat with the flow direction during flood events affected by the relative levels and flows of these watercourses/bodies. [page 5, Chapter 2, Volume 1]

- Water balance models for the site: surface water balance model for the site operations – Appendix S, Volume 7, page 68.

3.2.4 Data Uncertainties / Data Integrity Issues

- See Volumes 7 and 8

4 Impacts of Development

4.1 Groundwater Impacts from Project Activities

Groundwater impacts – information acquired from a desktop assessment was considered as inputs in the development of the groundwater model. A three-dimensional groundwater flow model (MODFLOW SURFACT) was used to simulate the Project's impacts on the groundwater regime over time. The model grid is approximately 75km in width (east to west) and 91 km in length (north to south). Two separate models were constructed for the project – a calibration model and a predictive model. A sensitivity analysis was carried out to rank the input parameters in terms of their influence on the predicted results. It was independently peer reviewed by Dr Noel Merrick, groundwater modeler, hydrogeologist, and geophysicist. A copy of the peer review report is at Appendix T.

Proponent's modeling indicates:

- Groundwater seepage varies throughout the mine life due to mine depth, strata being mined and hydraulic gradients induced by depressurization. Less than 1.5 Mega litres per day until Year 17, 2.1 ML/day Years 17-24 and up to 1.2 ML/day from Year 24 to closure. The contribution of seepage from the coal seams is relatively low. The predicted cumulative inflow of groundwater over the life of mine is approximately 5,500 ML. G
- Page 305 – clarifies that the model predicts an average groundwater seepage rate into the mining areas of 180 ML/year with a peak of up to 760 ML/year. ... [for reference: page 306 – average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10km of the project boundary) is 142 ML/year.
- Impacts on Permian Drawdown ...extends to a maximum of 3.2km in Year 25, predicts a drawdown of 25m or less in the Permian underlying the Narrabri Formation ... and groundwater levels recovering to higher than pre-mining levels ... post-mining. ... mining areas do not directly intersect the alluvial aquifers of the Narrabri and Gunnedah Formations. The ground water model indicates ...close to the mining areas will induce downward vertical flow from the overlying alluvial aquifers into the underlying Permian ...

therefore induces changes in groundwater levels in the alluvial aquifers ... As seasonal variation can be in the range of +/- 1m to 2m it is possible the groundwater drawdowns could be masked during periods of significant sustained recharge.

- The majority of the vegetation to be retained in the project boundary, including Mt Watermark is located in areas where the depth to groundwater is greater than 20m. As such any potential groundwater drawdown resulting from the project is considered unlikely to affect these vegetation communities as the groundwater is already beyond the reach of their roots. Therefore none of the vegetation communities within the project boundary are considered to be completely dependent on groundwater.
- Pages 119 to 136 of Volume1 and also Appendix T (Volume 8) for further detail

4.2 Surface Water Impacts from Project Activities

Volume 1, Page 306 – during average and dry years it is predicted that annual volumes up to 600 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP. **Pages 138 – 149 (surface waters and floods).**
A computer based simulation model (OPSIM) was used to assess dynamics of water balance (volume and salt loads) under varying rainfall and catchment conditions.

The EIS concludes: during the life of the project there is potential for the reduction of catchment flows to surrounding waterways including the Mooki River, Watermark Gully, Native Dog Gully and Lake Goran. A decrease the volume of stormwater runoff consequently result in a reduction of flood discharges:

- Less than 1% of the Mooki River catchment to the confluence with Watermark Gully;
- Approx. 17% of the catchment area of Watermark Gully to the Kamilaroi Highway;
- Approx. 29% of the catchment of Native Dog Gully; and
- Less than 0.4% of the catchment to Lake Goran.

The RAFTS runoff routing model was used to estimate the 2, 5, 10, 20, 50 and 100 year ARI design event flood discharges along Watermark Gully. The project will impact on Watermark Gully through a reduction in contributing catchment area by approx. 25% consequently affecting the magnitude and frequency of flows along the watercourse. In addition, the project will partially fill the main channel in the upper reaches of Watermark Gully for the development of the OEA associated with the Western Mining area. **This will result in a relocation of the main channel further to the east.**

The RAFTS runoff routing model was used to estimate flood discharges along the Mooki River catchment based on design rainfall intesntity-frequency0duration data. The TUFLOW fully two-dimensional hydrodynamic model was used to estimate design flood levels and velocities along the Mooki River and its floodplains, including Native Dog Gully for the 100 year ARI event. ... conclusions: Under a 100 year ARI design flood event along the Mooki River, a small area at the south-east corner of the disturbance boundary will be inundated to a depth of up to 1.7m.The area of inundation is located in a backwater area with very low flow velocities of less than 0.1m/s. Placement of overburden on this small area will not affect flood behavior on the floodplain however, it will reduce the flood storage by approx. 235ML. A shaped levee embankment may be required to be constructed within the Disturbance Boundary to prevent flooding of the mining areas. The remaining area within the Disturbance boundary will be flood free during a 100 year ARI design flood event along the Mooki River.

The project will not impact flood behavior on the Mooki River floodplain.

Appendix S (Volume 7): The water requirements of the project investigated using a site water balance model produced the following results summarized as: There is a 10% chance that the volume of external water supply required in any year from Year 4 to Year 19 will be of the order of 300 to 600 ML/a and under extreme drought conditions (1% chance) the annual volume of external water supply could potentially be 900 ML/a. Water required from external sources will be obtained under appropriate Water Access Licences to ensure no adverse impacts on water availability for other licensed water users.

A mine 'water management system' will be designed and operated to minimize the impacts of the project on downstream water quality. *The 'water management system' has not been detailed in the EIS.*

At completion of the mining, surface runoff from rehabilitated overburden emplacement areas will be released from the site. An area of approx. 108ha, which originally drained to lake Goran, will continue to drain to the mine final void. The changed topography following completion of the Project will have the following impacts on catchment areas:

- The catchment draining north via Watermark Gully to the Kamilaroi Hwy will increase by 5.2 km2, an increase of approximately 13%;
- The catchment draining to Lake Goran will be reduced by 6 km2 this represents a reduction in catchment area of less than 0.5% and, in practical terms, will have no measurable impact on inflows to the lake;
- The catchment draining north to the Mooki River floodplain will be increased by 1.4km2;
- The catchment draining south to Native Dog Gully and Mooki River floodplain will be reduced by 1.6km2, a decrease of approx. 2%.

Water balance simulation of the final void shows that water level is expected to reach an equilibrium water level approx. 20 to 30m below the overflow level. The lake will take approx. 100 years to reach the equilibrium level.

Watermark Gully is affected by a reduction in catchment area of up to about 25%, as well as filling of the upper reaches of the main channel by a proposed overburden emplacement area.

Flood behavior on the Mooki River floodplain will not be affected.

4.3 Landform and Land-use Change Impacts from Project Activities

See above.

4.4 Water Related Assets of National Environmental Significance

- Critically endangered and endangered ecological communities, and threatened flora species, within and surrounding the project area. These ecological communities and species are as identified in the Supplementary Director-General's Requirements (DGR's) (refer Attachment B):
  - **Threatened Ecological Communities**: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically endangered); Grey Box (*Eucalyptus macrocarpa*) grassy Woodlands and Derived native Grasslands of SE Australia (Endangered); Weeping Myall Woodlands ecological community (Endangered).

- **Threatened Flora species:** *Prasaophyllum* sp. Wybong (Critically endangered), *Pterostylis cobarensis* (Vulnerable), *Swainsona murrayana* (Vulnerable), *Thesium austral* (Vulnerable), *Tylophora linearis* (Endangered).

- In addition to areas being directly cleared by the proposal, there may be additional indirect impacts on such matters of NES that occur outside the project boundary, for example, through impacts on water-resources (e.g. groundwater).
- Depending on the extent of impacts on the groundwater and surface water ecosystems surrounding the project boundary, habitat (e.g. listed ecological communities or other vegetation) for threatened fauna species (such as those listed in Appendix A of the Supplementary DGR's) may also be indirectly impacted by the proposal.
- The Murray Cod, listed as vulnerable, occurs in the Namoi catchment. The proponent did not conduct surveys for this species "because no permanent watercourses occur in the Project Boundary". The Department's SPRAT profile indicates Murray Cod has the ability to live in a diverse range of habitats (throughout the Murray Darling Basin), it is considered a main channel specialist as it is frequently found in the main river channel and larger tributaries. However, it is found in floodplain channels when they contain water; although this usage appears limited. Juveniles are most commonly found in the main river channel until about one year of age, after which they branch out.

4.5 Impacts on Other Water Related Assets

See Volumes 7 and 8.

4.6 Data Uncertainties / Data Integrity Issues

See Volumes 7 and 8

5 Water Related Risk Assessment

5.1 Risk Assessment Overview

Volumes 7 and 8.

5.2 Risk Assessment

Volumes 7 and 8.

5.3 Discussion of Mitigation Measures

Surface water – Chapter 7, Appendix S (page 178):

- a proposal for a sediment and erosion control plan, *to be developed* – with a focus on turbidity, minimizing erosion of overburden emplacements (using things like contour drains). Details on the proposed monitoring program are very limited, with key details such as the locations of sample sites, frequency of monitoring, trigger levels and corrective actions etc. not provided. Further, the monitoring may be focused on the Mooki River and it is unclear if other nearby waterways are needed and will be included and addressed. The information provided does include the parameters to be sampled for, including: pH, EC, temp, DO, TSS, sulphate, TKN, TP, Total and dissolved metals incl. As, Ba, Be, Cd, Cr, Cu, Mn, Ni, Pb, Va, Zn, Fe, Hg.

Groundwater – Chapter 8, Appendix T (pages 315 – 319)

- In addition to monitoring bores installed for preparation of the EIS, the sites for additional monitoring will be determined post approval during development of the Water Management Plan. Fortnightly/Monthly monitoring should continue for the life of the

project. Groundwater samples will be tested for: pH, EC, DO, temperature, oxidation-reduction potential, major cations (calcium, magnesium, sodium and potassium), major anions (chloride, sulphate, carbonate/bicarbonate, minor anions (nitrate, nitrite, fluoride, reactive phosphorus) and selected metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, zinc). Trigger levels and associated corrective actions will be developed as part of the Water Management Plan. Management of groundwater beneath and adjacent to the Project will involve the establishment of a robust surface and groundwater level and quality monitoring program, for all groundwater and surface water sources. Should monitoring indicate the changes in groundwater levels or quality are more extensive than predicted, mitigation measures "will be considered."

5.4 Residual Risks

The EIS does not provide commentary on residual risk.

6 Cumulative Impacts

6.1 Regional Overview

EIS concludes that water required for the project that will come from external sources will be obtained under appropriate Water Access Licences to ensure no adverse impacts on water availability for other licensed water users.

EIS (Volume 1, Chapter 7, page 288) states that approved and proposed mining and coal seam projects in the study area were taken into consideration in the assessment of possible future cumulative social impacts. It is anticipated that in 2022, the project has the potential to occur simultaneously with four existing mining projects, two coal seam gas projects and six potential mine projects. The social impacts are outlined in Volume 1.

Volume 8, Appendix T, Part 12, is titled "Cumulative Effect of Multiple Projects" – it summarises the results of the cumulative impact assessment undertaken as part of the *Namoi Water Study*. It says on water balance: Predicted changes to river leakage as a result of groundwater drawdown in the SWS model are consistent with the Watermark model, which predicts a maximum loss of 0.1 ML/day as leakage from the Mooki River. Leakage from rivers to groundwater is relatively unchanged from 2010 to 2020. Leakage increases to 0.4 ML/day from 2040 to 2100. Groundwater flow from the bedrock to the Upper Namoi alluvium reduces by 1.0 ML/day from 2010 to 2060. The cumulative impact modeling produced a zone of depressurisation around the Watermark Project in the northern area of Zone 7. The Watermark model indicated that depressurization greater than 1 m in the Gunnedah Formation Aquifer is limited to Zone 7 and extends approx. 3.9 km from the Southern Mining Area (SMA). The Water Study model indicated that the drawdown in the Gunnedah Formation Aquifer extended slightly further, with the 1m drawdown contour 5km from the SMA. The more extensive zone of depressurization is presumably due to the cumulative impact of the BHP Caroona Project and the Project operating concurrently.

A section on cumulative impacts on matters of NES is included in the EIS Volume 5, however, the information within is extremely limited.

6.2 Cumulative Risk Assessment

Refer to Volumes 1, 5 and 8.

7 Regulatory Sign-off

Regulator: Environmental Assessment and Compliance Division (EACD)

FOR

Mahani Taylor
Director, NSW Section

Endorsed/please discuss

Signed:_____ Date: 12/3/13

James Tregurtha
Assistant Secretary:
South-Eastern Australia Environment Assessments

Agree/not agree

Signed:_____ Date: 12/3/2013

8 References and Attachments

Attachment A: Proponent's EIS (available electronically)

Attachment B: Supplementary DGR's (available electronically)

Request for Advice

Independent Expert Scientific Committee on CSG and Large Coal Mining

1. Summary Details

1.1 Project Title

Project name: Watermark coal project

1.2 Requesting Organisation

Requesting Organisation: Department of Sustainability, Environment, Water, Population and Communities

Regulator: n/a

Representative: James Tregurtha, Assistant Secretary, South Eastern Australia Assessments

Contact Details:

[redacted]

1.3 EPBC Act Referral

Reference: 2011/6201

Assessment / Secondary Officer:

[redacted]

1.4 Advice Stage

- Accredited Assessment, NSW Department of Planning and Infrastructure - Part 4, Division 4.1 of the NSW EP&A Act.
- NSW DP&I have released the Environmental Impact Statement for a period of public comment.
- The EIS documents for the project have been released for a period of public comment, which is open until Friday 26 April 2013.

1.5 Request Details

To inform the department's assessment of likely impacts on the quality and hydrological regimes of water systems that may support matters of national environmental significance (MNES) in and surrounding the project area, the department poses the following questions to the Committee:

1. Does the Committee consider that the proponent has provided sufficient information on the water resources and its management to assess likely significant impacts from its proposed action? – If the information is considered insufficient for that purpose, what advice regarding areas of inadequacy can the committee provide?

2. Is the assessment of the current condition of the ground and surface water environments in and surrounding the project area accurate?

3. Are the various models used to assess the potential impacts of the project on ground and surface water in and outside the project area, appropriate for the purpose and

acceptable as compared to known industry best practice? Are the data and assumptions, on which the models were based, valid and accurate? Have all reasonably foreseeable scenarios been modeled (e.g. low flow periods, climate change, simultaneous flooding events in surrounding water bodies etc.)?

4. Are the model output data valid, accurate and representative of the systems they are modeling (including the ephemeral waterways)? Have the output data been presented and interpreted in an appropriate, relevant way, relative to the likely impacts of the proposal, including for the flow regimes of ephemeral waterways within and surrounding the project boundary? What level of confidence can be applied to the results and conclusions presented in the EIS?

5. Has the EIS comprehensively identified, assessed and quantified all potential impacts of the proposal on water systems within and outside the project area? If not, what impacts have not been covered and/or what information is required?

6. Is the assessment of the nature and extent of post-rehabilitation impacts on ground and surface waters accurate?

7. Has the cost-benefit analysis (page 55) properly considered the potential negative impacts of the proposal on water-resources? If not, what would be required to address this?

8. Does the Committee find the water management, mitigation and monitoring measures proposed to be appropriate, accurate, reasonable and effective? To what degree, if any, do the proposed mitigation and management measures reduce impacts? Also:

- Are the water storages proposed during operation sufficient to ensure no contamination of downstream surface waters?
- Is baseline water monitoring data sufficient to provide an accurate and representative baseline against which changes may be determined during and after mining operations?
- Are the parameters to be measured in ground and surface water monitoring appropriate and sufficient to cover the likely water quality impacts?
- Are there any other mitigation measures that could be implemented to further reduce any impacts?

9. There are a number of other mines either existing or proposed in the area surrounding the proposed Watermark Coal project. The existence and operating management of these mines within this area raises the possibility of cumulative impacts. Does the Committee identify any particular concerns relating to cumulative impacts?

1.6 Proponent Details

Proponent Name: Shenhua Watermark Coal Pty Limited

Proponent Contact Details:

[redacted]

1.7 Website Links

EIS Documentation available on NSW DP&I website:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4975

Shenhua Watermark Coal Pty Limited website: (not available)

Please note: The specific references throughout this Request for Advice document to

figures, page numbers, volumes, appendices and so forth refer to the above EIS documentation (Attachment A – available electronically).
1.8 Public Submissions
During EPBC Act referral: 32 comments During assessment: The public comment period on the EIS is open until Friday 26 April 2013.

2. Project Description

2.1 Project Location
The project is located approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza within the Gunnedah Local Government Area. The project is located in the Gunnedah Basin which covers more than 15,000 square km in the north-western region of NSW. The Project is approximately 282 km by rail from the export Port of Newcastle. Figure 1 of the EIS shows the general location of the project site, and Figure 2 (page 6, Chapter 2, Volume 1) indicates the project boundary, and 1st – 4th order and higher streams in the near vicinity, Figure 9 (page 26, Volume 1) shows the layout of the project.
2.2 Project Description
Development and operation of an open cut coal mine for a period of 30 years, extracting up to 268 Mtpa of ROM. The EIS states a total of 4, 021 ha of woodland and grassland habitat will be removed. The proponent notes that indirect impacts on surrounding vegetation is also possible, but does not provide any information to quantify this. The EIS states there are deeper coal resources present beyond the 30 year mining limit. Shenhua Watermark may, depending on market factors and resource confirmation, seek further relevant approvals for the extraction of these. • The proponent does not indicate if they own any adjacent land or exploration licences for any such area. It is not clear where the additional resource (above) is located, how it overlaps with the current proposal or extends beyond it, nor likely timing for pursuing this additional resource.
2.3 Project Type
Development and operation of open cut coal mine.
2.4 Resource
The project will extract the open cut coal reserve from the **Hoskissons and Melvilles seams**.
2.5 Operation Area
• Conceptual detailed design is provided in Appendix B which will be revised and finalized upon seeking relevant additional building and construction approvals. • The orientation of individual components of the Mine Infrastructure Area (MIA), location and sizing of water management structures and the location of other associated facilities within the Disturbance Boundary are yet to be confirmed. The MIA is anticipated to

contain (at least) ... waste water treatment facility and water management infrastructure (see page 43 – 47).

- Total area of the lease does not appear to have been provided in the documentation, nor the depth of the pit.

2.6 Establishment Activities

The EIS indicates that works will be undertaken outside the outside the disturbance boundary (and quite possibly the project boundary) although no detailed information is provided on these proposed works.

The proponent has not included the size of the area within the project boundary. However, the disturbance area (not including indirect impacts) is described as **4, 084 ha** of land disturbance. Construction activities within the disturbance area will include:

- construction and operation of surface and groundwater management and reticulation infrastructure including pipelines, pumping stations/bore field and associated infrastructure for access to water from the groundwater aquifers in the vicinity of the Project, the Mooki River and private dams to the north-east of the project boundary
- construction and operation of a handling and preparation plant,
- waste disposal facilities,
- construction and operation of a rail spur, loop, overpass loading facility and connection to existing railway,
- As stated by the proponent: "Some of the infrastructure such as water, power and communications infrastructure will be located **outside the disturbance boundary (and quite possibly the project boundary).** Additional disturbance associated with ancillary works including fencing, firebreaks, **water diversion structures, pipelines, a bore field, minor contour banks,** access tracks, explosives storage facilities, power lines, **sediment and erosion control structures** will also be required and are part of the Project for which consent is sought."

Further detail on page 25, Section 3, Volume 1.

2.7 Operation Details

- The project seeks to recover approximately 268 Mt of ROM coal within the 30 year mining limit to produce approximately 159 Mt of product coal. Up to 1,629 Million bank cubic metres (Mbcm) of overburden material will be moved and approx. 108 Mt of coal reject and tailings will be produced during processing of ROM coal during the life of the project
- Topsoil will be stripped by scrapers, overburden blasted and removed by shovel or excavator and trucks before proceeding with coal extraction. The fleet will then progress through the sequence to uncover each coal seam to be extracted. Infrastructure supporting day to day activities will be constructed as required. Likely to include, among other things: erosion and sediment control structures, water reticulation systems, in-pit fuelling areas, and storage areas. An equipment list provided on page 37 (Table 7).
- Mine planning predicts approximately 240 blast events per year, or up to an average of 5 blast events per week will be required once mining rates raach a steady state.
- Placement and shaping of overburden and placement of rejects or tailings is described on page 36. Coal handling and preparation, tailings and reject management, page 37–40.
- Tailings and reject management (Volume 1, Chapter 3) – The CHPP will generate coarse

rock and fine tailings rejects representing the waste products of the coal preparation process. The indicative volument of coarse rejects and fine tailings to be produced by the Project is in Table 6 (page 36).Coarse rejects and fine tailings will be dewatered as part of the CHPP process and directed to a rejects bin via a conveyor system from the CHPP. This material will then be loaded onto haul trucks for co-disposal within the OEAs.

- Volume 1 (Chapter 3) – the project will require an ongoing and reliable water source to enable processing of coal and also for dust suppression. The water management system will be designed and operated to minimize the impacts of the Project on downstream water quality. The system will be operated to fully contain mine water on the mine site and to preferentially reuse this water. The project also proposes to draw water from adjoining water sources pursuant to water access licences already held or to be purchased from within the water market. One or more electric pump stations and a pipeline will be constructed to the Mooki River (see Figure 9). The main components of the water-related infrastructure for the project include: Sediment dams to collect and treat runoff from the OEAs; Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams; Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining; A dirty water storage system to store water pumped out of the mining areas and to collect runoff from the CCHPP and coal stockpile area. The mine water dams will be the first priority water sources for read watering and CHPP water demands; and raw water storage (the Main Dam) from the water supply pipeline.
- Further details provided in Section 7.3

2.8 Lifetime

- The Project will facilitate the extraction of up to 10 Million tonnes per annum ROM coal via open cut mining methods over a 30 year period.
- The project is proposed to be undertaken as expeditiously as possible. No dates are provided by the proponent, only a breakdown of actions referencing year 0 (year to commence) to year 30 of the proposed mine-life.
- Mining operations will commence in the north-west of the Eastern mining Area and by Year 17 active mining will be completed in this area. (see Figure 9); mining operations will then commence in the northern end of the Southern Mining Area – overburden from the SMA will initially be utilized to backfill the EMA void. By approx. year 21, the EMA will be completely backfilled and rehabilitated up to RL 380m. By year 24, active mining will be completed in the SMA. It will then commence in the eastern edge of the Western Mining Area and overburden from this area will but used to backfill the SMA void (completed by year 26). By Year 30 active mining in this area is completed leaving a final void in the WMA.
- There are deeper coal resources present beyond the 30 year mining limit. Shenhua Watermark may, depending on market factors and resource confirmation, seek further relevant approvals for the extraction of these. In this instance the WMA will be ideally placed for underground access to this coal resource.
    - No information is provided on the location of this additional resource, how it overlaps with the current project proposal or when it would be pursued.
- EIS states that should mining operations not continue beyond the 30 year mine plan, the orderly closure of the mine at the time could be achieved.

- See chapter 3 (volume 1) for more detail.

2.9 Residual Site Condition

See mine closure and rehabilitation information, below and in Volume 10, Appendix AA. Permanent changes to ground and surface waters as a result of the project are modeled and discussed in further detail in Volume 8 and Volume 7, respectively and are outlined below.

2.10 Site Rehabilitation

- Volume 1, Chapter 3: Rehabilitation activities will be undertaken progressively and as early as practicable to ensure that the total area of disturbance at any one time is minimized. This will be conducted in conjunction with the open cut mining process. Prior to the re-establishment of vegetation cover, temporary control measures will be utilized for erosion and sediment control. These measures *may* include sediment fences, sand bag sediment traps and rip rap scour protection (see Section 7.21.3). Consideration will be given to erosion and sediment control measures during the construction and operational phases such as restricting access or modifying activities during wet weather, establishing exclusion zones around areas undergoing rehabilitation, reporting erosion and sediment hazards and regular inspections and maintenance of structures.
- Volume 5, Appendix M, Chapter 10.6.3 – Approx. 2,386 ha is proposed to be rehabilitated within the Disturbance Area. Conservation has been given to the retention of land for agricultural purposes. The principle objective will be to recreate and establish, as best as possible, a self-sustaining post-mining landscape that resembles the original vegetation communities. The Biodiversity Management Plan (BMP) will contain further information on the staged rehabilitation of all open cut mining areas and will specify how the Project Boundary will be closed to mining and returned to other land uses. The rehabilitation of portions of the Disturbance Area would be a staged process.
- A final void will remain in the western portion of the disturbance area. The size and depth of this void is not described in the EIS.
- The EIS states a rehabilitation Management Plan (RMP) "will be developed".
- See Volume 10, Appendix AA for further detail.

3 Water Resources

3.1 Regional Water Balance Model

3.1.1 Regional Overview

- The surrounding area is primarily agriculture – pastoral activities and irrigated cropping. Within the project boundary, land use consists of grazing with limited cropping.
- The project is located approx. 25km south-east of the township of Gunnedah. The Gunnedah LGA is located approximately 320m above sea level (m AHD) on the Liverpool Plains of the Namoi River Valley. The region is generally flat. Topography is variable across the project boundary, ranging from Mt Watermark (512 m AHD) and Smokey Point (447m AHD) through to the black soil plains;
- Geological features are described on p29-33, Volume 8, Appendix T.
- A simulation of rainfall runoff for the Mooki River catchment is presented (page 51 of Appendix S) and the EIS also presents flood modeling conducted separately for Watermark Gully and Mooki River waterways.
- It is not clear if flood modeling has been conducted to incorporate a scenario of

simultaneous flooding in more than one waterway or to incorporate the potential impacts of climate change.

- It is not clear if the EIS has adequately identified and quantified potential connectivity between relevant ground and surface waters within and surrounding the site, and assessed possible impacts of the proposal on this connectivity.

3.1.2 Regional Groundwater

- The Gunnedah Formation does not exist within the project boundary. The closest occurrence being 900m from the NE corner of the Eastern Mining Area and 1.3k in the south; The Narrabri formation is generally represented by the quaternary alluvium soil boundary of Banks (1995). Accordingly, the Eastern and Southern Mining Areas are set back by a minimum of 150m from the Narrabri Formation.
- A large region of Tertiary volcanic known as the Liverpool Ranges occur some 45km to the south of the project boundary and cover an area of 5, 600 km^2. In a regional context, these tertiary aquifers are important to groundwater flow and constitute a significant recharge source for the alluvium. Flow is dominantly secondary through fracture networks as well as primary flow through weathered and porous vesicular zones within the unit. Fresh groundwater can be associated with the shallow tertiary basalts.
- The upper section of the alluvial groundwater system is characterized by clays, silts and discontinuous lenses of sand. The lower zones are comprised of coarser grained alluvial sands and gravels, semi confined by the overlying clays. Previous investigators have split the Upper Namoi alluvium into two major formations, the Narrabri Formation and the Gunnedah Formation. The Narrabri Formation is typically a brown clay dominated aquitard, which becomes darker near the surface with minor sands and gravels, whereas the Gunnedah Formation is typically a sand and gravel aquifer with minor clay lenses. The sand and gravel channel deposits range in thickness from 5m to 30m. The Narrabri Formation conformably overlies the Gunnedah Formation. The alluvial sequence has been divided in this way to allow the geological complexity that exists to be simplified and represented in models and groundwater flow.
- The Eastern and Southern Mining Areas are set back a minimum of approx. 1 km and 1.3km from the Gunnedah Formation, respectively. They are set back from the Upper Namoi alluvium by a minimum distance of 150m and at least 0.9km from the Gunnedah Formation aquifer. This means a significant zone of bedrock, with a minimum width of 150m will remain between the proposed Eastern and Southern Mining Areas and the black soil plains. If the mining area face in these Mining Areas adjacent to the buffer zone is sloped back for geotechnical reasons at an angle of about 45 degrees, this will increase the buffer distance to approx. 260m at the toe of the SMA and 230m at the toe of the EMA.
- Research in the district indicates recharge to the alluvial aquifers occurs via: surface water seepage through beds of major watercourses (significant), stream flow, seepage at the toe of ridge areas, diffuse rainfall infiltration, irrigation returns, flooding and bedrock up-flow.
- Figure 7.1 indicates the project boundary and the alluvium catchment boundary.
- EIS states "Measurable subsidence has occurred in the Lower Namoi Valley, host to over 30 years of irrigated agriculture. Similar to the Upper Namoi Valley, large quantities of water are extracted to irrigate predominantly cotton crops".

3.1.3 Regional Surface Water

- The project is located within the catchment of the Mooki River, a tributary of the Namoi River.
- Surface runoff from the Disturbance Area drains in one of three general directions:
  - North to the Mooki River floodplain, either via Watermark Gully or other smaller unnamed flow paths;
  - South to Native Dog Gully, a tributary of the Mooki River; or
  - West towards Lake Goran, a large ephemeral lake.

  The catchment boundary and directions of surface drainage are shown in Figure 3.2 (page 13, Appendix S).
- Historical water quality data provided in Appendix S.
- Volume 7, Appendix S, Figure 1.1 – project locality and surrounding waterways.
- Surface water balance model for the site operations – Appendix S, Volume 7, page 68.

3.1.4 Data Uncertainties / Data Integrity Issues

- Refer to Volumes 7 and 8.
- Refer also to the comment made in 2.5 (above).

3.2 Local Water Balance Model incorporating the Site

3.2.1 Site Overview

As above and below.

3.2.2 Local and Site Groundwater Overview

- The main aquifer unit identified within the project boundary is the Clare Sandstone, a relatively coarse and porous unit, particularly where subjected to weathering.
- Numerical simulation of groundwater flow in the aquifers was undertaken using the MODFLOW and SURFACT code.
- The EIS concludes that bores adjacent to the project boundary will not be significantly impacted by predicted reduction in groundwater levels of between 0.5m and 1.5m. Also, when mining is complete in the Southern and Eastern Mining Areas, there will be no net impact on the alluvial aquifer system water supplies due to the Project. Further, predictions from the modeling work indicate negligible effect on alluvial aquifer systems outside the project boundary.
- For further detail see: Chapter 8.

3.2.3 Local and Site Surface Water Overview

- Geomorpohology (Section 7.5, p 150) - Three primary watercourses were identified within the project boundary, including Watermark Gully, Native Dog Gully and the Mooki River. These watercourses are classified as first and second order streams, with the exception of the d/stream reach of NDG and the Mooki River which are third and fourth order streams, respectively. See figure 2. Further detail see pages 150 – 151
- The project is located in the Gunnedah Basin which covers more than 15,000 square km in the north-western region of NSW. The project is located within the catchment of the Mooki River, a tributary of the Namoi River. The headwaters of the Mooki River originate

on the northern slopes of the Liverpool Ranges and Coolah Tops, flowing in a northerly direction to the Namoi River north-east of Gunnedah. Several ephemeral first and second order streams traverse and drain the land within the Project Boundary, including Watermark Gully, Native Dog Gully and a series of smaller unnamed watercourses. Water bodies within the project boundary are primarily represented by farm dams. Further to the west is Lake Goran, which is a naturally occurring ephemeral lake. During periods of intense rainfall the lake overflows to the east via Native Dog Gully. The catchment of Lake Goran is drained by Coomoo Coomoo Creek, Moreduval Hut Gully and Lever Gully from the south and some unnamed watercourses from the north and west. Flooding in the project boundary largely occurs during high rainfall events along Watermark Gully. This regime is typically influenced by surface water runoff from Mt Watermark and the western ridges. Under similar conditions, Native Dog Gully is affected by backwater from the Mooki River. The floodplain area outside the project boundary between Native Dog Gully and Lake Goran is very flat with the flow direction during flood events affected by the relative levels and flows of these watercourses/bodies. [page 5, Chapter 2, Volume 1]

- Water balance models for the site: surface water balance model for the site operations – Appendix S, Volume 7, page 68.

3.2.4 Data Uncertainties / Data Integrity Issues

- See Volumes 7 and 8

4 Impacts of Development

4.1 Groundwater Impacts from Project Activities

Groundwater impacts – information acquired from a desktop assessment was considered as inputs in the development of the groundwater model. A three-dimensional groundwater flow model (MODFLOW SURFACT) was used to simulate the Project's impacts on the groundwater regime over time. The model grid is approximately 75km in width (east to west) and 91 km in length (north to south). Two separate models were constructed for the project – a calibration model and a predictive model. A sensitivity analysis was carried out to rank the input parameters in terms of their influence on the predicted results. It was independently peer reviewed by Dr Noel Merrick, groundwater modeler, hydrogeologist, and geophysicist. A copy of the peer review report is at Appendix T.

Proponent's modeling indicates:

- Groundwater seepage varies throughout the mine life due to mine depth, strata being mined and hydraulic gradients induced by depressurization. Less than 1.5 Mega litres per day until Year 17, 2.1 ML/day Years 17-24 and up to 1.2 ML/day from Year 24 to closure. The contribution of seepage from the coal seams is relatively low. The predicted cumulative inflow of groundwater over the life of mine is approximately 5,500 ML. G
- Page 305 – clarifies that the model predicts an average groundwater seepage rate into the mining areas of 180 ML/year with a peak of up to 760 ML/year. … [for reference: page 306 – average pumping rate from a single licensed agricultural bore in the Upper Namoi alluvium (within 10km of the project boundary) is 142 ML/year.
- Impacts on Permian Drawdown …extends to a maximum of 3.2km in Year 25, predicts a drawdown of 25m or less in the Permian underlying the Narrabri Formation … and groundwater levels recovering to higher than pre-mining levels … post-mining. … mining areas do not directly intersect the alluvial aquifers of the Narrabri and Gunnedah Formations. The ground water model indicates …close to the mining areas will induce downward vertical flow from the overlying alluvial aquifers into the underlying Permian …

therefore induces changes in groundwater levels in the alluvial aquifers ... As seasonal variation can be in the range of +/- 1m to 2m it is possible the groundwater drawdowns could be masked during periods of significant sustained recharge.

- The majority of the vegetation to be retained in the project boundary, including Mt Watermark is located in areas where the depth to groundwater is greater than 20m. As such any potential groundwater drawdown resulting from the project is considered unlikely to affect these vegetation communities as the groundwater is already beyond the reach of their roots. Therefore none of the vegetation communities within the project boundary are considered to be completely dependent on groundwater.
- Pages 119 to 136 of Volume1 and also Appendix T (Volume 8) for further detail

4.2 Surface Water Impacts from Project Activities

Volume 1, Page 306 – during average and dry years it is predicted that annual volumes up to 600 ML will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP. **Pages 138 – 149 (surface waters and floods).**
A computer based simulation model (OPSIM) was used to assess dynamics of water balance (volume and salt loads) under varying rainfall and catchment conditions.

The EIS concludes: during the life of the project there is potential for the reduction of catchment flows to surrounding waterways including the Mooki River, Watermark Gully, Native Dog Gully and Lake Goran. A decrease the volume of stormwater runoff consequently result in a reduction of flood discharges:

- Less than 1% of the Mooki River catchment to the confluence with Watermark Gully;
- Approx. 17% of the catchment area of Watermark Gully to the Kamilaroi Highway;
- Approx. 29% of the catchment of Native Dog Gully; and
- Less than 0.4% of the catchment to Lake Goran.

The RAFTS runoff routing model was used to estimate the 2, 5, 10, 20, 50 and 100 year ARI design event flood discharges along Watermark Gully. The project will impact on Watermark Gully through a reduction in contributing catchment area by approx. 25% consequently affecting the magnitude and frequency of flows along the watercourse. In addition, the project will partially fill the main channel in the upper reaches of Watermark Gully for the development of the OEA associated with the Western Mining area. **This will result in a relocation of the main channel further to the east.**

The RAFTS runoff routing model was used to estimate flood discharges along the Mooki River catchment based on design rainfall intesntity-frequency0duration data. The TUFLOW fully two-dimensional hydrodynamic model was used to estimate design flood levels and velocities along the Mooki River and its floodplains, including Native Dog Gully for the 100 year ARI event. ... conclusions: Under a 100 year ARI design flood event along the Mooki River, a small area at the south-east corner of the disturbance boundary will be inundated to a depth of up to 1.7m.The area of inundation is located in a backwater area with very low flow velocities of less than 0.1m/s. Placement of overburden on this small area will not affect flood behavior on the floodplain however, it will reduce the flood storage by approx. 235ML. A shaped levee embankment may be required to be constructed within the Disturbance Boundary to prevent flooding of the mining areas. The remaining area within the Disturbance boundary will be flood free during a 100 year ARI design flood event along the Mooki River.

The project will not impact flood behavior on the Mooki River floodplain.

Appendix S (Volume 7): The water requirements of the project investigated using a site water balance model produced the following results summarized as: There is a 10% chance that the volume of external water supply required in any year from Year 4 to Year 19 will be of the order of 300 to 600 ML/a and under extreme drought conditions (1% chance) the annual volume of external water supply could potentially be 900 ML/a. Water required from external sources will be obtained under appropriate Water Access Licences to ensure no adverse impacts on water availability for other licensed water users.

A mine 'water management system' will be designed and operated to minimize the impacts of the project on downstream water quality. *The 'water management system' has not been detailed in the EIS.*

At completion of the mining, surface runoff from rehabilitated overburden emplacement areas will be released from the site. An area of approx. 108ha, which originally drained to lake Goran, will continue to drain to the mine final void. The changed topography following completion of the Project will have the following impacts on catchment areas:

- The catchment draining north via Watermark Gully to the Kamilaroi Hwy will increase by 5.2 km2, an increase of approximately 13%;
- The catchment draining to Lake Goran will be reduced by 6 km2 this represents a reduction in catchment area of less than 0.5% and, in practical terms, will have no measurable impact on inflows to the lake;
- The catchment draining north to the Mooki River floodplain will be increased by 1.4km2;
- The catchment draining south to Native Dog Gully and Mooki River floodplain will be reduced by 1.6km2, a decrease of approx. 2%.

Water balance simulation of the final void shows that water level is expected to reach an equilibrium water level approx. 20 to 30m below the overflow level. The lake will take approx. 100 years to reach the equilibrium level.

Watermark Gully is affected by a reduction in catchment area of up to about 25%, as well as filling of the upper reaches of the main channel by a proposed overburden emplacement area.

Flood behavior on the Mooki River floodplain will not be affected.

4.3 Landform and Land-use Change Impacts from Project Activities

See above.

4.4 Water Related Assets of National Environmental Significance

- Critically endangered and endangered ecological communities, and threatened flora species, within and surrounding the project area. These ecological communities and species are as identified in the Supplementary Director-General's Requirements (DGR's) (refer Attachment B):
  - **Threatened Ecological Communities**: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically endangered); Grey Box (*Eucalyptus macrocarpa*) grassy Woodlands and Derived native Grasslands of SE Australia (Endangered); Weeping Myall Woodlands ecological community (Endangered).

- **Threatened Flora species:** *Prasaophyllum* sp. Wybong (Critically endangered), *Pterostylis cobarensis* (Vulnerable), *Swainsona murrayana* (Vulnerable), *Thesium austral* (Vulnerable), *and Tylophora linearis* (Endangered).

- In addition to areas being directly cleared by the proposal, there may be additional indirect impacts on such matters of NES that occur outside the project boundary, for example, through impacts on water-resources (e.g. groundwater).
- Depending on the extent of impacts on the groundwater and surface water ecosystems surrounding the project boundary, habitat (e.g. listed ecological communities or other vegetation) for threatened fauna species (such as those listed in Appendix A of the Supplementary DGR's) may also be indirectly impacted by the proposal.
- The Murray Cod, listed as vulnerable, occurs in the Namoi catchment. The proponent did not conduct surveys for this species "because no permanent watercourses occur in the Project Boundary". The Department's SPRAT profile indicates Murray Cod has the ability to live in a diverse range of habitats (throughout the Murray Darling Basin); it is considered a main channel specialist as it is frequently found in the main river channel and larger tributaries. However, it is found in floodplain channels when they contain water; although this usage appears limited. Juveniles are most commonly found in the main river channel until about one year of age, after which they branch out.

4.5 Impacts on Other Water Related Assets

See Volumes 7 and 8.

4.6 Data Uncertainties / Data Integrity Issues

See Volumes 7 and 8

5 Water Related Risk Assessment

5.1 Risk Assessment Overview

Volumes 7 and 8.

5.2 Risk Assessment

Volumes 7 and 8.

5.3 Discussion of Mitigation Measures

Surface water – Chapter 7, Appendix S (page 178):

- a proposal for a sediment and erosion control plan, *to be developed* – with a focus on turbidity, minimizing erosion of overburden emplacements (using things like contour drains). Details on the proposed monitoring program are very limited, with key details such as the locations of sample sites, frequency of monitoring, trigger levels and corrective actions etc. not provided. Further, the monitoring may be focused on the Mooki River and it is unclear if other nearby waterways are needed and will be included and addressed. The information provided does include the parameters to be sampled for, including: pH, EC, temp, DO, TSS, sulphate, TKN, TP, Total and dissolved metals incl. As, Ba, Be, Cd, Cr, Cu, Mn, Ni, Pb, Va, Zn, Fe, Hg.

Groundwater – Chapter 8, Appendix T (pages 315 – 319)

- In addition to monitoring bores installed for preparation of the EIS, the sites for additional monitoring will be determined post approval during development of the Water Management Plan. Fortnightly/Monthly monitoring should continue for the life of the

project. Groundwater samples will be tested for: pH, EC, DO, temperature, oxidation-reduction potential, major cations (calcium, magnesium, sodium and potassium), major anions (chloride, sulphate, carbonate/bicarbonate, minor anions (nitrate, nitrite, fluoride, reactive phosphorus) and selected metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, zinc). Trigger levels and associated corrective actions will be developed as part of the Water Management Plan. Management of groundwater beneath and adjacent to the Project will involve the establishment of a robust surface and groundwater level and quality monitoring program, for all groundwater and surface water sources. Should monitoring indicate the changes in groundwater levels or quality are more extensive than predicted, mitigation measures "will be considered."

5.4 Residual Risks

The EIS does not provide commentary on residual risk.

6 Cumulative Impacts

6.1 Regional Overview

EIS concludes that water required for the project that will come from external sources will be obtained under appropriate Water Access Licences to ensure no adverse impacts on water availability for other licensed water users.

EIS (Volume 1, Chapter 7, page 288) states that approved and proposed mining and coal seam projects in the study area were taken into consideration in the assessment of possible future cumulative social impacts. It is anticipated that in 2022, the project has the potential to occur simultaneously with four existing mining projects, two coal seam gas projects and six potential mine projects. The social impacts are outlined in Volume 1.

Volume 8, Appendix T, Part 12, is titled "Cumulative Effect of Multiple Projects" – it summarises the results of the cumulative impact assessment undertaken as part of the *Namoi Water Study*. It says on water balance: Predicted changes to river leakage as a result of groundwater drawdown in the SWS model are consistent with the Watermark model, which predicts a maximum loss of 0.1 ML/day as leakage from the Mooki River. Leakage from rivers to groundwater is relatively unchanged from 2010 to 2020. Leakage increases to 0.4 ML/day from 2040 to 2100. Groundwater flow from the bedrock to the Upper Namoi alluvium reduces by 1.0 ML/day from 2010 to 2060. The cumulative impact modeling produced a zone of depressurisation around the Watermark Project in the northern area of Zone 7. The Watermark model indicated that depressurization greater than 1 m in the Gunnedah Formation Aquifer is limited to Zone 7 and extends approx. 3.9 km from the Southern Mining Area (SMA). The Water Study model indicated that the drawdown in the Gunnedah Formation Aquifer extended slightly further, with the 1m drawdown contour 5km from the SMA. The more extensive zone of depressurization is presumably due to the cumulative impact of the BHP Caroona Project and the Project operating concurrently.

A section on cumulative impacts on matters of NES is included in the EIS Volume 5, however, the information within is extremely limited.

6.2 Cumulative Risk Assessment

Refer to Volumes 1, 5 and 8.

7 Regulatory Sign-off

Regulator: Environmental Assessment and Compliance Division (EACD)

Kate Gowland
Ag/Director, NSW Section

Endorsed/please discuss

Signed: Kate Gowland

Date: 8 April 2013

James Tregurtha
Assistant Secretary:
South-Eastern Australia Environment Assessments

Agree/not agree

Signed: _____

Date: 17/4/2013

8 References and Attachments

Attachment A: Proponent's EIS (available electronically)

Attachment B: Supplementary DGR's (available electronically)

iesc
Independent Expert Scientific Committee
on Coal Seam Gas and Large Coal Mining Development

Advice to decision maker on coal mining project

Proposed action: Watermark Coal Project (EPBC 2011/6201) – New Development

Requesting agency	Department of Sustainability, Environment, Water, Population and Communities
Date of request	17 April 2013
Date request accepted	17 April 2013
Advice stage	Environment Impact Assessment (draft)
Summary of request from the regulator	The Department of Sustainability, Environment, Water, Population and Communities (the Department) is currently assessing the proposed project in accordance with the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Department notifies the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee) of an opportunity to comment on the draft Environmental Impact Statement. Specifically, the Department poses the following questions to the Committee: 1. Does the Committee consider that the proponent has provided sufficient information on the water resources and its management to assess likely significant impacts from its proposed action? If the information is considered insufficient for that purpose, what advice regarding areas of inadequacy can the Committee provide? 2. Is the assessment of the current condition of the ground and surface water environments in and surrounding the project area accurate? 3. Are the various models used to assess the potential impacts of the project on ground and surface water, in and outside the project area, appropriate for the purpose and acceptable as compared to known industry best practice? Are the data and assumptions on which the models were based valid and accurate? Have all reasonably foreseeable scenarios been modelled (e.g. low flow periods, climate change, simultaneous flooding events in surrounding water bodies etc.)? 4. Are the model output data valid, accurate and representative of the systems they are modelling (including the ephemeral waterways)? Have the output data been presented and interpreted in an appropriate, relevant way, relative to the likely impacts of the proposal, including for the flow regimes of ephemeral waterways within and surrounding the project boundary? What level of confidence can be applied to the results and conclusions presented in the EIS?

5. Has the EIS comprehensively identified, assessed and quantified all potential impacts of the proposal on water systems within and outside the project area? If not, what impacts have not been covered and/or what information is required?

6. Is the assessment of the nature and extent of post-rehabilitation impacts on ground and surface waters accurate?

7. Has the cost-benefit analysis (page 55) properly considered the potential negative impacts of the proposal on water resources? If not, what would be required to address this?

8. Does the Committee find the water management, mitigation and monitoring measured proposed to be appropriate, accurate, reasonable and effective? To what degree, if any, do the proposed mitigation and management measures reduce impacts? Also:

    a. Are the water storages proposed during operation sufficient to ensure no contamination of downstream surface waters?

    b. Is baseline water monitoring data sufficient to provide an accurate and representative baseline against which changes may be determined during and after mining operations?

    c. Are the parameters to be measured in ground and surface water monitoring appropriate and sufficient to cover the likely water quality impacts?

    d. Are there any other mitigation measures that could be implemented to further reduce any impacts?

9. There are a number of other mines either existing or proposed in the area surrounding the proposed Watermark Coal project. The existence and operating management of these mines within this area raises the possibility of cumulative impacts. Does the Committee identify any particular concerns relating to cumulative impacts?

Advice

The Committee was requested to provide advice to the Commonwealth regulator on the Watermark Coal Project in New South Wales at the Environmental Impact Assessment (draft) stage. This advice draws upon aspects of information in the draft Environmental Impact Statement, together with the expert deliberations of the Committee. The draft Environmental Impact Statement and information accessed by the Committee are listed in the source documentation at the end of this advice.

The proposed project is a new development for an open cut coal mine, producing up to 10 million tonnes per annum of Run of Mine coal for up to 30 years, located 25 km from Gunnedah and immediately west of Breeza in Northern New South Wales. The site is adjacent to the Mooki River, which is a major tributary of the Namoi Catchment. The target coal seams are contained within the Black Jack Group of the late Permian strata of the Gunnedah Basin and include the Hoskissons and Melvilles seams. The disturbance area for the proposed project covers 4,084 ha.

Cumulative impacts on the Namoi Catchment

The Committee encourages the regulator to consider the water related impacts of the proposed project in a cumulative assessment context such as that presented in the Namoi Catchment Water Study. This Study presents a range of coal seam gas and coal mining development scenarios. The Study provides predictions of surface water losses and groundwater drawdown which should be used to provide context to individual project

impact assessments.

A regional water balance is an important component of a cumulative assessment and the Committee suggests, in relation to the Watermark project, that defined regional boundaries can be logically drawn, i.e. groundwater from the Liverpool Range to Gin's Leap and surface water from the project site to the Boggabri gauging station.

The Committee considers that the proposed project is likely to enhance the risk of salinity in the region. The proposed project is likely to result in salinity impacts from overflow of water storages, seepage from the backfilled and proposed open mine voids, connectivity between the alluvium and Permian strata and the removal of woodland from the proposed project site. A regional perspective on salinity is important to properly assess the significance of such impacts and this should be addressed through the development of a regional salt balance.

The Committee, in line with its Information Guidelines[1], has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

In the main, the proponent has used relevant data and information, with the exception of the areas noted below. The proponent has referred to data sources specific to the Namoi catchment, such as aspects of the proposed framework for assessing the cumulative risk of mining on natural resource assets in the Namoi catchment (Eco Logical, 2011) and the Namoi Catchment Water Study (Schlumberger, 2012).

However, the documentation provided would benefit from further information in relation to:

- Downstream aquatic ecosystems, assets and receptors;
- Groundwater dependence of vegetation communities (including the critically endangered White Box Yellow Box Blakey's Red Gum Woodland and Derived Native Grassland and endangered ecological communities found on site);
- Evidence for the assertion of no hydraulic connection to the Great Artesian Basin;
- Evidence for the low hydraulic conductivities modelled in the coal seams and their distribution;
- Evidence for groundwater model assumptions relating to constant irrigation use and constant conditions across the northern boundary; and
- Evidence for faulting and the role of faults in impeding or transmitting groundwater flow.

Appropriate methodologies which have been applied correctly: key conclusions

The proponent has selected appropriate methodologies in their environmental assessment, including a semi-quantitative risk assessment and appropriate use of software for the modelling of groundwater, flooding and the site water balance. The numerical groundwater modelling has undergone sensitivity and uncertainty analysis and peer review. However, the water budget across the groundwater model domain does not constitute a regional water balance and a regional salt balance has not been provided. Further, the Committee has concerns with respect to the application of these methodologies in some circumstances.

With respect to the application of these methodologies:

- The effectiveness of control measures used to address preliminary risks cannot be determined as these controls will be embedded in management plans which have not been provided;
- Insufficient justification and verification has been provided for the groundwater conceptualisation, particularly with regard to interconnectivity between the Upper Namoi Alluvium and Permian sequence,

which decreases confidence in conclusions drawn from the numerical groundwater model; and

- No sensitivity analysis has been performed on the site water balance to date and there has been no consideration of the potential impacts of climate variability, which results in a reduced level of confidence in the modelled results.

Reasonable values and parameters in calculation: key conclusions

The values and parameters used in calculations by the proponent appear plausible, with the exceptions and differences noted above and following:

- Climate data from early and recent years are underrepresented in the realisations modelled in the site water balance;

- Calculations of additional site water supply requirements have used average rather than maximum values and have not considered water availability; and

- The proponent classifies the Hoskissons and Melvilles coal seams as aquitards, whereas Schlumberger (2012) classified these coal seams as aquifers.

Question 1: Does the Committee consider that the proponent has provided sufficient information on the water resources and its management to assess likely significant impacts from its proposed action? If the information is considered insufficient for that purpose, what advice regarding areas of inadequacy can the Committee provide?

1. The Committee considers that applying a water balance model is the most appropriate basis for assessing potential changes in water resources and impacts on aquatic ecosystems, assets and receptors. The deficiencies in the regional and site water balances make a comprehensive assessment of likely significant impacts as a result of the proposed project difficult. Further areas where the assessment documentation could benefit from additional information are outlined below and have been addressed in questions 3, 4, 5, 6, 8 and 9.

    a. In relation to the site water balance, the earliest and latest periods of historical data are underrepresented in the realisations modelled. The Committee has limited confidence in the predicted lack of release of mine water and recommends that, in order to minimise downstream water quality and ecological impacts, the proponent:

        i. Undertake sensitivity analysis on the site water balance;

        ii. Use the results of the site water balance sensitivity analysis, as well as predicted available water determinations, surface water availability and any applicable access rules to ensure that water supply licences will meet site water requirements under a full range of foreseeable conditions;

        iii. Design mine water storages to contain a 1:1000 year average recurrence interval storm event; and

        iv. Develop contingency plans to deal with the event of an emergency discharge of water from a mine water dam.

    b. In relation to a regional water balance, the Committee recommends that a regional water balance be developed to allow for assessment of significant impacts. This water balance should:

        i. Extend across the regional surface and groundwater systems to defined monitoring points, beyond which there will be no measurable impacts as a result of the proposed project, e.g. groundwater to Gin's Leap and surface water to the Namoi River at Boggabri gauging station;

        ii. Detail the set of water stores and the flow of water between those stores under current conditions

within this region;

iii. Assess the change as a result of the proposed project to the quantity or quality of water within any store or flow of water between these stores;

iv. Take into account a range of foreseeable climatic scenarios; and

v. Undergo sensitivity analysis.

c. Significant impacts are also likely as a result of the proposed project's increase in salt loads downstream of the proposed project site, into a catchment already at risk from salinity. The project assessment documentation would therefore benefit from the inclusion of a local and regional salt balance. A salt balance should:

i. Detail the set of salt stores and the transfer of salt between those stores under current conditions within this region;

ii. Assess the change as a result of the proposed project to the quantity of salt within any store or transfer of salt between these stores;

iii. Take into account a range of foreseeable climatic scenarios; and

iv. Undergo sensitivity analysis.

Question 2: Is the assessment of the current condition of the ground and surface water environments in and surrounding the project area accurate?

2. The assessment that surface and groundwater systems are generally in poor condition is accurate and supported by evidence. The Mooki River adjacent to the proposed project boundary is highly degraded and riparian vegetation is absent. Further, in terms of usage, the Upper Namoi Alluvium is a very important groundwater source in New South Wales and its stress has been well documented.

3. Insufficient information has been provided by the proponent that clearly identifies outside of the proposed project boundary: aquatic ecosystems, assets and receptors that are dependent on surface and groundwater systems; their current condition and how these assets and receptors will be impacted by both the proposed project; and any additional cumulative impacts.

Question 3: Are the various models used to assess the potential impacts of the project on ground and surface water, in and outside the project area, appropriate for the purpose and acceptable as compared to known industry best practice? Are the data and assumptions on which the models were based valid and accurate? Have all reasonably foreseeable scenarios been modelled (e.g. low flow periods, climate change, simultaneous flooding events in surrounding water bodies etc.)?

4. The surface water balance and flood models and the numerical groundwater model used by the proponent are fit for purpose and consistent with best industry practice.

a. The data and assumptions for these models are accurate and valid, with the exception of the issues detailed below in relation to the numerical groundwater modelling.

i. Insufficient justification and verification has been provided for the hydrogeological conceptualisation, particularly with regard to the nature of faulting and interconnectivity between the Upper Namoi Alluvium and Permian sequence, which decreases confidence in conclusions drawn from the numerical groundwater model.

ii. The assumptions of constant conditions at the northern boundary and constant groundwater use are both inaccurate. These assumptions limit the predictive ability of the model as it does not accurately represent the current conditions.

iii. The extent of the Gunnedah Formation has been determined by the proponent based on geophysical surveys, but there has been no field verification of the results. Without verification, confidence is limited in the predicted drawdown impacts on the Gunnedah Formation and resulting impacts on groundwater users.

iv. Hydraulic conductivities for target coal seams have not been adequately justified. The parameters used have unknown spatial distribution and extend over a large range, with some values orders of magnitude lower than those used by Schlumberger (2012) and other groundwater studies including the same Permian sequence for previous referrals in the Namoi Catchment. The Committee considers that the large range of hydraulic conductivities could overly influence the model's predicted zone of depressurisation and that further evidence is required to justify the parameters used by the proponent.

v. Insufficient evidence has been provided to justify the presence of faults and their behaviour in transmitting or preventing groundwater flow in the groundwater model. The modelled results appear to show that the extent of the drawdown is limited by these faults. Further work should be carried out to confirm both the existence of these faults and their ability to act as hydraulic barriers. This assessment should include the potential for fractures and faults to transmit water, particularly from the Upper Namoi Alluvium.

b. Not all reasonably foreseeable scenarios have been considered by the proponent in their modelling.

i. The site water balance modelling has not considered the potential for increasing climate variability.

ii. The assessment of cumulative impacts has only considered Scenario 2 of the Namoi Catchment Water Study and therefore has excluded other foreseeable scenarios, including Scenario 3.

Question 4: Are the model output data valid, accurate and representative of the systems they are modelling (including the ephemeral waterways)? Have the output data been presented and interpreted in an appropriate, relevant way, relative to the likely impacts of the proposal, including for the flow regimes of ephemeral waterways within and surrounding the project boundary? What level of confidence can be applied to the results and conclusions presented in the EIS?

5. The Committee has identified concerns relating to input data, assumptions, sensitivities and the number of scenarios modelled for groundwater and water balance modelling, which decrease confidence in the outputs from these models. With respect to presentation and interpretation of model outputs:

a. Site water balance results have been presented in full only for long-term average conditions, which does not allow for interpretation of the performance of the mine water management system under climate extremes previously experienced in the region;

b. Predicted groundwater drawdowns have not been presented for all model layers and the drawdown contours presented have not been adequately discussed. In particular:

i. Drawdown within the coal seams is likely to be greater than predicted by the proponent, as low hydraulic conductivity values have not been adequately justified and could be influencing the limited drawdown extent;

ii. It is difficult to determine the validity of the modelled impact of the faults, if any, on groundwater movement, in particular the role of these faults in impeding groundwater drawdown; and

iii. Drawdowns for the rest of the Permian sequence in this area have not been presented by the proponent, but are modelled in the Namoi Catchment Water Study. The Committee considers that drawdown contours for these Permian units should be presented. If no drawdown is predicted by the model for these units, then an explanation should be provided as to why this will not occur;

and

c. Model outputs should be presented with an understanding of their sensitivity or uncertainty and referenced in terms of the impact to any water dependent assets.

Question 5: Has the EIS comprehensively identified, assessed and quantified all potential impacts of the proposal on water systems within and outside the project area? If not, what impacts have not been covered and/or what information is required?

6. Whilst the proponent has identified most potential impacts on water resources, the assessment and quantification of these impacts is not comprehensive. In addition to the information gaps identified in the assessment against the Information Guidelines and under questions 1,2, 3, 4, 6, 8 and 9, the project assessment documentation would be improved by including additional information on the following potential impacts:

    a. The detailed design and construction details of pump site on the Mooki River and the diversion on Watermark Gully, including flood extents and flow velocities, to ensure that these constructions are stable and will not result in erosion or changes to downstream turbidity;

    b. Predicted flood extents along the Mooki River which extend into the Eastern mining area. Proposed mitigation actions need to be clarified;

    c. Impacts on dryland salinity as a result of the proposed direct removal of woodland; and

    d. The intersection of the current water table, potential drawdown and the depth of the root zone of protected vegetation communities.

Question 6: Is the assessment of the nature and extent of post-rehabilitation impacts on ground and surface waters accurate?

7. Post-rehabilitation, both the final void and seepage from backfilled pits present potentially significant long-term environmental hazards, which have not been adequately addressed by the proponent.

    a. The Western mining area void will have an area of 100 ha and depth of 60 metres. There are significant differences in the time to reach equilibrium and the water level at which this is achieved when the void is modelled from a groundwater or surface water perspective. As such, the Committee has limited confidence in the prediction that the void will not overtop. The Committee considers that voids are a long-term environmental legacy and backfilling of voids and pit lakes represents best environmental practice.

    b. The Southern and Eastern mining area voids are proposed to be backfilled and predicted to recover relatively quickly. The proponent has modelled seepage from these mining areas, which they predict to be 0.08 ML/day 2,000 years after mining. Sensitivity analysis shows that the salt loads from this seepage from the Southern mining area could reach up to 17 kg/ha/day. The Committee recommends that the proponent investigate the potential impacts from seepage on downstream aquatic ecosystems, assets and receptors; commence long-term monitoring; and prepare a mitigation and management plan to address any potential impacts.

Question 7: Has the cost-benefit analysis (page 55) properly considered the potential negative impacts of the proposal on water resources? If not, what would be required to address this?

8. It is not within the Committee's terms of reference to consider the adequacy of cost-benefit analyses. However, in light of the question asked, the one-page cost-benefit analysis on page 55 of the draft Environmental Impact Statement is not comprehensive and methodologically robust. It includes only the environmental benefits and socio-economic costs of the chosen project alternative and notably not the environmental costs, including potential negative impacts on water resources.

Question 8: Does the Committee find the water management, mitigation and monitoring measures proposed to be appropriate, accurate, reasonable and effective? To what degree, if any, do the proposed mitigation and management measures reduce impacts?

9. The proposed control measures typically include management and mitigation actions, which are yet to be articulated in management plans. As such, the effectiveness of these measures cannot be determined at this stage. The Committee makes recommendations for mitigation and management in Question 8d and monitoring is discussed in Question 8b.

8a: Are the water storages proposed during operation sufficient to ensure no contamination of downstream surface waters?

10. No. There is potential for contamination of downstream surface waters from mobilisation of accumulated seepage (see Question 6), emergency release from mine water storages (see Question 1) and overflow of sediment dams. The key contaminant of concern is salt.

    a. Sediment dams that collect runoff from overburden emplacement areas are designed to overflow to ephemeral streams (although the frequency, quality and volumes of these predicted events are unknown). The proponent intends to mitigate impacts through treatment with a flocculant, or by moving the excess water to other storages on site where possible. Treatment with a flocculant will only control solids and other potential contaminants, including salt, are not proposed to be treated. These mitigation actions are insufficient without a full understanding of the potential impacts of these saline releases on downstream aquatic ecosystems, assets and receptors.

    b. The Committee recommends that the proponent provide estimates of the frequency, quality and quantity of discharges of water (particularly saline water) proposed from the site, including potential emergency discharges, seepage and overflows from sedimentation dams. Further, the environmental assessment would benefit from a thorough investigation of the impacts of these discharges on the regional salt and water balance and downstream aquatic ecosystems, assets and receptors, including access to flows in the unregulated Mooki River water source.

8b: Is baseline water monitoring data sufficient to provide an accurate and representative baseline against which changes may be determined during and after mining operations?

11. Ground and surface water monitoring data has been collected by the proponent in and adjacent to the proposed site on a regular basis for over two years, which will be used in addition to New South Wales Government monitoring data to determine a baseline at these locations. The Committee recommends that, should the proposed project go ahead:

    a. Baseline monitoring of surface and groundwater systems continue during and post operations, as potential impacts of salt water seepage are predicted to extend beyond 2,000 years into the future;

    b. Extensions to the groundwater monitoring network should be made in the alluvium and target coal seams both within and beyond the predicted zone of depressurisation; as the Committee is concerned that the proponent's predicted zone of depressurisation is limited;

    c. Extensions to the groundwater monitoring network should also ensure that there is sufficient baseline information in aquifers which have a lower monitoring bore density including the Jurassic sediments of the Surat Basin and the Clare Sandstone; and

    d. The proponent provide for additional monitoring sites as required for investigations recommended by the Committee on the water balance (Question 1), groundwater modelling (Question 3), seepage (Question 6), salt balance (Question 8a) and interconnectivity (Question 9).

8c: Are the parameters to be measured in ground and surface water monitoring appropriate and sufficient to cover the likely water quality impacts?

12. The water quality parameters measured in the proponent's ground and surface water monitoring program are appropriate. In order to manage potential risks to downstream assets and receptors as a result of loss of catchment flows, overflow of sediment dams, mobilisation of accumulated seepage from backfilled voids and potential emergency discharge, the Committee recommends that ongoing baseline water quality sampling is carried out on a monthly basis, as well as after any significant rainfall events at the 12 sites nominated by the proponent, including the ephemeral Watermark Gully.

8d: Are there any other mitigation measures that could be implemented to further reduce any impacts?

13. The Committee recommends that the proponent develop:

    a. A comprehensive sediment control plan,

    b. A detailed flood mitigation plan which prevents flooding of the Eastern pit under a 1 in 1000 year flood event; and

    c. Surface and groundwater management plans that include:

        i. Regular quality and quantity monitoring, as outlined above;

        ii. Site-specific quality and quantity triggers which are sensitive enough to provide an early warning of potential deviations from a defined baseline, but buffer seasonal climate variations; and

        iii. Appropriate management actions for each trigger and backup mitigation actions should the proposed management action not be effective.

14. The proponent intends to mitigate their impacts on biodiversity through the revegetation of offset areas. Revegetation has the potential to control dryland salinity as well as conserve biodiversity. The Committee recommends that the proponent and regulator consider potential effects on local or regional dryland salinity when choosing offset sites.

Question 9: There are a number of other mines either existing or proposed in the area surrounding the proposed Watermark Coal Project. The existence and operating management of these mines within this area raises the possibility of cumulative impacts. Does the Committee identify any particular concerns relating to cumulative impacts?

15. The Committee identifies the following concerns relating to cumulative impacts, noting that the surface and groundwater systems likely to be impacted are in a poor / stressed condition,: :

    a. The sensitivity analysis performed by Schlumberger (2012) showed that the drawdown as a result of cumulative impacts in the Upper Namoi Alluvium Zone 7 is predicted to exceed 2 m, which is significant as the average saturated thickness of the alluvium in this zone is only 13 m (noting that Schlumberger have a low level of confidence in the prediction due to limited data);

    b. The proponent has not addressed cumulative impacts on hard rock groundwater, despite the modelling by Schlumberger (2012) of cumulative drawdown in extensive areas of the Gunnedah water management area of greater than 10 m;

    c. The proponent has not addressed cumulative impacts on surface water flow, despite modelled loss in flows by Schlumberger (2012), which show a cumulative reduction in flow in the Namoi River near Narrabri, equivalent to about half the current surface water extraction from the regulated Namoi River below Keepit Dam;

    d. The proponent has not addressed cumulative impacts on water quality, despite the predicted increase in salt loads to ephemeral water courses as a result of the proposed project and existing risk of salinity within the catchment; and

    e. There is no link provided by the proponent between these likely cumulative impacts and water

dependent assets and receptors.

16. The Committee recommends that adoption of the following will provide for a more robust cumulative impact assessment:

    a. A broader consideration of the Namoi Catchment Water Study's findings, particularly with respect to the use of scenario 3 and impacts to surface water and the Gunnedah-Oxley Basin; and

    b. A local-scale focused investigation into groundwater gradients and flow, with particular regard to effects of predicted drawdown in the Permian sequence, based on connectivity between the Permian sequence, the alluvium and surface water. This investigation should be undertaken before projects proceed that are predicted to impact on the Upper Namoi Alluvium Zone 3, Zone 8 or Zone 7 in particular.

17. The Northern Inland Catchments, which includes the Namoi catchment, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible for this Bioregional Assessment to assist the knowledge base for regional scale assessments.

Date of advice	27 May 2013
Source documentation available to the Committee in the formulation of this advice	Hansen Bailey Pty Ltd 2013. Watermark Coal Project Environmental Impact Statement. Prepared for Shenhua Watermark Pty Ltd. February 2013.
References cited within the Committee's advice	[1] Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources available at: http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf Eco Logical Australia 2011. Proposed Framework for Assessing the Cumulative Risk of Mining on Natural Resource Assets in the Namoi Catchment, 14 Sep 2011. Schlumberger Water Services 2012. Namoi Catchment Water Study Independent Expert Final Study Report. Prepared for Department of Trade and Investment, Regional Infrastructure and Services, New South Wales. Report no. 50371/P4-R2 FINAL.

REQUEST FOR ADVICE

Summary			
Requesting agency/agencies	Department of the Environment		
Project title	Watermark Coal Project, NSW	**Proponent**	Shenhua Watermark Pty Ltd
Reference no.	2011/6201	**State**	NSW
Project stage	The project was determined a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) on 22 December 2011 for likely significant impacts on migratory species and nationally threatened species and communities. The project was assessed through the accredited NSW environmental impact assessment process under the *Environmental Planning and Assessment Act 1979* (EP&A Act) coordinated by the NSW Department of Planning and Environment (DPE). The project was approved by the NSW Planning Assessment Commission (PAC) on 28 January 2015. As such, the assessment documentation has been provided to the Department and the project is currently in the assessment and approval stage under the EPBC Act.		
Timing	A statutory deadline for a final decision under the EPBC is due 13 March 2015. It is likely, however, this decision will be extended (as appropriate) in order to seek and consider further advice from the IESC.		
Documentation	All documentation is available on DPE's website. This includes: • Environmental Impact Statement • Response to Submissions • DPE's Recommendation to the PAC • PAC's Independent Review • DPE's Response to PAC Review Report • DPE's Final Assessment Report • PAC's Determination Previous advice has been sought from the IESC in April 2013. That advice was received by the Department of the Environment in May 2013, which met the EPBC Act requirements. Further to receiving IESC 2013 advice, the groundwater model has undergone several peer reviews by recognised experts in the field. This includes: a peer review by groundwater modelling specialist, Dr Noel Merrick, during the EIS stage; expert advice on groundwater impacts from groundwater specialist Dr Colin Mackie commissioned by the NSW Planning and Assessment Commission; and advice on surface and groundwater impacts from Dr Steve Perrens and Dr Frans Kalf respectively, commissioned by DPE.		

Description of the proposed project				
Development type	☐ Coal Seam Gas	☒ Open cut coal mine	☐ Underground coal mine	
	☐ Other:	**Site**	☒ New	☐ Expansion
Operational life	30	**Scale**	Up to 10 Mtpa ROM coal (proposed total extraction is 268 Mt).	
Geological basin	Gunnedah Basin	**Coal resource**	Hoskissons and Melvilles Coal seams	
Assessment of impacts to water resources				
Surface water catchment	Mooki River, Naomi	**Groundwater basin**	Gunnedah-Oxley	
Key water related assets	• There are two key aquifer systems that could be affected by the project: the alluvial aquifers associated with the Upper Namoi Alluvium (Narrabri Formation and the Gunnedah Formation), and the Permian 'hard rock' aquifers associated with deeper bedrock strata (including coal seams, weathered rock, sandstones, fracture zones and volcanic). • The Gunnedah Formation is a highly productive aquifer characterised by high water yields and good quality water. This aquifer is generally referred to as the primary aquifer system in the region.			
Relevant water management policies, regulations or information	• NSW water sharing plans - available from NSW Office of Water website • All water take is accounted for under these water sharing plans, no net increase in extraction.			
Key issues (identified by the requesting agency)	• Since seeking advice from the IESC in April 2013, which met the EPBC Act requirements, I note the passage of time and that additional investigations and studies have since been undertaken by the proponent. Further, the NSW Government has commissioned independent reviews of the groundwater model. • I am seeking clarification on how these studies address previous IESC concerns. See questions to the IESC below.			

Request for Advice			
Question 1 Following consideration of the listed documentation, would the IESC make any revisions to their previous advice, including but not limited to: a) on the groundwater modelling predictions over time; and b) the conclusions drawn with regard to the assessment of impacts to ground water dependant ecosystems; and what consequences could result if impacts extend beyond that predicted, particularly in regards to EPBC-listed ecological communities in the area. **Question 2** Could the IESC comment specifically on the conclusions drawn that the zone of depressurisation in the Permian is unlikely to extend beyond that described; and what regional implications may occur if the depressurisation in the Permian extends to, or beyond, those impacts predicted? **Question 3** Is the IESC satisfied the proposed surface water and groundwater monitoring programmes are robust and any potential impacts on water resources and water related assets (including the Upper Namoi Alluvium and the Permian) will be detected? Is there appropriate spatial and temoral coverage? Could the IESC provide advice on the appropriate management responses if triggers are exceeded?			
Contact information			
Agency contact officer/s	Ms Charmayne Murray Acting Assistant Secretary South-Eastern Australia Environment Assessments Tel. 6274 2128 Email: charmayne.murray@environment.gov.au		
Approval			
Delegate	The Hon Greg Hunt MP Minister for the Environment		
Signature		**Date**	26 February 2015

Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development

REQUEST FOR ADVICE

Summary			
Request from	Hon Greg Hunt, Minister for the Environment		
Project title	Watermark Coal Project, NSW	**Proponent**	Shenhua Watermark Pty Ltd
Reference no.	2011/6201	**State**	NSW
Project stage	The project was determined a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) on 22 December 2011 for likely significant impacts on migratory species and nationally threatened species and communities. The project was assessed through the accredited NSW environmental impact assessment process under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) coordinated by the NSW Department of Planning and Environment (DPE). The project was approved by the NSW Planning Assessment Commission (PAC) on 28 January 2015. As such, the assessment documentation has been provided to the Department and the project is currently in the assessment and approval stage under the EPBC Act. Previous advice has been sought from the IESC in April 2013. That advice was received by the Department of the Environment in May 2013, which met the EPBC Act requirements. Further to receiving IESC 2013 advice, the groundwater model has undergone several peer reviews by recognised experts in the field. This includes: a peer review by groundwater modelling specialist, Dr Noel Merrick, during the EIS stage; expert advice on groundwater impacts from groundwater specialist Dr Colin Mackie commissioned by the NSW Planning and Assessment Commission; and advice on surface and groundwater impacts from Dr Steve Perrens and Dr Frans Kalf respectively, commissioned by DPE. On 26 February 2015, I requested further advice from the IESC in relation to the Watermark Coal Project and understand this request is currently being considered. I am now seeking further advice from the IESC in relation to questions raised by the community.		
Timing	I have paused the approval clock in order to seek and consider this advice from the IESC.		
Documentation	• Watermark Coal Project Assessment documentation as provided on NSW Planning Assessment Commission website – available at http://www.pac.nsw.gov.au/Projects/PACDeterminations/tabid/104/ctl/vie		

wreview/mid/459/pac/445/view/readonly/myctl/rev/Default.aspx

- BHP Caroona Coal Mine – Gateway Application Submission Documentation in relation to groundwater model and impacts - available at http://www.bhpbilliton.com/home/society/regulatory/Pages/default.aspx

- Namoi Catchment Water Study – July 2012 – available at http://www.resourcesandenergy.nsw.gov.au/info/namoi-catchment-water-study

- NSW Office of Water, Upper Namoi Groundwater Source – Status Report 2011– available at http://www.water.nsw.gov.au/ArticleDocuments/34/avail_ground_upper_namoi_groundwater_source_status_report_2011.pdf.aspx

- NSW Office of Water 2010, Upper Namoi Groundwater Sources – Resource condition assessment report – available at http://www.water.nsw.gov.au/ArticleDocuments/34/avail_ground_upper_namoi_resource_condition_assessment_report_2010.pdf.aspx

- Peer Review of the Upper Namoi Alluvium Numerical Groundwater Model – available at http://www.mdba.gov.au/kid/files/1731-PeerReviewOfTheUpperNamoiGroundwaterModel.pdf

- Namoi subregion Bioregional Assessment –

  1.1 Context statement for the Namoi subregion – available at http://data.bioregionalassessments.gov.au/doc/BA-NIC-NAM-110-ContextStatement-20140603.pdf

  1.2 Coal and coal seam gas resource assessment for the Namoi subregion – available at http://data.bioregionalassessments.gov.au/doc/BA-NIC-NAM-120-ResourceAssessment-20141029.pdf

- Kelly et al 2007, Groundwater Knowledge Gaps in the Namoi Catchment Management Area, - available at http://www.cottoncrc.org.au/files/42a19560-8477-4703-b3b9-994d00a509af/NVGWSS.pdf

- Acworth, R., Timms, W., 2009. Evidence for connected water processes through smectite-dominated clays at Breeza, New South Wales. Australian Journal of Earth Sciences 56 (1), 81–96.

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Description of the proposed project				
Development type	☐ Coal Seam Gas	☒ Open cut coal mine	☐ Underground coal mine	
	☐ Other:	**Site**	☒ New	☐ Expansion
Operational life	30	**Scale**	Up to 10 Mtpa ROM coal (proposed total extraction is 268 Mt).	
Geological basin	Gunnedah Basin	**Coal resource**	Hoskissons and Melvilles Coal seams	
Assessment of impacts to water resources				
Surface water catchment	Mooki River subcatchment, Naomi Catchment	**Groundwater basin**	Gunnedah-Oxley	
Key water related assets	• There are two key aquifer systems that could be affected by the project: the alluvial aquifers associated with the Upper Namoi Alluvium (Narrabri Formation and the Gunnedah Formation), and the Permian 'hard rock' aquifers associated with deeper bedrock strata (including coal seams, weathered rock, sandstones, fracture zones and volcanic). • The Gunnedah Formation is a highly productive aquifer characterised by high water yields and good quality water. This aquifer is generally referred to as the primary aquifer system in the region.			
Relevant water management policies, regulations or information	• NSW water sharing plans - available from NSW Office of Water website • All water take is accounted for under these water sharing plans, no net increase in extraction.			
Key issues	• In consideration of this project, all current and relevant scientific information should be considered. Any potential data gaps in information and knowledge should be highlighted. • As noted in my previous request for advice, since the initial IESC advice of 27 May 2013, additional investigations and studies have been undertaken by the proponent and the NSW Government has commissioned independent reviews of the groundwater model. • On 27 February 2015, I visited the Liverpool Plains area and listened to concerns of farmers and Indigenous leaders. A number of reports and submissions generated by the community were provided to me at the meeting of the 27 February 2015 or have been provided by email since. This information has been provided to the IESC for consideration. • The submissions included specific questions raised by Ms Juanita Hamparsum and Ms Fiona Simson, President, NSW Farmers. Given the significance of water resources in the region and the concerns raised, I am seeking that the advice from the IESC specifically addresses each of the questions raised by Ms Fiona Simson and Ms Juanita Hamparsum. These questions are the basis for the request for advice and are provided below.			

Request for Advice
Questions from Ms Juanita Hamparsum

1) Has the revised information provided by the proponent addressed all of the Committees advice issued on 27 May 2013?

2) What are the key uncertainties and risks of the project and/or potential impacts on groundwater and surface water resources?

3) The proponent has concluded that there is a low risk of direct hydraulic connection between the Upper Namoi Alluvium and the Permian sequence and has therefore concluded that the floodplain alluviums will not be impacted. Does the Committee agree with this conclusion?

4) Is justification and verification of the conceptual groundwater model adequate? Has the proponent adequately addressed the uncertainty of hydraulic connectivity and impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers? Are the confidence levels around the predicted impacts to these structures sufficiently high to be relied upon to make a decision around matters of national environmental significance?

5) Are the revised groundwater models and the relevant data, assumptions and analyses valid and adequate to assess the potential impacts to groundwater?

6) Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from changes to surface or groundwater resources?

   a. Has the proponent adequately addressed the salinity risks associated with the project at a local and regional scale?

   b. Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from salinity impacts?

7) Are there any significant gaps in the scientific data presented that should be obtained to increase the confidence levels around the predicted impacts? If so, what data should be obtained?

8) Are the proposed management responses to groundwater alluvium interception adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

9) Are the proposed management responses to increasing salinity levels adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

10) Has the proponent adequately assessed the cumulative impacts to the region in the context of all current, proposed and possible extractive industry projects?

11) Has the proponent adequately assessed the cumulative impacts to the bioregion?

Questions from Ms Fiona Simson, President NSW Famers

1) Has the information provided by the proponent addressed concerns raised by the IESC in its advice issued on 27 May 2013?

2) Is the conceptual groundwater model appropriate and adequate? Does the Committee consider that any changes should be made to the conceptual groundwater model?

3) Are the revised groundwater models, relevant data, assumptions and analysis adequate to assess the potential impacts to groundwater at a local and regional scale?

4)

   a. What are the key uncertainties and risks of the project and/or potential impacts on groundwater and surface water resources?

   b. What additional measures and commitments could be required or undertaken to monitor, mitigate and manage impacts resulting from changes to surface or groundwater resources at a local and regional scale?

5)

   a. Has the revised information adequately addressed any salinity risks associated with the project at a local and regional scale?

   b. Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from salinity impacts?

6)

   a. Has the proponent adequately addressed the uncertainty of hydraulic connectivity and impacts to the Gunnedah formation, Narrabri formation and Permian 'hard rock' aquifers?

   b. Are the confidence levels around the predicted impacts to these structures sufficiently high to be relied upon to make a decision around matters of national environmental significance?

   c. Are there any significant gaps in the scientific data presented that should be obtained to increase the confidence levels around the predicted impacts? If so, what data should be obtained?

7) Are the proposed management responses to groundwater alluvium interception adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

8) Are the proposed management responses to increasing salinity levels adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

9) The proponent has concluded that there is a low risk of hydraulic connection between the Upper Namoi Alluvium and the Permian sequence and has therefore concluded that the floodplain alluviums will not be impacted. Does the Committee agree with this conclusion?

Contact information			
Agency contact officer/s	**Ms Paula Stagg** **A/g Assistant Secretary** **South-Eastern Australia Environment Assessments** **Tel. 6274 1444** **Email: Paula.Stagg@environment.gov.au**		
Approval			
	The Hon Greg Hunt MP Minister for the Environment		
Signature		**Date**	23 March 2015

Independent Expert Scientific Committee
on Coal Seam Gas and Large Coal Mining Development

Advice to decision maker on coal mining project

IESC 2015-066 and IESC 2015-067:
Watermark Coal Project (EPBC 2011/6201) – New Development

Requestor	Minister for the Environment, the Hon Greg Hunt MP	
Date of request	26 February 2015 (2015-066)	23 March 2015 (2015-067)
Date request accepted	27 February 2015 (2015-066)	26 March 2015 (2015-067)
Advice stage	Approval	

Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) was requested by the Minister for the Environment on 26 February 2015 to provide advice on the Watermark Coal Project proposed by Shenhua Watermark Coal Pty Ltd in New South Wales, which is addressed in this advice IESC 2015-066. On 23 March 2015, the Minister requested further advice in relation to questions raised by the community, which is addressed in IESC advice 2015-067 (Attachment A) and should be read in conjunction with this advice IESC 2015-066. The requests were published by the Commonwealth regulator and are publicly available by searching for EPBC 2011/6201 under the 'referrals' page at www.environment.gov.au/node/18622.

The IESC previously provided advice on the proposed project to the former Commonwealth Department of Sustainability, Environment, Water, Population and Communities on 27 May 2013 (IESC 2013-023; see Attachment B). In developing these new advices (IESC 2015-066 and IESC 2015-067) the IESC has considered additional information including the proponent's response (Hansen Bailey, 2013c) to the earlier advice of the IESC on the proposed project (IESC 2013-023). In January 2015, the project was approved with conditions by the New South Wales Planning Assessment Commission (PAC). The review and determination reports prepared by the PAC, the assessment reports prepared by the New South Wales Department of Planning and Environment (DPE) and relevant available analyses have also been considered in preparing these advices. The project assessment documentation and additional published information accessed by the IESC are listed in the source documentation at the end of IESC advice 2015-067 (Attachment A).

The proposed project is a new open cut coal mine and associated facilities located west of Breeza, 35 kilometres south-west of Gunnedah on the Liverpool Plains in the Namoi Valley. Coking and thermal coal would be extracted from the Hoskissons and Melvilles coal seams of the Permian Black Jack Group within the Gunnedah Basin at a rate of up to 10 million tonnes per annum of run-of-mine coal for a period of 30 years.

IESC 2015-066 Advice

The IESC's advice, in response to the Minister's specific questions of 26 February 2015, is provided below.

Question 1: Following consideration of the listed documentation, would the IESC make any revisions to their previous advice? Including, but not limited to:

a) the groundwater modelling predictions over time; and

b) the conclusions drawn with regard to the assessment of impacts to groundwater dependent ecosystems; and what consequences could result if impacts extend beyond that predicted, particularly in regards to EPBC-listed ecological communities in the area.

Response

1. Yes. A number of the matters raised in IESC 2013-023 have been examined or explained in the additional information including the groundwater conceptualisation, influence of faults and sensitivity analysis of the water balance modelling. However there remain some information gaps which need to be addressed.

    a. In relation to numerical groundwater modelling predictions, the source documentation is considered to be sufficiently robust to draw conclusions as to the most likely impacts on the Upper Namoi Alluvium, particularly the Gunnedah Formation, at a regional scale. If the proposed project is approved, additional monitoring and finer-scale groundwater modelling should be undertaken as mining progresses to improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of the finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

    b. In relation to conclusions drawn with regard to the assessment of impacts to groundwater dependent ecosystems (GDEs), there remains an unassessed risk to GDEs within the groundwater drawdown extent where groundwater is less than 20 m below the surface. Potential impacts to GDEs have been ruled out by the proponent as the ecological communities considered were deemed not wholly dependent on groundwater. However, by definition (Richardson et al., 2011), GDEs include ecosystems that opportunistically use groundwater and potential impacts should be considered for all GDEs.

    c. It is considered unlikely that groundwater drawdown will extend beyond that predicted in the sensitivity and uncertainty analyses in the Environmental Impact Statement (Hansen Bailey, 2013a; EIS). Although considered unlikely, if drawdown impacts were to extend further than predicted, direct and indirect consequences to GDEs, including EPBC-listed ecological communities (such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland) remain uncertain as GDEs have not been surveyed and vegetation mapping has not been provided outside the proposed project boundary.

Explanation

2. The matters from IESC 2013-023 listed below have been responded to or are expected to be addressed through the implementation of NSW Government consent conditions (PAC, 2015).

    a. Water quantity impacts at a regional scale have been assessed in the context of water licensing and extraction limits defined in water sharing plans, which the NSW regulator uses as an alternative approach to undertaking regional water balance modelling.

b. The predicted salt loads from the proposed project are likely to have a negligible impact on salinity at a regional scale and therefore a regional salt balance is not needed.

c. The impact of climate variability on site water management was considered in the sensitivity analysis on the site water balance in the proponent's response to submissions (Hansen Bailey, 2013b; RTS).

d. Information has been provided that addresses the influence of faults within the proposed project area, the representation of these faults within the numerical groundwater model and their effect on model outcomes, as well as the sensitivity of the model to zones of high hydraulic conductivity. It is therefore considered that additional work on faults would not substantially add to the utility of the model in predicting impacts. However, if the proposed project receives approval, the improved characterisation and representation of faults should be included in ongoing revisions to the model, particularly in finer-scale models for each pit (as described in response to Question 3a of this advice IESC 2015-066).

e. Constant conditions across the northern boundary included in the numerical groundwater model, whilst not explicitly representing seasonal variations, are unlikely to significantly affect predictions of impacts from mining, due to the distance of the boundary from the predicted groundwater drawdown extent.

f. The distribution and range of hydraulic conductivities within the coal seams utilised in the numerical groundwater model are considered appropriate and representative. The values used are consistent with local field and laboratory data.

g. A flood mitigation plan which considers the impact of a 1,000 year average recurrence interval flood event would be addressed by design of a levee to mitigate a probable maximum flood, as per the NSW Government consent condition 25 (PAC, 2015).

3. The key matters in IESC 2013-023 that need further information are outlined below. These could be addressed through collection of additional data before and during operations, with subsequent comparison and updates to predictions and regular reporting, review and action taken.

   a. A targeted monitoring programme as discussed in response to Question 3a of this advice (IESC 2015-066).

   b. Finer-scale numerical groundwater modelling, with a particular focus on the conceptualisation and parameterisation of the fresh and weathered Permian strata in the zone between the proposed pits and the Upper Namoi Alluvium as discussed in response to Question 3a of this advice (IESC 2015-066).

   c. Identification and assessment of potential impacts to water dependent ecosystems and salt-sensitive biota within and beyond the proposed project boundary as discussed below in paragraphs 4-7.

   d. Assessment of local-scale cumulative impacts as discussed below in paragraph 8.

   e. Assessment of long-term impacts associated with the final landform as discussed below in paragraphs 9-10.

Water dependent ecosystems

4. The potential impacts to water dependent ecosystems as a result of the predicted hydrological impacts remain uncertain due to insufficient survey effort. Little information has been provided that clearly identifies: ecological assets beyond the proposed project boundary that are dependent (either fully or partially) on surface water and groundwater systems; their current

condition; and how these assets may be impacted by both the proposed project and any cumulative impacts.

5. In order to better understand the potential impacts to GDEs, a systematic assessment of GDEs including EPBC-listed ecological communities is needed.

    a. Areas of shallow groundwater (less than 20 m below ground level) and groundwater discharge should be identified from the hydrogeological conceptualisation.

    b. Vegetation and wetland mapping, and fauna (such as stygofauna, macroinvertebrates and fish), flora and habitat surveys should be overlaid to identify areas of potential GDEs.

    c. Techniques from the Australian GDE Toolbox (Richardson et al., 2011) should then be applied to confirm groundwater use by vegetation and other biota and identify groundwater discharge to surface water bodies.

6. Groundwater levels along Native Dog Gully are within two metres of the surface (Hansen Bailey, 2013a, App U, Table 1), so riparian vegetation associated with Native Dog Gully should be assessed for groundwater dependence and potential groundwater drawdown impacts.

7. Potential impacts to GDEs associated with the Mooki River have not been well characterised. There is no consideration of the potential ecological impact of groundwater drawdown on the instream community in the Mooki River. The combined impacts of loss of streamflow as well as changes to water quality, particularly salt loads during 'first flush' events on Native Dog Gully and the Mooki River, should be further considered. This consideration should be informed by finer-scale modelling of the Mooki River, Native Dog Gully and associated alluvium in the vicinity of the eastern and southern pits supplemented by appropriate continuous or event-based monitoring of water quality and aquatic biota (see response to Question 3a in this advice IESC 2015-066).

Assessment of cumulative impacts

8. There is a risk of cumulative impacts to the south of the proposed project area, where the maximum alluvial groundwater drawdown as a result of the proposed project is predicted and there is the potential for groundwater drawdown associated with the proposed Caroona Coal Project. To better understand cumulative impacts, further investigation into local connectivity between the Permian and alluvial groundwater systems, particularly the properties of the fresh and weathered Permian strata in the zone between the proposed pits and the Upper Namoi Alluvium is warranted. A local-scale investigation into this connectivity should be undertaken by the proponents of this project and the Caroona Coal Project, as per IESC advice on both projects (IESC 2013-023 and IESC 2014-047). If the project is approved, this investigation could occur before mining of the southern pit, and be built into the water management plan protocol with nearby mine owners as per the NSW Government consent condition 26c (vi) (PAC, 2015).

Final landform

9. Given the local long-term salinity risk associated with the proposed final void, the design should be supported by ongoing hydrological modelling that takes into account new information gathered during mining. This information should include additional characterisation of the spatial extent and hydraulic properties of Quaternary sediments, which may intersect the western edge of the final void (GHD, 2011) and uncertainty analysis that incorporates the potential influence of climate variability.

10. The rehabilitation management plan will also be critical to manage long-term risks associated with the void and final landform. Potential 'worst-case' scenarios should be considered and

addressed within this plan, such as the potential for the void water level consistently rising above local groundwater levels, void overtopping, and local-scale salinity associated with groundwater seepages not being successfully managed by the existing rehabilitation methods.

Question 2: Could the IESC comment specifically on the conclusions drawn that the zone of depressurisation in the Permian is unlikely to extend beyond that described; and what regional implications may occur if the depressurisation in the Permian extends to, or beyond, those impacts predicted?

Response

11. The extent of depressurisation in Permian and alluvial aquifers is considered unlikely to extend beyond that described in the sensitivity and uncertainty analysis in the EIS. This conclusion is based on two factors.

    a. The proponent's groundwater conceptualisation and numerical model parameterisation are considered reasonable based on the available field data, sensitivity and uncertainty analysis in the EIS, information provided in response to a review by UNSW (DPE, 2014, App C) and consistency with additional modelling scenarios proposed by Dr Col Mackie (Hansen Bailey, 2014, App A).

    b. Other issues in relation to the numerical groundwater model, such as the representation of the Leard Formation, Benelabri Formation and drawdown contours for layer 11, are considered unlikely to have a significant impact on predictions.

12. Whilst considered unlikely, if depressurisation in the Permian extends beyond that predicted, the regional implications relate to increased impacts to water level or pressure of the groundwater resource associated with the Upper Namoi Alluvium and potentially other users of the Upper Namoi Alluvium. A robust monitoring programme is needed to ensure that potential exceedance of triggers relating to predicted impacts to water resources and associated ecosystems, such as groundwater drawdown, are detected early, as discussed in the response to Question 3 of this advice (IESC 2015-066).

13. Whilst considered unlikely, if impacts did extend beyond those predicted in the sensitivity and uncertainty analysis in the EIS, there is no likelihood of transmission of impacts to the Great Artesian Basin (GAB) because of the clear geological and spatial separation between the mine site and the aquifers of the GAB (see paragraph 23 of this advice IESC 2015-066).

Explanation

Conceptualisation and parameterisation

14. The proponent's conceptualisation, recharge and hydraulic conductivity estimates and their reported uncertainty assessment are justified, given the current understanding of the groundwater system and available data, including measured parameters. However, as additional information is collected from targeted monitoring the numerical groundwater model should be revised so that accurate predictions drive any necessary action in a timely manner.

Permian/weathered zone

15. The proponent has conceptualised the weathered zones, including those between the proposed pits and the Upper Namoi Alluvium, as zones of enhanced hydraulic conductivity. This approach is more likely to overestimate than underestimate potential impacts to the Upper Namoi Alluvium.

16. Studies by the Bureau of Rural Sciences (Macauley & Kellett, 2009) in a similar geological environment have concluded that saprolite acts as a continuous impermeable blanket over the GAB, and prevents hydraulic connection between the alluvium and the GAB sequence. Whilst there is no GAB sequence within the numerical groundwater model domain, the saprolite in this domain has the potential to form a similar low permeability layer, which would limit the transmission of groundwater impacts to the Upper Namoi Alluvium.

17. Calibrated parameters for the numerical groundwater model are within the bounds of measured parameters from pumping tests and smaller scale field and laboratory tests. There are relatively few hydraulic conductivity measurements available for the Permian strata. Model calibration, parameterisation and reliability are therefore expected to be better in the Upper Namoi Alluvium for which more data is available. For this reason, as understanding of the hydraulic characteristics of Permian strata is improved through time-series data from additional targeted monitoring, especially in the zones between the pits and the alluvium, modelling should be refined to enable early warnings of trigger exceedances and inform management options, as discussed in response to Question 3a of this advice (IESC 2015-066).

Alluvium and colluvium

18. The proponent conceptualises groundwater within the Upper Namoi Alluvium as occurring within two distinct systems: the poor quality, lower yielding Narrabri Formation and the fresher, highly productive Gunnedah Formation. While it is very likely that there is significant local-scale variation in the hydraulic parameters and connectivity of the alluvial sediments, the simplification made in the proponent's conceptualisation is appropriate at the regional scale and is consistent with previous modelling studies in the region.

19. Geological mapping (GHD, 2011) indicates zones of colluvial and alluvial deposits around the proposed western pit, which have on some occasions been referred to as 'paleochannels' (P8, for example). Hydrogeological data presented in the EIS, although limited, suggests that these zones have relatively low hydraulic conductivity and high salinity (the latter also a strong indicator implying low hydraulic conductivity and little natural throughflow of groundwater). The numerical groundwater model has represented these deposits as weathered material, with enhanced hydraulic conductivity. This approach is appropriate and likely to overestimate any potential impacts on the Upper Namoi Alluvium.

20. Better definition and parameterisation of the hydrogeology and geology at a local-scale, particularly in relation to the alluvium and colluvium, should inform finer-scale numerical groundwater modelling discussed in response to Question 3a of this advice (IESC 2015-066) to improve confidence in the prediction of local groundwater drawdown effects and clear identification and response to mine-induced impacts.

Sensitivity and uncertainty analysis

21. The sensitivity analysis and uncertainty analysis within Hansen Bailey (2013a) provide investigation of uncertainties associated with key variables: hydraulic conductivity, storativity and recharge. These analyses provide a good estimate of the median impact and improve confidence in impact predictions. Additional Monte Carlo simulations would improve the reliability of estimations for the extremes of the predictive interval.

Numerical groundwater model - representation of hydrostratigraphy and groundwater drawdown

22. There are several minor issues with the presentation of information relating to model layers and possible issues with the representation of hydrostratigraphic units in the model, as outlined below. Confidence in the model's predictions would be improved if more information were

provided relating to the model layers, but it is considered that resolution of these issues would not have a substantial impact on model predictions.

a. Groundwater drawdown contours have not been provided for model layer 11 (described as representing the Watermark to Maules Creek Formations), which underlies layers 1 and 2 in the northern and eastern area of the model. Presentation of modelled drawdown in this layer for all scenarios would assist in confirming that there is a low likelihood of drawdown in the overlying Upper Namoi Alluvium to the north-east of the proposed project area.

b. The Leard Formation is not described as being incorporated into any of the numerical model layers. It is presumed that it has been included in layer 11. Given that this stratum is located deep in the groundwater system in the vicinity of the mine and does not have high hydraulic conductivity, it is unlikely that its inclusion or otherwise would have a significant impact on the model's predictions.

c. The Benelabri Formation is shown in the EIS to overlie the Clare Sandstone. However in relevant literature it is described as underlying the Clare Sandstone. This inconsistency is not likely to impact the model results.

Great Artesian Basin

23. The areas of Pilliga Sandstone immediately to the south and west of the proposed project area are outliers and are not hydraulically connected to the Pilliga Sandstone aquifer of the GAB, which outcrops approximately 66 km to the west of the proposed project area. Therefore any impact to groundwater in the Pilliga Sandstone in the proposed project area is not expected to be transmitted to the GAB.

Question 3a: Is the IESC satisfied the proposed surface water and groundwater monitoring programmes are robust and any potential impacts on water resources and water related assets (including the Upper Namoi Alluvium and Permian) will be detected? Is there appropriate spatial and temporal coverage?

Response

24. No. The proposed monitoring programme has not changed from that used to obtain baseline information and its spatial and temporal coverage is not considered sufficient to:

a. Enable derivation of appropriate trigger values for water quality.

b. Ensure early warnings of impacts exceeding predictions in time to implement corrective action and management strategies.

c. Determine exceedance of triggers in a quantifiable and robust manner, and to be capable of determining the contribution of the proposed project to any observed impacts, as distinct from those caused by other users and climatic conditions.

d. Obtain the additional data needed to reduce uncertainties in the numerical groundwater model predictions.

e. Detect post-mining impacts.

25. Noting that the NSW Government consent condition 26c(iv) (PAC, 2015) requires monitoring of post-mining groundwater recovery to continue for at least ten years, the additional information provided by the proponent is unclear as to the scale and extent of water monitoring following the cessation of mining.

26. A staged approach to further monitoring would be appropriate to be undertaken in line with the proposed mine plan, particularly in the Permian strata and weathered zone in the area between the mine pits (in particular the eastern and southern pits) and Upper Namoi Alluvium. This monitoring should be undertaken in conjunction with development of finer-scale groundwater models focussing on each pit, with more detailed definition of strata, seasonal variation and boundary conditions. Improved understanding of the hydrogeological system gained during operations in one pit should be used to assess potential impacts associated with the next pit. The knowledge gained during operations should be used to inform the assessment of potential impacts from the final landform, including the proposed void and potential seepages and determination of mitigation or management strategies.

27. Suggested expansions to surface water and groundwater monitoring spatial coverage are identified below. Commitments for surface water and groundwater monitoring should be presented as part of a water monitoring plan and should be consistent with the National Water Quality Management Strategy (ANZECC and ARMCANZ, 2000). Where additional sites have been identified, monitoring should begin immediately to establish baseline conditions before mining commences.

Explanation

Surface Water

28. The surface water monitoring programme should be designed to:

    a. Establish the flow regime in ephemeral water courses and monitor any changes to the flow resulting from the proposed project.

    b. Enable determination of exceedance of site-specific water quality triggers in Watermark Gully, Native Dog Gully and the Mooki River and subsequent initiation of management options.

    c. Improve the local-scale understanding of surface-groundwater interactions along the Mooki River in the vicinity of the proposed project area, to inform finer-scale groundwater modelling discussed in paragraph 26 of this advice (IESC 2015-066).

    d. Enable detection, monitoring and management of impacts to salt-sensitive biota within and downstream of the project area. Current lack of surveys for water-dependent and salt-sensitive biota hampers determination of suitable monitoring protocols.

29. This monitoring programme should include:

    a. Event-based water quality monitoring and continuous monitoring of flow and electrical conductivity (EC) in Native Dog Gully to provide context for water quality measurements.

    b. Monitoring of water flow and quality (including continuous monitoring of EC) in Watermark Gully downstream of the eastern pit to detect any impacts from runoff from the overburden emplacement area.

    c. The addition of selenium, aluminium and molybdenum to the suite of dissolved metals tested on a regular basis in watercourses downstream of the proposed project area to determine whether runoff from overburden emplacement areas presents any risk to water resources or water-related assets.

Groundwater

30. The monitoring programme should be designed to:

a. Enable clear determination of any exceedance of early-warning triggers, before reaching limits for groundwater drawdown in the Upper Namoi Alluvium as defined in NSW Government consent condition 25 (PAC, 2015).

b. Enable groundwater pressures and quality impacts from the proposed project to be differentiated from impacts as a result of other groundwater users and climatic conditions.

c. Reduce numerical groundwater model uncertainty to enable improved predictions of likely impacts, and subsequent management options.

31. This monitoring programme would include:

a. Monitoring of control wells located well outside zones of potential mining-induced impacts.

b. Monitoring of groundwater levels and quality to inform assessment of recharge into and any flow from the Narrabri Formation to the Gunnedah Formation within the Upper Namoi Alluvium.

c. Monitoring and determination of the influence of other groundwater and surface water takes including nearby mines in the vicinity of the proposed project.

32. Additional multi-level (nested) monitoring wells should be installed to the north and south of the eastern pit, followed by the area to the south of the southern pit (where mining is not proposed to begin for 17 years), to identify any changes in groundwater pressure and provide information to reduce uncertainty in parameter estimation and predictions from finer-scale groundwater models noted in paragraph 26 of this advice (IESC 2015-066). Tests should be undertaken during monitoring well installation to obtain additional data on hydraulic parameters. The nested monitoring points should be located in each significant hydrogeological layer, particularly the Permian and weathered zone, correlating to those created in updated groundwater models. This would assist in early detection of unexpected depressurisation and clear identification and response to mine-induced impacts.

33. The additional information (Hansen Bailey, 2014, App A) has identified the need for more monitoring wells to be installed and located within the predicted zone of depressurisation to assess the extent and rate of depressurisation against numerical groundwater model predictions. Even though groundwater drawdown is not predicted in the Upper Namoi Alluvium to the north of the eastern pit, additional multi-level (nested) monitoring wells should be placed in this area to confirm model predictions and provide an early warning of any variation from predicted depressurisation in this area.

Question 3b: Could the IESC provide advice on the appropriate management responses if triggers are exceeded?

Response

34. Groundwater, surface water and ecological triggers and subsequent management responses are proposed to be developed within management plans in the post approval process. The IESC is unable to comment on their appropriateness as the plans are not yet available.

35. Where triggers and limits are exceeded, management responses for surface water and groundwater should be clearly stated within an enforceable adaptive management framework. Management responses may include, but should not be limited to, the elements listed below.

a. Ecotoxicity testing of discharges and surface waters to assess bioavailability of contaminants in these mixtures.

b. Water allocation and engineering management options including: water treatment; dam sizing; increasing the capacity of the water management system; and redesign, capping and revegetation of overburden. The proponent suggests cut off measures and reinjection of water into depressurised aquifers to mitigate groundwater drawdown. A stronger rationale is needed for reinjection with consideration given to: the goals of the option; the likely sources of water for reinjection; the suitability of the water with regards to matching water quality at the injection site; the potential impacts to both the injection site and the source site; and evaluation of the reinjection against alternative management options such as purchasing additional groundwater licences or altering the mine plan.

c. Mine plan management options including limiting depth and lateral extents of mining to reduce effects of depressurisation.

d. Regular ongoing assessment, validation, recalibration and peer review of models to reduce uncertainties in model predictions and to enable proposed management processes.

e. Regulatory options where groundwater drawdown limits are exceeded and reassessment of suitability of approval limits and triggers.

Groundwater

36. In light of the results of the sensitivity and uncertainty analysis undertaken for the EIS it would have been beneficial to have a corresponding uncertainty analysis for the scenarios posed by Dr Col Mackie and referenced by the PAC (Scenarios 3, 6, 7, and 11 in Hansen Bailey, 2014, App A) in order to understand more fully the potential for exceeding the conditions relating to groundwater drawdown impacts in the Upper Namoi Alluvium set in the NSW Government consent (PAC, 2015). In the absence of such an uncertainty analysis, strong emphasis should be placed on developing:

    a. A monitoring programme that enables early warnings of greater depressurisation than predicted.

    b. Robust enforceable management protocols (for proponent and regulator) for action to be taken in time so that limits are not exceeded.

Surface Water

37. The mitigation and management measures that will be employed if salt loads exceed the site-specific trigger values in Watermark Gully, Native Dog Gully or the Mooki River should be proposed by the proponent based on its assessment of salt-sensitive biota as discussed in paragraph 28.d of this advice (IESC 2015-066).

38. Excess salt loads from sediment dam spills can be mitigated by increasing the size of sediment dams or the mine water system to reduce the volume and frequency of overflow. Contingency measures should be developed to prevent the release of sediment dam water in extreme rainfall events if the water quality, particularly salt load and total suspended solids, is not suitable for release.

39. The Mine Rehabilitation Plan should consider measures to prevent impacts to the biota of Native Dog Gully and the Mooki River from long-term saline seepage from the eastern and southern mining areas. Measures could include:

    a. Monitoring overburden emplacement area runoff as discussed in paragraph 29.b of this advice (IESC 2015-066) to refine estimates of long-term salt loads.

b. Design of overburden emplacement areas based on updated hydrogeological information gained during mining, including capping and revegetation to minimise seepage.

Date of advice	27 April 2015

IESC 2015-067 Advice

The IESC's advice, in response to the Minister's additional request of 23 March 2015 concerning questions raised by the community, is provided below.

Questions from Ms Juanita Hamparsum

Question 1: Has the revised information provided by the proponent addressed all of the Committees advice issued on 27 May 2013?

Response

40. No, not all matters have been addressed at this stage. A number of the matters raised in IESC 2013-023 have been examined or explained in the additional information or would be addressed through the implementation of NSW Government consent conditions (PAC, 2015) including: the groundwater conceptualisation; likely impacts on the Upper Namoi Alluvium, particularly the Gunnedah Formation, at a regional scale; the influence of faults; and sensitivity analysis of the water balance modelling.

41. The key matters in IESC 2013-023 that need further information are outlined below. These could be addressed through collection of additional data before and during operations with subsequent comparison and updates to predictions as needed, and regular reporting, review and action taken, if the mine is approved:

    a. A targeted monitoring programme.

    b. Finer-scale numerical groundwater modelling, with a particular focus on the conceptualisation and parameterisation of the fresh and weathered Permian strata in the zone between the proposed pits and the Upper Namoi Alluvium.

    c. Identification and assessment of potential impacts to water dependent ecosystems, including EPBC-listed communities (such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland), and salt-sensitive biota within and beyond the proposed project boundary.

    d. Assessment of local-scale cumulative impacts.

    e. Long-term impacts associated with the final landform.

Question 2: What are the key uncertainties and risks of the project and/or potential impacts on groundwater and surface water resources?

Response

42. The key potential impact associated with the proposed project is change to groundwater pressure and/or level within the Upper Namoi Alluvium groundwater resource. The IESC considers that impacts to the highly productive Upper Namoi Alluvium groundwater resource are likely to be less than those predicted in the numerical groundwater model sensitivity and uncertainty analysis of the Environmental Impact Statement (Hansen Bailey, 2013a; EIS). An uncertainty analysis would be needed to judge whether groundwater impacts to the Upper Namoi Alluvium may exceed those predicted using Dr Col Mackie's preferred scenarios (Hansen Bailey, 2014, App A), which constitute the groundwater drawdown limit in the NSW Government consent conditions (PAC, 2015). There is also the potential for local-scale impacts to surface water quality and long-term salinity changes associated with the final landform.

43. The main factors that influence groundwater drawdown in the Upper Namoi Alluvium are recharge and hydraulic parameters, particularly for weathered and unweathered Permian strata between the proposed pits and the Upper Namoi Alluvium. These factors influence the potential for drawdown in the Permian sequence to be transmitted to the overlying Upper Namoi Alluvium.

44. There is uncertainty as to the potential impacts to aquatic ecosystems as a result of the hydrological impacts predicted, due to insufficient survey effort. Little information has been provided that clearly identifies: ecological assets beyond the proposed project boundary that are dependent (either fully or partially) on surface water and groundwater systems; their current condition; and how these assets will be impacted by both the proposed project and any cumulative impacts. Should the project be approved, these information needs could be met by targeted additional data collection and improvements to the monitoring and management programme before and during operations.

Question 3: The proponent has concluded that there is a low risk of direct hydraulic connection between the Upper Namoi Alluvium and the Permian sequence and has therefore concluded that the floodplain alluviums will not be impacted. Does the Committee agree with this conclusion?

Response

45. The proponent's numerical groundwater model, which the IESC considers to be reasonable, demonstrates a direct hydraulic connection between the Upper Namoi Alluvium and the Permian strata and predicts groundwater drawdown within the floodplain alluviums as a result of the proposed project. The magnitude and extent of groundwater drawdown in the alluvial aquifers is considered unlikely to be significant, based on predictions described in the sensitivity and uncertainty analyses in the EIS. To improve confidence in groundwater drawdown predictions over time, additional data should be gathered on the hydraulic connectivity between the Permian strata and the Upper Namoi Alluvium (as discussed in response to Question 3a within IESC 2015-066).

Question 4: Is justification and verification of the conceptual groundwater model adequate? Has the proponent adequately addressed the uncertainty of hydraulic connectivity and impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers? Are the confidence levels around the predicted impacts to these structures sufficiently high to be relied upon to make a decision around matters of national environmental significance?

Response

46. Yes. The proponent's groundwater conceptualisation is considered to be adequate on the basis of alignment of the range of modelled parameter values with field data and the consistency of the proponent's conceptualisation with previous hydrogeological studies in the region. Should the project be approved, further verification resulting from additional monitoring and finer-scale modelling (as described in IESC 2015-066, paragraph 26) would improve confidence in predictions.

47. Yes. The numerical groundwater model sensitivity analysis and uncertainty analysis within the EIS, information provided in response to a review by UNSW (DPE, 2014, App C) and additional modelling scenarios proposed by Dr Col Mackie (Hansen Bailey, 2014, App A), have reasonably addressed uncertainties associated with the model including potential variability of hydraulic conductivity. These analyses improve confidence that impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers are not likely to exceed those predicted in the sensitivity and uncertainty analyses in the EIS.

48. Yes. The proponent's documentation is considered to be sufficiently robust and confidence levels surrounding the current numerical groundwater modelling are considered to be sufficient to draw conclusions surrounding the most likely range of groundwater drawdown impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers. There remains an unassessed risk to GDEs, which include EPBC-listed ecological communities (such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland) within the groundwater drawdown extent. Potential impacts to GDEs have been ruled out by the proponent as the GDEs considered were deemed not wholly dependent on groundwater. However, by definition (Richardson et al., 2011), GDEs include ecosystems that opportunistically use groundwater and potential impacts should be considered for all GDEs. Additionally, potential impacts to water dependent ecosystems beyond the proposed project area remain uncertain due to insufficient survey effort.

Question 5: Are the revised groundwater models and the relevant data, assumptions and analyses valid and adequate to assess the potential impacts to groundwater?

Response

49. Yes. The revised groundwater models, relevant data, assumptions and analysis are considered to be adequate to assess the potential hydrological impacts to groundwater. The proponent's groundwater conceptualisation and model parameterisation are considered to be reasonable based on the available field data, sensitivity and uncertainty analysis in the EIS, information provided in response to a review by UNSW (DPE, 2014, App C) and consistency with additional modelling scenarios proposed by Dr Col Mackie (Hansen Bailey, 2014, App A). Should the project progress, additional monitoring and finer-scale groundwater modelling would improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of the finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

Question 6: Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from changes to surface or groundwater resources?

Response

50. Yes, the IESC has identified additional measures that should be implemented to monitor, mitigate and manage the potential impacts to water resources and water-related assets.

51. The spatial and temporal coverage of the surface water, groundwater and ecological monitoring programmes should be expanded to ensure monitoring is sufficient to:

    a. Enable derivation of appropriate trigger values for water quality and ecological values for each water resource.

    b. Ensure early warnings of impacts exceeding predictions, in time to implement corrective action and management strategies.

    c. Determine exceedance of triggers in a quantifiable robust manner, and to be capable of determining the contribution of the proposed project to any observed impacts, as distinct from those caused by other users and climatic conditions.

    d. Obtain the additional data needed to reduce uncertainties in the numerical groundwater model predictions.

    e. Detect post-mining impacts.

52. IESC 2015-066 makes specific suggestions for expanding the proposed surface water and groundwater monitoring spatial coverage (see paragraphs 26-33). An ecological monitoring programme should be informed by surveys of water-dependent and salt-sensitive biota within and downstream of the project area.

53. If triggers and limits are exceeded, management responses for surface water and groundwater should be clearly stated within an enforceable adaptive management framework and may include, but should not be limited to, the elements listed below.

    a. Ecotoxicity testing of discharges and surface waters to assess bioavailability of contaminants in these mixtures.

    b. Water allocation and engineering management options including: water treatment; dam sizing; increasing the capacity of the water management system; and redesign, capping and revegetation of overburden. The proponent suggests cut off measures and reinjection of water into depressurised aquifers to mitigate groundwater drawdown. A stronger rationale is needed for reinjection with consideration given to: the goals of the option; the likely sources of water for reinjection; the suitability of the water with regards to matching water quality at the injection site; the potential impacts to both the injection site and the source site; and evaluation of the reinjection against alternative management options such as purchasing additional groundwater licences or altering the mine plan.

    c. Mine plan management options including limiting depth and lateral extents of mining to reduce effects of depressurisation.

    d. Regular ongoing assessment, validation, recalibration and peer review of models to reduce uncertainties in model predictions and to enable initiation and/or variation of proposed management processes.

    e. Regulatory options where groundwater drawdown limits are exceeded and reassessment of suitability of approval limits and triggers.

Question 6(a): Has the proponent adequately addressed the salinity risks associated with the project at a local and regional scale?

Response

54. Yes at the regional scale but not at the local scale. The current lack of adequate surveys identifying water-dependent and salt-sensitive biota prevents an assessment of the risk of sediment dam saline discharges and long-term seepages at the local scale. Salt-sensitive biota within and downstream of the proposed project area should be identified, assessed for potential impacts and monitored.

55. The predicted salt loads from the proposed project are likely to have a negligible impact on salinity at a regional scale. As such the regional-scale salinity risk is considered to have been adequately addressed.

Question 6(b): Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from salinity impacts?

Response

56. Yes, the IESC has identified additional measures that should be implemented to manage the potential impacts from salinity at the local scale. Additions to the monitoring programme should include the elements listed below.

a. Identification, establishment of trigger values and monitoring of salt-sensitive biota within and downstream of the proposed project area.

b. Event-based water quality monitoring and continuous monitoring of flow and electrical conductivity (EC) in Native Dog Gully to provide context for water quality measurements, establish the flow regime, and monitor changes to the regime as a result of the proposed project.

c. Monitoring of water flow and quality (including continuous monitoring of EC) in Watermark Gully downstream of the eastern pit to detect any impacts from runoff from the overburden emplacement area.

57. The surface water management plan should detail the mitigation and management measures that will be employed if salt loads exceed the site-specific trigger values in Watermark Gully, Native Dog Gully or the Mooki River.

58. Management responses may include, but should not be limited to: water treatment; dam sizing; increasing the capacity of the water management system; and redesign, capping and revegetation of overburden.

Question 7: Are there any significant gaps in the scientific data presented that should be obtained to increase the confidence levels around the predicted impacts? If so, what data should be obtained?

Response

59. In relation to numerical groundwater modelling predictions, the scientific data is considered to be sufficiently robust to draw conclusions as to the most likely impacts on the Upper Namoi Alluvium, particularly the Gunnedah Formation, at a regional scale. Should the project progress, additional monitoring and finer-scale groundwater modelling would improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

60. A staged approach to further monitoring would be appropriate to be undertaken in line with the proposed mine plan, particularly in the Permian strata and weathered zone in the area between the mine pits (in particular the eastern and southern pits) and Upper Namoi Alluvium. This monitoring should be undertaken in conjunction with development of finer-scale groundwater models focussing on each pit, with more detailed definition of strata, seasonal variation and boundary conditions. Improved understanding of the hydrogeological system gained during operations in one pit should be used to assess potential impacts associated with the next pit. The knowledge gained during operations should be used to inform the assessment of potential impacts from the final landform, including the proposed void and potential seepages and determination of mitigation or management strategies.

61. Additional information on the following matters would improve confidence levels around the potential impacts to water resources. The IESC considers that these information needs could be met by targeted additional data collection and improvements to the monitoring and management programme before and during operations.

a. Identification of GDEs beyond the proposed project boundary and an assessment of their current condition, any potential impacts from the proposed project, and any cumulative impacts.

b. An assessment of the potential ecological impact of the project on the instream community in the Mooki River. The combined impacts of loss of streamflow as well as changes to water

quality, particularly salt loads and dissolved metals during 'first flush' events on Native Dog Gully and the Mooki River should be further considered.

c. A thorough assessment of the risk to water resources and water-related assets from runoff from overburden emplacement areas. This assessment should be informed by the monitoring of surface water quality in Watermark Gully downstream of the eastern pit and the addition of selenium, aluminium and molybdenum to the suite of metals tested on a regular basis in watercourses downstream of the proposed project area.

Question 8: Are the proposed management responses to groundwater alluvium interception adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

Response

62. The adequacy of these measures cannot be determined at this stage as management responses have not been stated explicitly. To ensure management responses are adequate, clear trigger and limit exceedance levels and robust regulatory enforcement mechanisms should be established.

Explanation

63. Groundwater triggers and subsequent management responses are proposed to be developed within water management plans in the post approval process. The IESC is unable to comment on their appropriateness, as the plans are not yet available.

64. The additional information (Hansen Bailey, 2014, App A) has identified the need for more monitoring wells to be installed and located within the predicted zone of depressurisation to assess the extent and rate of depressurisation against numerical groundwater model predictions. Even though groundwater drawdown is not predicted in the Upper Namoi Alluvium to the north of the eastern pit, additional multi-level (nested) monitoring wells should be placed in this area to confirm model predictions and provide an early warning of any variation from predicted depressurisation in this area.

65. In light of the results of the sensitivity and uncertainty analysis undertaken for the EIS it would have been beneficial to have a corresponding uncertainty analysis for the scenarios posed by Dr Col Mackie and referenced by the PAC (Scenarios 3, 6, 7, and 11 in Hansen Bailey, 2014, App A) in order to understand more fully the potential for exceeding the conditions relating to groundwater drawdown impacts in the Upper Namoi Alluvium set in the NSW Government consent (PAC, 2015). In the absence of such an uncertainty analysis, a strong emphasis should be placed on developing:

a. A monitoring programme that enables early warnings of greater depressurisation than predicted.

b. Robust, enforceable management protocols (for proponent and regulator) for action to be taken in time so that limits are not exceeded.

Question 9: Are the proposed management responses to increasing salinity levels adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

Response

66. The adequacy of these measures cannot be determined at this stage as proposed management responses are to be included in the water management plan.

67. Yes. The IESC has identified additional measures to mitigate and manage the potential impacts from salinity at the local scale as per paragraphs 56-58 of this advice (IESC 2015-067).

Question 10: Has the proponent adequately assessed the cumulative impacts to the region in the context of all current, proposed and possible extractive industry projects?

Response

68. The proponent appropriately utilised the Namoi Catchment Water Study (SWS, 2012) to assess potential cumulative impacts to groundwater in the context of the current and proposed projects included within the bioregional assessment coal and coal seam gas resource assessment for the Namoi subregion (Northey, Pinetown and Sander, 2014). To better understand cumulative impacts, further investigation into local connectivity between the Permian and alluvial groundwater systems, particularly the properties of the fresh and weathered Permian strata in the zone between the proposed pits and the Upper Namoi Alluvium is warranted. Further investigation into the potential cumulative impacts to surface water and GDEs, as identified in SWS (2012), could also be undertaken.

69. There is a risk of cumulative impacts to the south of the proposed project area, where the maximum alluvial groundwater drawdown as a result of the proposed project is predicted and there is the potential for groundwater drawdown associated with the proposed Caroona Coal Project. A local-scale investigation into this connectivity should be undertaken by the proponents of this project and the Caroona Coal Project, as per IESC advice on both projects (IESC 2013-023 and IESC 2014-047). If the project is approved, this investigation could occur before mining of the southern pit and be built into the water management plan protocol with nearby mine owners as per the NSW Government consent condition 26c (vi) (PAC, 2015).

Question 11: Has the proponent adequately assessed the cumulative impacts to the bioregion?

Response

70. It is not considered necessary for the proponent to assess cumulative impacts to the bioregion. The proponent has referred to data sources specific to the Namoi catchment, such as aspects of the proposed framework for assessing the cumulative risk of mining on natural resource assets in the Namoi Catchment (Eco Logical, 2011) and the Namoi Catchment Water Study (SWS, 2012). The Australian Government's bioregional assessment of the Namoi subregion will provide additional information and analyses to further assess potential cumulative impacts.

71. Data and relevant information from the proposed project, including that collected during the life of the mine, should be made accessible for this Bioregional Assessment to assist the knowledge base for regional-scale assessments.

Questions from Ms Fiona Simson, President NSW Farmers

Question 1: Has the information provided by the proponent addressed concerns raised by the IESC in its advice issued on 27 May 2013?

Response

72. No, not all matters have been addressed at this stage. A number of the matters raised in IESC 2013-023 have been examined or explained in the additional information or would be addressed through the implementation of NSW Government consent conditions (PAC, 2015) including: the groundwater conceptualisation; likely impacts on the Upper Namoi Alluvium,

particularly the Gunnedah Formation, at a regional scale; the influence of faults; and sensitivity analysis of the water balance modelling.

73. The key matters in IESC 2013-023 that need further information are outlined below. These could be addressed through collection of additional data before and during operations, with subsequent comparison and updates to predictions as needed and regular reporting, review and action taken, if the mine is approved:

    a. A targeted monitoring programme

    b. Finer-scale numerical groundwater modelling, with a particular focus on the conceptualisation and parameterisation of the fresh and weathered Permian strata in the zone between the proposed pits and the Upper Namoi Alluvium

    c. Identification and assessment of potential impacts to water dependent ecosystems, including EPBC-listed communities (such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland), and salt-sensitive biota within and beyond the proposed project boundary.

    d. Assessment of local-scale cumulative impacts.

    e. Long-term impacts associated with the final landform.

Question 2: Is the conceptual groundwater model appropriate and adequate? Does the Committee consider that any changes should be made to the conceptual groundwater model?

Response

74. Yes, the proponent's groundwater conceptualisation is considered to be appropriate and adequate to assess potential groundwater drawdown impacts to groundwater resources as a result of the proposed project. This view is based on the alignment of the range of modelled parameter values with field data and the consistency of the proponent's conceptualisation with previous hydrogeological studies in the region. Should the project be approved, further verification resulting from additional monitoring and finer-scale groundwater modelling (as described in IESC 2015-066, paragraph 26) would improve confidence in predictions.

Question 3: Are the revised groundwater models, relevant data, assumptions and analysis adequate to assess the potential impacts to groundwater at a local and regional scale?

Response

75. Yes. The revised groundwater models, relevant data, assumptions and analysis are considered to be adequate to assess the potential hydrological impacts to groundwater. The proponent's groundwater conceptualisation and model parameterisation are considered to be reasonable based on the available field data, sensitivity and uncertainty analysis in the EIS, information provided in response to a review by UNSW (DPE, 2014, App C) and consistency with additional modelling scenarios proposed by Dr Col Mackie (Hansen Bailey, 2014, App A). Should the project progress, additional monitoring and finer-scale groundwater modelling would improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

Question 4a: What are the key uncertainties and risks of the project and/or potential impacts on groundwater and surface water resources?

Response

76. The key potential impact associated with the proposed project is change to groundwater pressure and/or level within the Upper Namoi Alluvium groundwater resource. The IESC considers that impacts to the highly productive Upper Namoi Alluvium groundwater resource are likely to be less than those predicted in the numerical groundwater model sensitivity and uncertainty analysis within the EIS (Hansen Bailey, 2013a). An uncertainty analysis would be needed to judge whether groundwater impacts to the Upper Namoi Alluvium may exceed those predicted using Dr Col Mackie's preferred scenarios (Hansen Bailey, 2014, App A), which constitute the groundwater drawdown limit in the NSW Government consent conditions (PAC, 2015). There is also the potential for local-scale impacts to surface water quality and long-term salinity changes associated with the final landform.

77. The main factors that influence drawdown in the Upper Namoi Alluvium are recharge and hydraulic parameters, particularly for weathered and unweathered Permian strata between the proposed pits and the Upper Namoi Alluvium. These factors influence the potential for drawdown in the Permian sequence to be transmitted to the overlying Upper Namoi Alluvium.

78. There is uncertainty as to the potential impacts to aquatic ecosystems as a result of the hydrological impacts predicted, due to insufficient survey effort. Little information has been provided that clearly identifies: ecological assets beyond the proposed project boundary that are dependent (either fully or partially) on surface water and groundwater systems; their current condition; and how these assets may be impacted by both the proposed project and any cumulative impacts. Should the project be approved, these information needs could be met by targeted additional data collection and improvements to the monitoring and management programme before and during operations.

Question 4b: What additional measures and commitments could be required or undertaken to monitor, mitigate and manage impacts resulting from changes to surface or groundwater resources at a local and regional scale?

Response

79. The IESC has identified additional monitoring and management measures that should be implemented to monitor, mitigate and manage the potential impacts to water resources and water-related assets at a local and regional scale.

80. The spatial and temporal coverage of the surface water, groundwater and ecological monitoring programmes should be expanded to ensure monitoring is sufficient to:

    a. Enable derivation of appropriate trigger values for water quality and ecological values for each water resource.

    b. Ensure early warnings of impacts exceeding predictions, in time to implement corrective action and management strategies.

    c. Determine exceedance of triggers in a quantifiable robust manner and to be capable of determining the contribution of the proposed project to any observed impacts, as distinct from those caused by other users and climatic conditions.

    d. Obtain the additional data needed to reduce uncertainties in the numerical groundwater model predictions.

    e. Detect post-mining impacts.

81. IESC 2015-066 makes specific suggestions for expanding the proposed surface water and groundwater monitoring spatial coverage (see paragraphs 26-33). An ecological monitoring programme should be informed by surveys of water-dependent and salt-sensitive biota within and downstream of the project area.

82. If triggers and limits are exceeded, management responses for surface water and groundwater should be clearly stated within an enforceable adaptive management framework and may include, but should not be limited to, the elements listed below.

    a. Ecotoxicity testing of discharges and surface waters to assess bioavailability of contaminants in these mixtures.

    b. Water allocation and engineering management options including: water treatment; dam sizing; increasing the capacity of the water management system; and redesign, capping and revegetation of overburden. The proponent suggests cut off measures and reinjection of water into depressurised aquifers to mitigate groundwater drawdown. A stronger rationale is needed for reinjection with consideration given to: the goals of the option; the likely sources of water for reinjection; the suitability of the water with regards to matching water quality at the injection site; the potential impacts to both the injection site and the source site; and evaluation of the reinjection against alternative management options such as purchasing additional groundwater licences or altering the mine plan.

    c. Mine plan management options including limiting depth and lateral extents of mining to reduce effects of depressurisation.

    d. Regular ongoing assessment, validation, recalibration and peer review of models to reduce uncertainties in model predictions and to enable initiation and/or variation of proposed management processes.

    e. Regulatory options where groundwater drawdown limits are exceeded and reassessment of suitability of approval limits and triggers.

Question 5a: Has the revised information adequately addressed any salinity risks associated with the project at a local and regional scale?

Response

83. Yes, at the regional scale, but not at the local scale. The current lack of adequate surveys identifying water-dependent and salt-sensitive biota prevents an assessment of the risk of sediment dam saline discharges and long-term seepages at the local scale. Salt-sensitive biota within and downstream of the proposed project area should be identified, assessed for potential impacts and monitored.

84. The predicted salt loads from the proposed project are likely to be have a negligible impact on salinity at a regional scale. As such the regional-scale salinity risk is considered to have been adequately addressed.

Question 5b: Are there additional measures and commitments required to monitor, mitigate and manage impacts resulting from salinity impacts?

Response

85. Yes, the IESC has identified additional measures that should be implemented to monitor, mitigate and manage the potential impacts from salinity at the local scale. Additions to the monitoring programme should include the elements listed below.

a. Identification, establishment of trigger values and monitoring of salt-sensitive biota within and downstream of the proposed project area.

b. Event-based water quality monitoring and continuous monitoring of flow and electrical conductivity (EC) in Native Dog Gully to provide context for water quality measurements, establish the flow regime, and monitor changes to the regime as a result of the proposed project.

c. Monitoring of water flow and quality (including continuous monitoring of EC) in Watermark Gully downstream of the eastern pit to detect any impacts from runoff from the overburden emplacement area.

86. The surface water management plan should detail the mitigation and management measures that will be employed if salt loads exceed the site-specific trigger values in Watermark Gully, Native Dog Gully or the Mooki River.

87. Management responses may include, but should not be limited to: water treatment; dam sizing; increasing the capacity of the water management system; and redesign, capping and revegetation of overburden.

Question 6a: Has the proponent adequately addressed the uncertainty of hydraulic connectivity and impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers?

Response

88. Yes. The numerical groundwater model sensitivity analysis and uncertainty analysis within the EIS, information provided in response to a review by UNSW (DPE, 2014, App C) and additional modelling scenarios proposed by Dr Col Mackie (Hansen Bailey, 2014, App A), have reasonably addressed uncertainties associated with the model including potential variability of hydraulic conductivity. These analyses improve confidence that impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers are not likely to exceed those predicted in the sensitivity and uncertainty analyses in the EIS.

89. As described in the IESC 2015-066 (paragraph 26) the proponent should undertake further monitoring and finer-scale groundwater modelling as the project progresses to further reduce uncertainty. This will improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

Question 6b: Are the confidence levels around the predicted impacts to these structures sufficiently low to be relied upon to make a decision around matters of national environmental significance?

Response

90. In relation to groundwater modelling predictions, the source documentation is considered to be sufficiently robust to draw conclusions to the most likely range of groundwater drawdown impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers. However, there remains an unassessed risk to GDEs and the proponent should undertake further monitoring and finer-scale groundwater modelling as the project progresses, as described in IESC 2015-066 (paragraph 26), to further improve confidence and ensure that accurate predictions drive any necessary action in a timely manner to keep impacts within the bounds of those originally predicted.

91. While the confidence levels around predicted groundwater drawdown impacts to the Gunnedah Formation, Narrabri Formation and Permian 'hard rock' aquifers are reasonable, there remains an unassessed risk to GDEs, which include EPBC-listed ecological communities (such as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland) within the groundwater drawdown extent. Potential impacts to GDEs have been ruled out by the proponent as the GDEs considered were deemed not wholly dependent on groundwater. However, by definition (Richardson et al., 2011), GDEs include ecosystems that opportunistically use groundwater and potential impacts should be considered for all GDEs. Additionally potential impacts to water dependent ecosystems beyond the proposed project area remain uncertain due to insufficient survey effort.

Question 6c: Are there any significant gaps in the scientific data presented that should be obtained to increase the confidence levels around the predicted impacts? If so, what data should be obtained?

Response

92. In relation to numerical groundwater modelling predictions, the scientific data is considered to be sufficiently robust to draw conclusions as to the most likely impacts on the Upper Namoi Alluvium, particularly the Gunnedah Formation, at a regional scale. Should the project progress, additional monitoring and finer-scale groundwater modelling would improve confidence in predictions and support clear identification and response to mine-induced impacts at a local scale. Calibration and validation of finer-scale models would only be feasible with observations of the actual responses of the local groundwater system to the proposed project.

93. A staged approach to further monitoring would be appropriate to be undertaken in line with the proposed mine plan, particularly in the Permian strata and weathered zone in the area between the mine pits (in particular the eastern and southern pits) and the Upper Namoi Alluvium. This monitoring should be undertaken in conjunction with development of finer-scale groundwater models focussing on each pit, with more detailed definition of strata, seasonal variation and boundary conditions. Improved understanding of the hydrogeological system gained during operations in one pit should be used to assess potential impacts associated with the next pit. The knowledge gained during operations should be used to inform the assessment of potential impacts from the final landform, including the proposed void and potential seepages and determination of mitigation or management strategies.

94. Additional information on the following matters would improve confidence levels around the potential impacts to water resources. The IESC considers that these information needs could be met by targeted additional data collection and improvements to the monitoring and management programme before and during operations.

    a. Identification of GDEs beyond the proposed project boundary and an assessment of their current condition, any potential impacts from the proposed project, and any cumulative impacts.

    b. An assessment of the potential ecological impact of the project on the instream community in the Mooki River. The combined impacts of loss of streamflow as well as changes to water quality, particularly salt loads and dissolved metals during 'first flush' events on Native Dog Gully and the Mooki River should be further considered.

    c. A thorough assessment of the risk to water resources and water-related assets from runoff from overburden emplacement areas. Monitoring of surface water quality in Watermark Gully downstream of the eastern pit, and the addition of selenium, aluminium and molybdenum to the suite of metals tested on a regular basis in watercourses downstream of the proposed project area..

Question 7: Are the proposed management responses to groundwater alluvium interception adequate? If not, are there additional measures and commitments required to mitigate and manage impacts?

Response

95. The adequacy of these measures cannot be determined at this stage as mitigation and management responses have not been stated explicitly. To ensure management responses are adequate, clear trigger and limit exceedance levels, and robust regulatory enforcement mechanisms should be established.

Explanation

96. Groundwater triggers and subsequent management responses are proposed to be developed within water management plans in the post approval process. The IESC is unable to comment on their appropriateness, as the plans are not yet available.

97. The additional information (Hansen Bailey, 2014, App A) has identified the need for more monitoring wells to be installed and located within the predicted zone of depressurisation to assess the extent and rate of depressurisation against numerical groundwater model predictions. Even though groundwater drawdown is not predicted in the Upper Namoi Alluvium to the north of the eastern pit, additional multi-level (nested) monitoring wells should be placed in this area to confirm model predictions and provide an early warning of any variation from predicted depressurisation in this area.

98. In light of the results of the sensitivity and uncertainty analysis undertaken for the EIS it would have been beneficial to have a corresponding uncertainty analysis for the scenario posed by Dr Col Mackie and referenced by the PAC (Scenarios 3, 6, 7, and 11 in Hansen Bailey, 2014, App A) in order to understand more fully the potential for exceeding the conditions relating to groundwater drawdown impacts in the Upper Namoi Alluvium set in the NSW Government consent (PAC, 2015). In the absence of such an uncertainty analysis, a strong emphasis should be placed on developing:

    a. A monitoring programme that enables early warnings of greater depressurisation than predicted.

    b. Robust enforceable management protocols (for proponent and regulator) for action to be taken in time so that limits are not exceeded.

Question 8: Are the proposed management responses to increasing salinity levels adequate? If not, are there additional measure and commitments required to mitigate and manage impacts?

Response

99. The adequacy of these measures cannot be determined at this stage as the proposed mitigation and management responses are to be included in the water management plan.

100. The IESC has identified additional measures to mitigate and manage the potential impacts from salinity at the local scale as per the response to Question 5(b) above (paragraphs 85-87 of this advice IESC 2015-067).

Question 9: The proponent has concluded that there is a low risk of hydraulic connection between the Upper Namoi Alluvium and the Permian sequence and has therefore concluded that the floodplain alluviums will not be impacted. Does the Committee agree with this conclusion?

Response

101. The proponent's numerical groundwater model, which the IESC considers to be reasonable, demonstrates a direct hydraulic connection between the Upper Namoi Alluvium and the Permian strata and predicts groundwater drawdown within the floodplain alluviums as a result of the proposed project. The magnitude and extent of groundwater drawdown in the alluvial aquifers is considered unlikely to be significant, based on predictions described in the sensitivity and uncertainty analyses in the EIS. To improve confidence in groundwater drawdown predictions over time, additional data should be gathered on the hydraulic connectivity between the Permian strata and the Upper Namoi Alluvium (as discussed in response to Question 3a within IESC 2015-066).

Date of advice 27 April 2015

Source documentation available to the IESC in the formulation of IESC advice 2015-066 and 2015-067

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Advice to decision maker on coal mining project

Proposed action: Watermark Coal Project (EPBC 2011/6201) – New Development

Requesting agency	Department of Sustainability, Environment, Water, Population and Communities
Date of request	17 April 2013
Date request accepted	17 April 2013
Advice stage	Environment Impact Assessment (draft)

Advice

The Committee was requested to provide advice to the Commonwealth regulator on the Watermark Coal Project in New South Wales at the Environmental Impact Assessment (draft) stage. This advice draws upon aspects of information in the draft Environmental Impact Statement, together with the expert deliberations of the Committee. The draft Environmental Impact Statement and information accessed by the Committee are listed in the source documentation at the end of this advice.

The proposed project is a new development for an open cut coal mine, producing up to 10 million tonnes per annum of Run of Mine coal for up to 30 years, located 25 km from Gunnedah and immediately west of Breeza in Northern New South Wales. The site is adjacent to the Mooki River, which is a major tributary of the Namoi Catchment. The target coal seams are contained within the Black Jack Group of the late Permian strata of the Gunnedah Basin and include the Hoskissons and Melvilles seams. The disturbance area for the proposed project covers 4,084 ha.

Cumulative impacts on the Namoi Catchment

The Committee encourages the regulator to consider the water related impacts of the proposed project in a cumulative assessment context such as that presented in the Namoi Catchment Water Study. This Study presents a range of coal seam gas and coal mining development scenarios. The Study provides predictions of surface water losses and groundwater drawdown which should be used to provide context to individual project impact assessments.

A regional water balance is an important component of a cumulative assessment and the Committee suggests, in relation to the Watermark project, that defined regional boundaries can be logically drawn, i.e. groundwater from the Liverpool Range to Gin's Leap and surface water from the project site to the Boggabri gauging station.

The Committee considers that the proposed project is likely to enhance the risk of salinity in the region. The proposed project is likely to result in salinity impacts from overflow of water storages, seepage from the backfilled and proposed open mine voids, connectivity between the alluvium and Permian strata and the removal of woodland from the proposed project site. A regional perspective on salinity is important to properly assess the significance of such impacts and this should be addressed through the development of a regional salt balance.

The Committee, in line with its Information Guidelines[1], has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

In the main, the proponent has used relevant data and information, with the exception of the areas

noted below. The proponent has referred to data sources specific to the Namoi catchment, such as aspects of the proposed framework for assessing the cumulative risk of mining on natural resource assets in the Namoi catchment (Eco Logical, 2011) and the Namoi Catchment Water Study (Schlumberger, 2012).

However, the documentation provided would benefit from further information in relation to:

- Downstream aquatic ecosystems, assets and receptors;
- Groundwater dependence of vegetation communities (including the critically endangered White Box Yellow Box Blakey's Red Gum Woodland and Derived Native Grassland and endangered ecological communities found on site);
- Evidence for the assertion of no hydraulic connection to the Great Artesian Basin;
- Evidence for the low hydraulic conductivities modelled in the coal seams and their distribution;
- Evidence for groundwater model assumptions relating to constant irrigation use and constant conditions across the northern boundary; and
- Evidence for faulting and the role of faults in impeding or transmitting groundwater flow.

Appropriate methodologies which have been applied correctly: key conclusions

The proponent has selected appropriate methodologies in their environmental assessment, including a semi-quantitative risk assessment and appropriate use of software for the modelling of groundwater, flooding and the site water balance. The numerical groundwater modelling has undergone sensitivity and uncertainty analysis and peer review. However, the water budget across the groundwater model domain does not constitute a regional water balance and a regional salt balance has not been provided. Further, the Committee has concerns with respect to the application of these methodologies in some circumstances.

With respect to the application of these methodologies:

- The effectiveness of control measures used to address preliminary risks cannot be determined as these controls will be embedded in management plans which have not been provided;
- Insufficient justification and verification has been provided for the groundwater conceptualisation, particularly with regard to interconnectivity between the Upper Namoi Alluvium and Permian sequence, which decreases confidence in conclusions drawn from the numerical groundwater model; and
- No sensitivity analysis has been performed on the site water balance to date and there has been no consideration of the potential impacts of climate variability, which results in a reduced level of confidence in the modelled results.

Reasonable values and parameters in calculation: key conclusions

The values and parameters used in calculations by the proponent appear plausible, with the exceptions and differences noted above and following:

- Climate data from early and recent years are underrepresented in the realisations modelled in the site water balance;
- Calculations of additional site water supply requirements have used average rather than maximum values and have not considered water availability; and

- The proponent classifies the Hoskissons and Melvilles coal seams as aquitards, whereas Schlumberger (2012) classified these coal seams as aquifers.

Question 1: Does the Committee consider that the proponent has provided sufficient information on the water resources and its management to assess likely significant impacts from its proposed action? If the information is considered insufficient for that purpose, what advice regarding areas of inadequacy can the Committee provide?

102. The Committee considers that applying a water balance model is the most appropriate basis for assessing potential changes in water resources and impacts on aquatic ecosystems, assets and receptors. The deficiencies in the regional and site water balances make a comprehensive assessment of likely significant impacts as a result of the proposed project difficult. Further areas where the assessment documentation could benefit from additional information are outlined below and have been addressed in questions 3, 4, 5, 6, 8 and 9.

    a. In relation to the site water balance, the earliest and latest periods of historical data are underrepresented in the realisations modelled. The Committee has limited confidence in the predicted lack of release of mine water and recommends that, in order to minimise downstream water quality and ecological impacts, the proponent:

        i. Undertake sensitivity analysis on the site water balance;

        ii. Use the results of the site water balance sensitivity analysis, as well as predicted available water determinations, surface water availability and any applicable access rules to ensure that water supply licences will meet site water requirements under a full range of foreseeable conditions;

        iii. Design mine water storages to contain a 1:1000 year average recurrence interval storm event; and

        iv. Develop contingency plans to deal with the event of an emergency discharge of water from a mine water dam.

    b. In relation to a regional water balance, the Committee recommends that a regional water balance be developed to allow for assessment of significant impacts. This water balance should:

        i. Extend across the regional surface and groundwater systems to defined monitoring points, beyond which there will be no measurable impacts as a result of the proposed project, e.g. groundwater to Gin's Leap and surface water to the Namoi River at Boggabri gauging station;

        ii. Detail the set of water stores and the flow of water between those stores under current conditions within this region;

        iii. Assess the change as a result of the proposed project to the quantity or quality of water within any store or flow of water between these stores;

        iv. Take into account a range of foreseeable climatic scenarios; and

        v. Undergo sensitivity analysis.

    c. Significant impacts are also likely as a result of the proposed project's increase in salt loads downstream of the proposed project site, into a catchment already at risk from salinity. The project assessment documentation would therefore benefit from the inclusion of a local and regional salt balance. A salt balance should:

i. Detail the set of salt stores and the transfer of salt between those stores under current conditions within this region;

ii. Assess the change as a result of the proposed project to the quantity of salt within any store or transfer of salt between these stores;

iii. Take into account a range of foreseeable climatic scenarios; and

iv. Undergo sensitivity analysis.

Question 2: Is the assessment of the current condition of the ground and surface water environments in and surrounding the project area accurate?

103. The assessment that surface and groundwater systems are generally in poor condition is accurate and supported by evidence. The Mooki River adjacent to the proposed project boundary is highly degraded and riparian vegetation is absent. Further, in terms of usage, the Upper Namoi Alluvium is a very important groundwater source in New South Wales and its stress has been well documented.

104. Insufficient information has been provided by the proponent that clearly identifies outside of the proposed project boundary: aquatic ecosystems, assets and receptors that are dependent on surface and groundwater systems; their current condition and how these assets and receptors will be impacted by both the proposed project; and any additional cumulative impacts.

Question 3: Are the various models used to assess the potential impacts of the project on ground and surface water, in and outside the project area, appropriate for the purpose and acceptable as compared to known industry best practice? Are the data and assumptions on which the models were based valid and accurate? Have all reasonably foreseeable scenarios been modelled (e.g. low flow periods, climate change, simultaneous flooding events in surrounding water bodies etc.)?

105. The surface water balance and flood models and the numerical groundwater model used by the proponent are fit for purpose and consistent with best industry practice.

a. The data and assumptions for these models are accurate and valid, with the exception of the issues detailed below in relation to the numerical groundwater modelling.

i. Insufficient justification and verification has been provided for the hydrogeological conceptualisation, particularly with regard to the nature of faulting and interconnectivity between the Upper Namoi Alluvium and Permian sequence, which decreases confidence in conclusions drawn from the numerical groundwater model.

ii. The assumptions of constant conditions at the northern boundary and constant groundwater use are both inaccurate. These assumptions limit the predictive ability of the model as it does not accurately represent the current conditions.

iii. The extent of the Gunnedah Formation has been determined by the proponent based on geophysical surveys, but there has been no field verification of the results. Without verification, confidence is limited in the predicted groundwater drawdown impacts on the Gunnedah Formation and resulting impacts on groundwater users.

iv. Hydraulic conductivities for target coal seams have not been adequately justified. The parameters used have unknown spatial distribution and extend over a large range, with some values orders of magnitude lower than those used by Schlumberger (2012) and other groundwater studies including the same Permian sequence for previous referrals in the Namoi Catchment. The Committee considers that the large range of hydraulic conductivities could overly influence the model's predicted zone of depressurisation and

that further evidence is required to justify the parameters used by the proponent.

v. Insufficient evidence has been provided to justify the presence of faults and their behaviour in transmitting or preventing groundwater flow in the groundwater model. The modelled results appear to show that the extent of groundwater drawdown is limited by these faults. Further work should be carried out to confirm both the existence of these faults and their ability to act as hydraulic barriers. This assessment should include the potential for fractures and faults to transmit water, particularly from the Upper Namoi Alluvium.

b. Not all reasonably foreseeable scenarios have been considered by the proponent in their modelling.

i. The site water balance modelling has not considered the potential for increasing climate variability.

ii. The assessment of cumulative impacts has only considered Scenario 2 of the Namoi Catchment Water Study and therefore has excluded other foreseeable scenarios, including Scenario 3.

Question 4: Are the model output data valid, accurate and representative of the systems they are modelling (including the ephemeral waterways)? Have the output data been presented and interpreted in an appropriate, relevant way, relative to the likely impacts of the proposal, including for the flow regimes of ephemeral waterways within and surrounding the project boundary? What level of confidence can be applied to the results and conclusions presented in the EIS?

106. The Committee has identified concerns relating to input data, assumptions, sensitivities and the number of scenarios modelled for groundwater and water balance modelling, which decrease confidence in the outputs from these models. With respect to presentation and interpretation of model outputs:

a. Site water balance results have been presented in full only for long-term average conditions, which does not allow for interpretation of the performance of the mine water management system under climate extremes previously experienced in the region;

b. Predicted groundwater drawdowns have not been presented for all model layers and the drawdown contours presented have not been adequately discussed. In particular:

i. Groundwater drawdown within the coal seams is likely to be greater than predicted by the proponent, as low hydraulic conductivity values have not been adequately justified and could be influencing the limited drawdown extent;

ii. It is difficult to determine the validity of the modelled impact of the faults, if any, on groundwater movement, in particular the role of these faults in impeding groundwater drawdown; and

iii. Groundwater drawdown for the rest of the Permian sequence in this area have not been presented by the proponent, but are modelled in the Namoi Catchment Water Study. The Committee considers that drawdown contours for these Permian units should be presented. If no drawdown is predicted by the model for these units, then an explanation should be provided as to why this will not occur; and

c. Model outputs should be presented with an understanding of their sensitivity or uncertainty and referenced in terms of the impact to any water dependent assets.

Question 5: Has the EIS comprehensively identified, assessed and quantified all potential impacts of

the proposal on water systems within and outside the project area? If not, what impacts have not been covered and/or what information is required?

107. Whilst the proponent has identified most potential impacts on water resources, the assessment and quantification of these impacts is not comprehensive. In addition to the information gaps identified in the assessment against the Information Guidelines and under questions 1,2, 3, 4, 6, 8 and 9, the project assessment documentation would be improved by including additional information on the following potential impacts:

    a. The detailed design and construction details of pump site on the Mooki River and the diversion on Watermark Gully, including flood extents and flow velocities, to ensure that these constructions are stable and will not result in erosion or changes to downstream turbidity;

    b. Predicted flood extents along the Mooki River which extend into the Eastern mining area. Proposed mitigation actions need to be clarified;

    c. Impacts on dryland salinity as a result of the proposed direct removal of woodland; and

    d. The intersection of the current water table, potential groundwater drawdown and the depth of the root zone of protected vegetation communities.

Question 6: Is the assessment of the nature and extent of post-rehabilitation impacts on ground and surface waters accurate?

108. Post-rehabilitation, both the final void and seepage from backfilled pits present potentially significant long-term environmental hazards, which have not been adequately addressed by the proponent.

    a. The Western mining area void will have an area of 100 ha and depth of 60 metres. There are significant differences in the time to reach equilibrium and the water level at which this is achieved when the void is modelled from a groundwater or surface water perspective. As such, the Committee has limited confidence in the prediction that the void will not overtop. The Committee considers that voids are a long-term environmental legacy and backfilling of voids and pit lakes represents best environmental practice.

    b. The Southern and Eastern mining area voids are proposed to be backfilled and predicted to recover relatively quickly. The proponent has modelled seepage from these mining areas, which they predict to be 0.08 ML/day 2,000 years after mining. Sensitivity analysis shows that the salt loads from this seepage from the Southern mining area could reach up to 17 kg/ha/day. The Committee recommends that the proponent investigate the potential impacts from seepage on downstream aquatic ecosystems, assets and receptors; commence long-term monitoring; and prepare a mitigation and management plan to address any potential impacts.

Question 7: Has the cost-benefit analysis (page 55) properly considered the potential negative impacts of the proposal on water resources? If not, what would be required to address this?

109. It is not within the Committee's terms of reference to consider the adequacy of cost-benefit analyses. However, in light of the question asked, the one-page cost-benefit analysis on page 55 of the draft Environmental Impact Statement is not comprehensive and methodologically robust. It includes only the environmental benefits and socio-economic costs of the chosen project alternative and notably not the environmental costs, including potential negative impacts on water resources.

Question 8: Does the Committee find the water management, mitigation and monitoring measures

proposed to be appropriate, accurate, reasonable and effective? To what degree, if any, do the proposed mitigation and management measures reduce impacts?

110. The proposed control measures typically include management and mitigation actions, which are yet to be articulated in management plans. As such, the effectiveness of these measures cannot be determined at this stage. The Committee makes recommendations for mitigation and management in Question 8d and monitoring is discussed in Question 8b.

8a: Are the water storages proposed during operation sufficient to ensure no contamination of downstream surface waters?

111. No. There is potential for contamination of downstream surface waters from mobilisation of accumulated seepage (see Question 6), emergency release from mine water storages (see Question 1) and overflow of sediment dams. The key contaminant of concern is salt.

    a. Sediment dams that collect runoff from overburden emplacement areas are designed to overflow to ephemeral streams (although the frequency, quality and volumes of these predicted events are unknown). The proponent intends to mitigate impacts through treatment with a flocculant, or by moving the excess water to other storages on site where possible. Treatment with a flocculant will only control solids and other potential contaminants, including salt, are not proposed to be treated. These mitigation actions are insufficient without a full understanding of the potential impacts of these saline releases on downstream aquatic ecosystems, assets and receptors.

    b. The Committee recommends that the proponent provide estimates of the frequency, quality and quantity of discharges of water (particularly saline water) proposed from the site, including potential emergency discharges, seepage and overflows from sedimentation dams. Further, the environmental assessment would benefit from a thorough investigation of the impacts of these discharges on the regional salt and water balance and downstream aquatic ecosystems, assets and receptors, including access to flows in the unregulated Mooki River water source.

8b: Is baseline water monitoring data sufficient to provide an accurate and representative baseline against which changes may be determined during and after mining operations?

112. Ground and surface water monitoring data has been collected by the proponent in and adjacent to the proposed site on a regular basis for over two years, which will be used in addition to New South Wales Government monitoring data to determine a baseline at these locations. The Committee recommends that, should the proposed project go ahead:

    a. Baseline monitoring of surface and groundwater systems continue during and post operations, as potential impacts of salt water seepage are predicted to extend beyond 2,000 years into the future;

    b. Extensions to the groundwater monitoring network should be made in the alluvium and target coal seams both within and beyond the predicted zone of depressurisation; as the Committee is concerned that the proponent's predicted zone of depressurisation is limited;

    c. Extensions to the groundwater monitoring network should also ensure that there is sufficient baseline information in aquifers which have a lower monitoring bore density including the Jurassic sediments of the Surat Basin and the Clare Sandstone; and

    d. The proponent provide for additional monitoring sites as required for investigations recommended by the Committee on the water balance (Question 1), groundwater modelling (Question 3), seepage (Question 6), salt balance (Question 8a) and interconnectivity

(Question 9).

8c: Are the parameters to be measured in ground and surface water monitoring appropriate and sufficient to cover the likely water quality impacts?

113. The water quality parameters measured in the proponent's ground and surface water monitoring program are appropriate. In order to manage potential risks to downstream assets and receptors as a result of loss of catchment flows, overflow of sediment dams, mobilisation of accumulated seepage from backfilled voids and potential emergency discharge, the Committee recommends that ongoing baseline water quality sampling is carried out on a monthly basis, as well as after any significant rainfall events at the 12 sites nominated by the proponent, including the ephemeral Watermark Gully.

8d: Are there any other mitigation measures that could be implemented to further reduce any impacts?

114. The Committee recommends that the proponent develop:

a. A comprehensive sediment control plan,

b. A detailed flood mitigation plan which prevents flooding of the Eastern pit under a 1 in 1000 year flood event; and

c. Surface and groundwater management plans that include:

i. Regular quality and quantity monitoring, as outlined above;

ii. Site-specific quality and quantity triggers which are sensitive enough to provide an early warning of potential deviations from a defined baseline, but buffer seasonal climate variations; and

iii. Appropriate management actions for each trigger and backup mitigation actions should the proposed management action not be effective.

115. The proponent intends to mitigate their impacts on biodiversity through the revegetation of offset areas. Revegetation has the potential to control dryland salinity as well as conserve biodiversity. The Committee recommends that the proponent and regulator consider potential effects on local or regional dryland salinity when choosing offset sites.

Question 9: There are a number of other mines either existing or proposed in the area surrounding the proposed Watermark Coal Project. The existence and operating management of these mines within this area raises the possibility of cumulative impacts. Does the Committee identify any particular concerns relating to cumulative impacts?

116. The Committee identifies the following concerns relating to cumulative impacts, noting that the surface and groundwater systems likely to be impacted are in a poor / stressed condition,: :

a. The sensitivity analysis performed by Schlumberger (2012) showed that the groundwater drawdown as a result of cumulative impacts in the Upper Namoi Alluvium Zone 7 is predicted to exceed 2 m, which is significant as the average saturated thickness of the alluvium in this zone is only 13 m (noting that Schlumberger have a low level of confidence in the prediction due to limited data);

b. The proponent has not addressed cumulative impacts on hard rock groundwater, despite the modelling by Schlumberger (2012) of cumulative groundwater drawdown in extensive areas of the Gunnedah water management area of greater than 10 m;

c. The proponent has not addressed cumulative impacts on surface water flow, despite modelled loss in flows by Schlumberger (2012), which show a cumulative reduction in flow in the Namoi River near Narrabri, equivalent to about half the current surface water extraction from the regulated Namoi River below Keepit Dam;

d. The proponent has not addressed cumulative impacts on water quality, despite the predicted increase in salt loads to ephemeral water courses as a result of the proposed project and existing risk of salinity within the catchment; and

e. There is no link provided by the proponent between these likely cumulative impacts and water dependent assets and receptors.

117. The Committee recommends that adoption of the following will provide for a more robust cumulative impact assessment:

a. A broader consideration of the Namoi Catchment Water Study's findings, particularly with respect to the use of scenario 3 and impacts to surface water and the Gunnedah-Oxley Basin; and

b. A local-scale focused investigation into groundwater gradients and flow, with particular regard to effects of predicted groundwater drawdown in the Permian sequence, based on connectivity between the Permian sequence, the alluvium and surface water. This investigation should be undertaken before projects proceed that are predicted to impact on the Upper Namoi Alluvium Zone 3, Zone 8 or Zone 7 in particular.

118. The Northern Inland Catchments, which includes the Namoi catchment, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible for this Bioregional Assessment to assist the knowledge base for regional scale assessments.

Date of advice	27 May 2013
Source documentation available to the Committee in the formulation of this advice	Hansen Bailey Pty Ltd 2013. Watermark Coal Project Environmental Impact Statement. Prepared for Shenhua Watermark Pty Ltd. February 2013.
References cited within the Committee's advice	[1] Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources available at: http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf Eco Logical Australia 2011. Proposed Framework for Assessing the Cumulative Risk of Mining on Natural Resource Assets in the Namoi Catchment, 14 Sep 2011. Schlumberger Water Services 2012. Namoi Catchment Water Study Independent Expert Final Study Report. Prepared for Department of Trade and Investment, Regional Infrastructure and Services, New South Wales. Report no. 50371/P4-R2 FINAL.