Hume Coal Project

Briefing to NSW Independent Planning Commission

11 February 2019

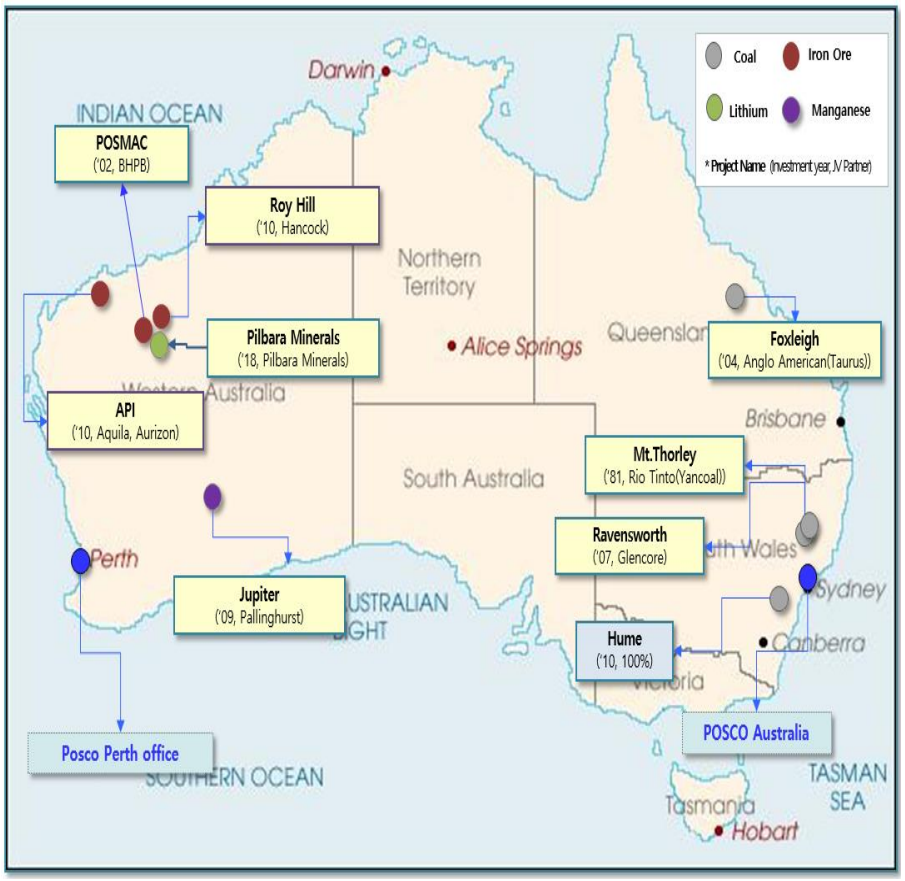
Hume Coal Pty Limited
ABN 90 070 017 784

Agenda

1. Project Introduction

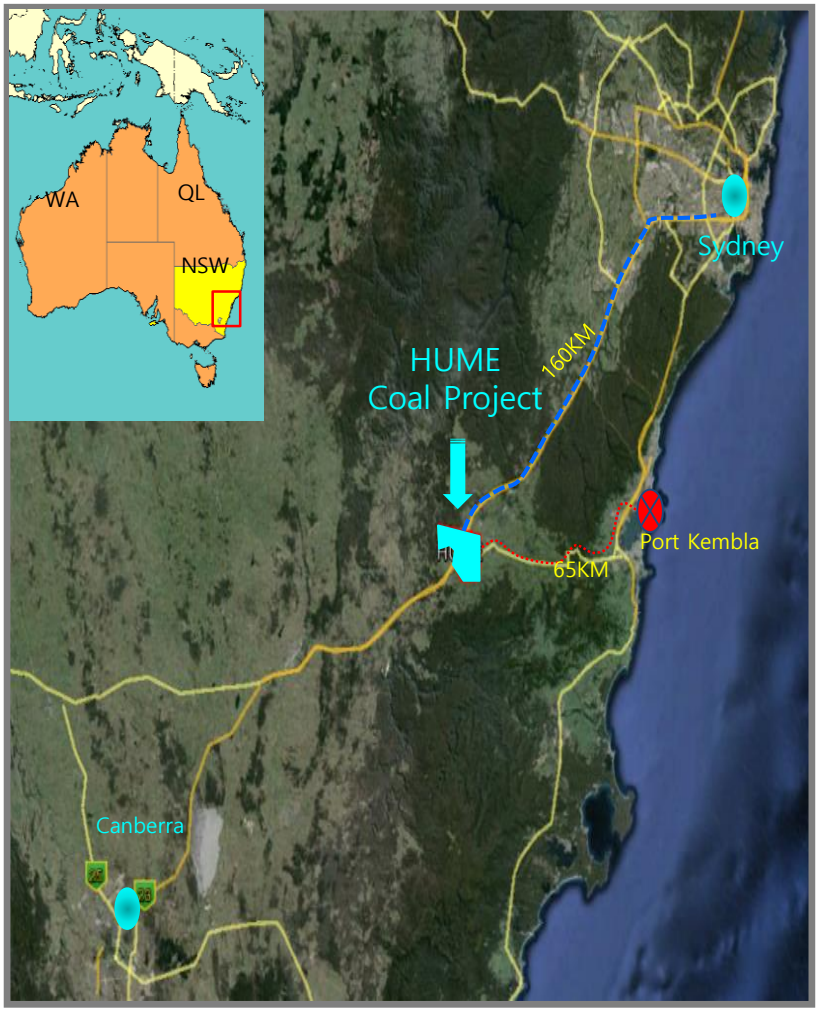
2. Key Issues
   - Mine Design & Operation
   - Water Management & Impacts
   - Economics

POSCO in Australia



- In Australia since 1981
- Currently in Mt.Thorley, Foxleigh, Roy Hill, POSMAC… JV. (Coal 4, Iron Ore 3, Lithium 1, Mn 1)
- Posco has invested more than $5bn in Australia by end of 2018.
- Purchase around $7bn of Raw materials (coal, iron ore etc.) for steel making from Australia p.a.
- Purchase about $500m of coal from NSW p.a.

POSCO–Hume Coal Project



- Acquired as part of a JV in 2010
- Acquired 100% in 2013
- Will have invested more than $200m by end of 2019

Project Introduction

Project Description - Hume Coal Project

Low impact underground coal mine:

- 50Mt ROM coal from the Wongawilli Seam
- 39Mt of saleable coal over 23yr mine life
- 55% metallurgical & 45% thermal coal
- Nominal 3Mtpa coal for sale
- $373m NPV of direct benefits to NSW
- 300 full time jobs, 400 construction jobs

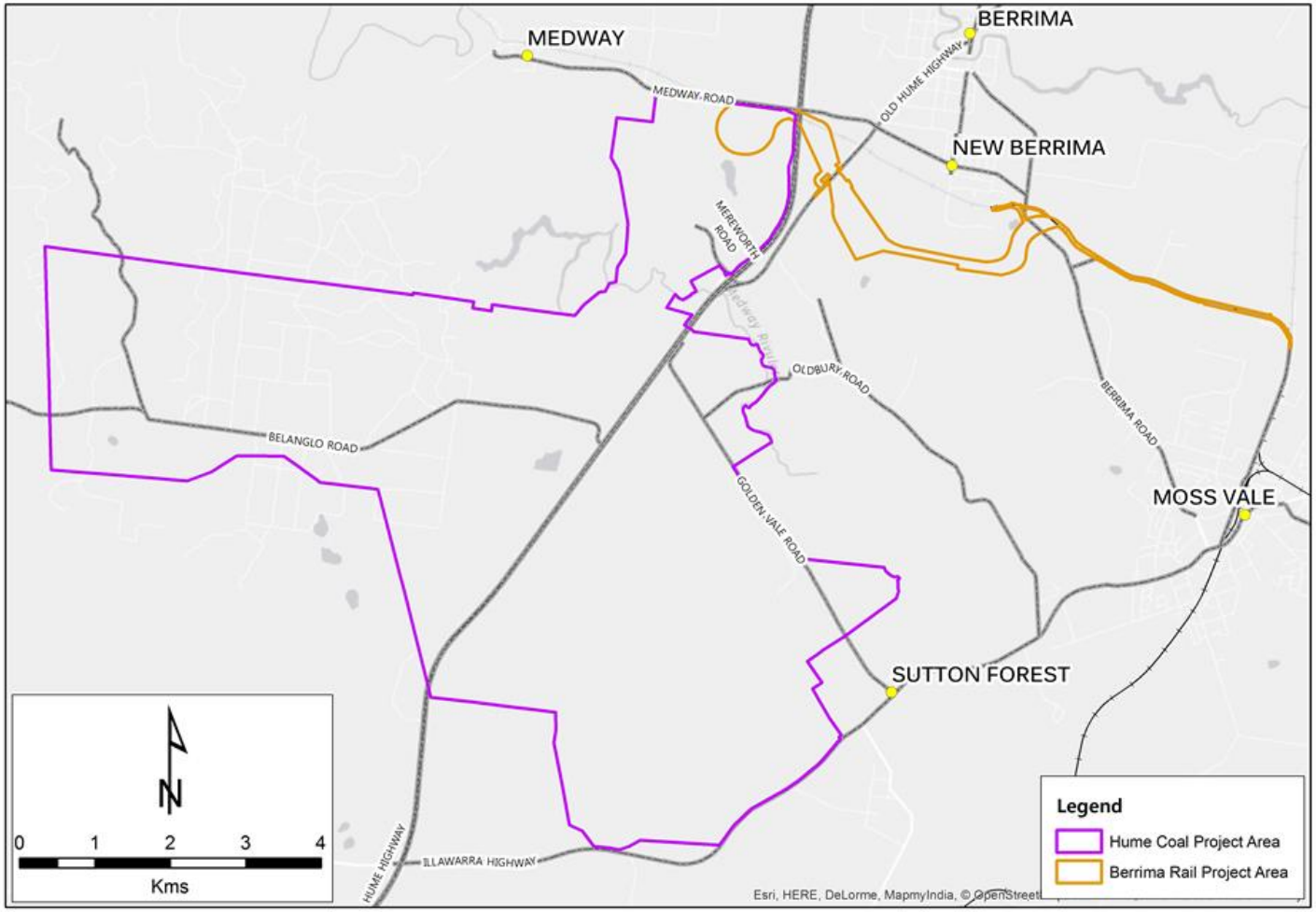
Project Description - Berrima Rail Project

A new 1km rail spur and loop connecting to existing rail infrastructure:

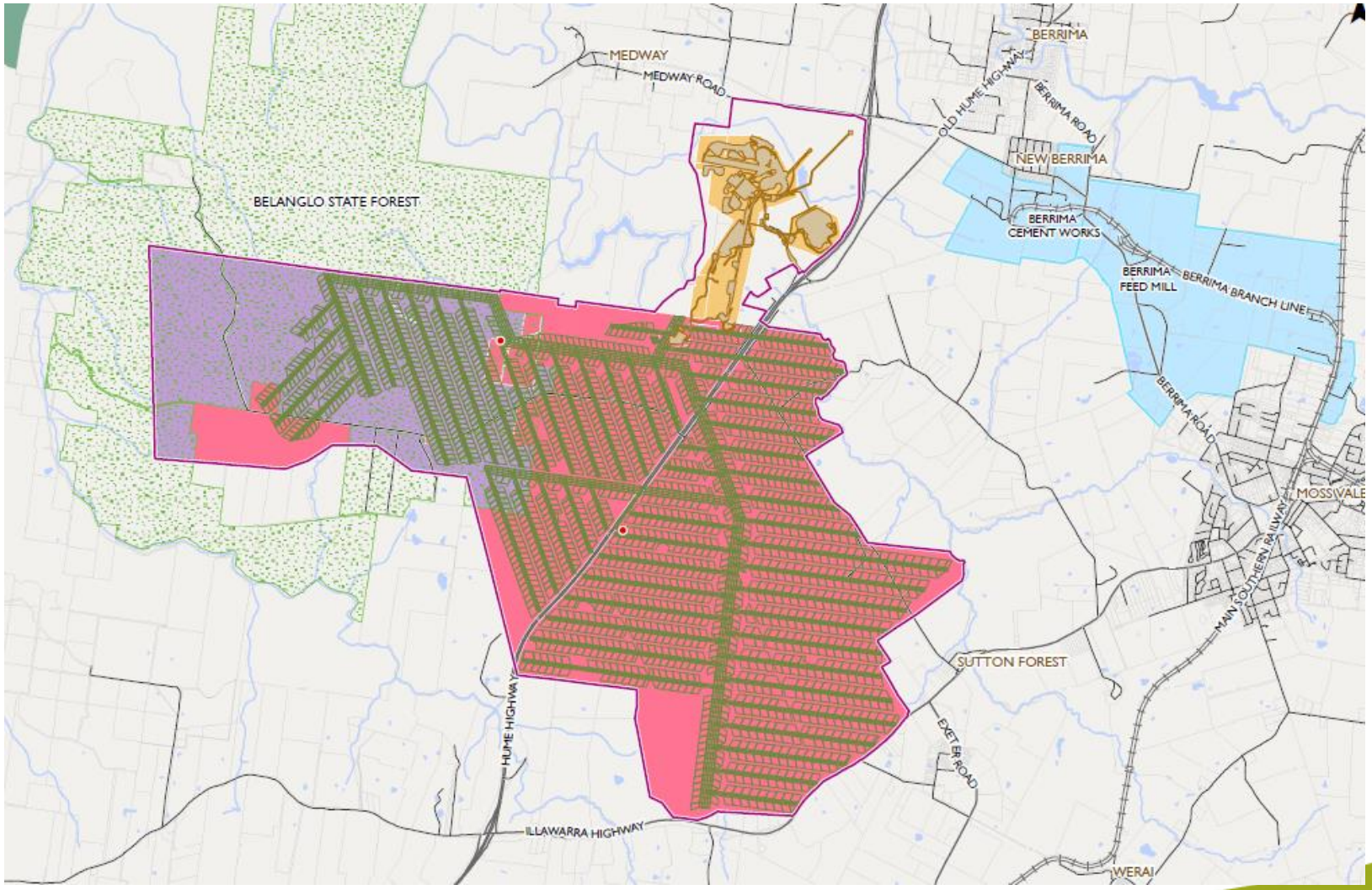
- Coal will be railed to Port Kembla
- Up to 4Mtpa of rail capacity is available
- Port Capacity 18Mtpa, 13.3Mtpa unused
- 5 train movements per day (3Mtpa)
- Covered coal wagons will be utilised

Project History

Location - Overview



Project Layout



Provision of High Quality Coking Coal

- The Southern Coalfield is the only significant source of quality hard metallurgical or coking coal in NSW.
- Within the project area, the coal has all the necessary characteristics to produce a product that generally meets export coking coal specifications, and contains some highly attractive qualities such as ultralow phosphorous.

Project Location

- Rail links to the **Port Kembla Coal Terminal**, currently an under-utilised asset that is ready to accept coal from the Hume Coal Project.
- Close to the **Moss Vale Enterprise Corridor**, an area established by the local council to encourage an increase in industrial, employment generating land uses in the area.
- The surface infrastructure area situated on predominantly cleared land to avoid sensitive environmental features, and is in an area with limited neighbouring sensitive receivers.
- Due to the underground, non-caving nature of the mine, existing land uses will continue across 98% of the project area, without impacts from mine-induced subsidence.

Landownership & Land use

- The main land uses within and adjacent to the project area are agricultural, industrial, extractive, forestry, rural residential and residential.
- Over half of the area comprises cleared land.
- Only 2% of the project area will be required for surface infrastructure area.

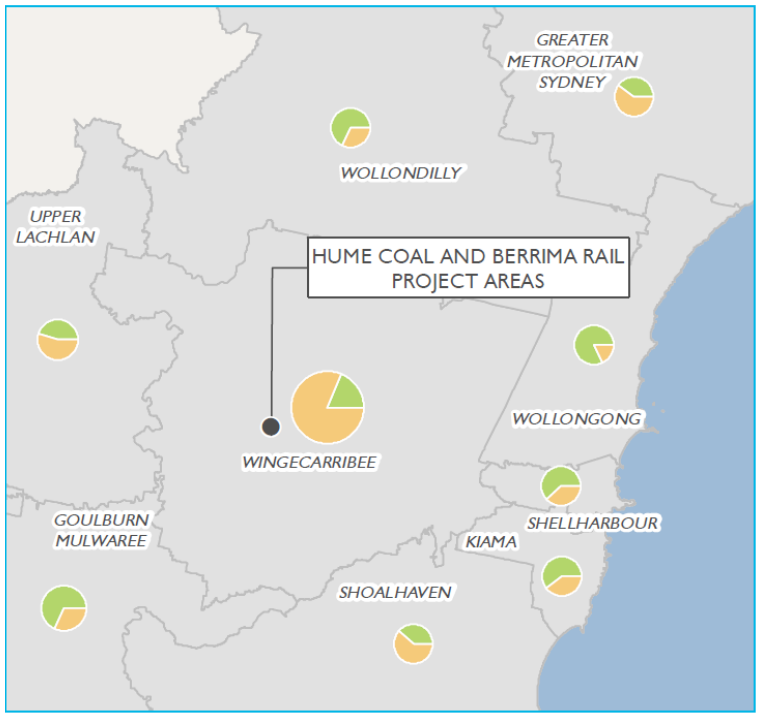
Landownership

Land tenure	Area (ha)
Government owned land	1,383
Freehold land (Hume Coal and its subsidiaries)	1,253
Freehold land (other)	2,403
Crown land	12
Total	5,051

Community

- 31% of the individual community submissions were in support of the projects, and 69% objected
- The majority of the individual community submissions from the Wingecarribee LGA opposed the two projects.
- Majority of submissions from the LGAs of Wollongong, Shellharbour, Kiama, Goulburn-Mulwaree and Wollondilly support the project
- Vast majority of objections were in ‘form letter’ format (92%)
- ~40% of form letters came from Sydney

Community



- DP&E state *"the vast majority of the community (Wingecarribee LGA residents) have expressed their opposition to the project"*

Best Practice Impact Mitigation

The project's design includes features that exceed the normal practices used in Australian coal mines and go beyond minimum regulatory standards, particularly:

- A low impact underground coal mine resulting in negligible subsidence which greatly reduces surface and groundwater impacts
- Sealing panels with bulkheads after extraction and reject backfilling, which allows the early recovery of groundwater levels.
- Rejects will be placed underground, removing the need for a permanent surface emplacement.
- Full and empty coal wagons travelling to and from the mine will be covered.

DP&E Assessment

DP&E focused on Mine Design, Groundwater and Economics. These will be addressed in the following sections.

DP&E assessed the potential impacts including:

- Noise & Vibration
- Air Quality & Greenhouse Gas Emissions
- Traffic
- Biodiversity
- Heritage
- Agriculture
- Rehabilitation

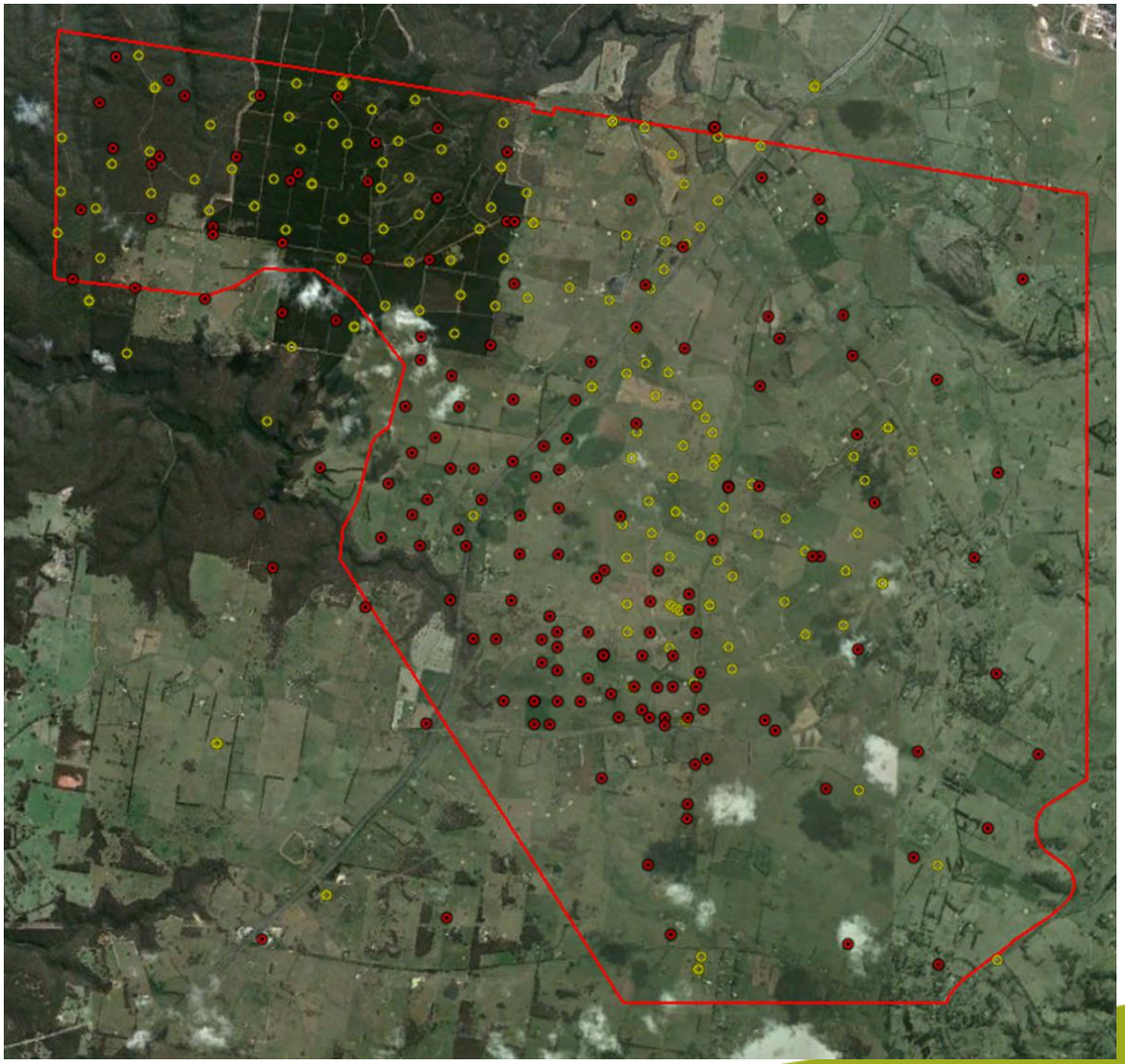
DP&E concluded that "*these potential impacts would be similar to, or less than, other approved underground mining projects. The Department accepts that these potential impacts are likely to be able to be managed, mitigated or offset to achieve an acceptable level of environmental performance*"

Mine Design & Operation

Key DP&E Issues- Mining

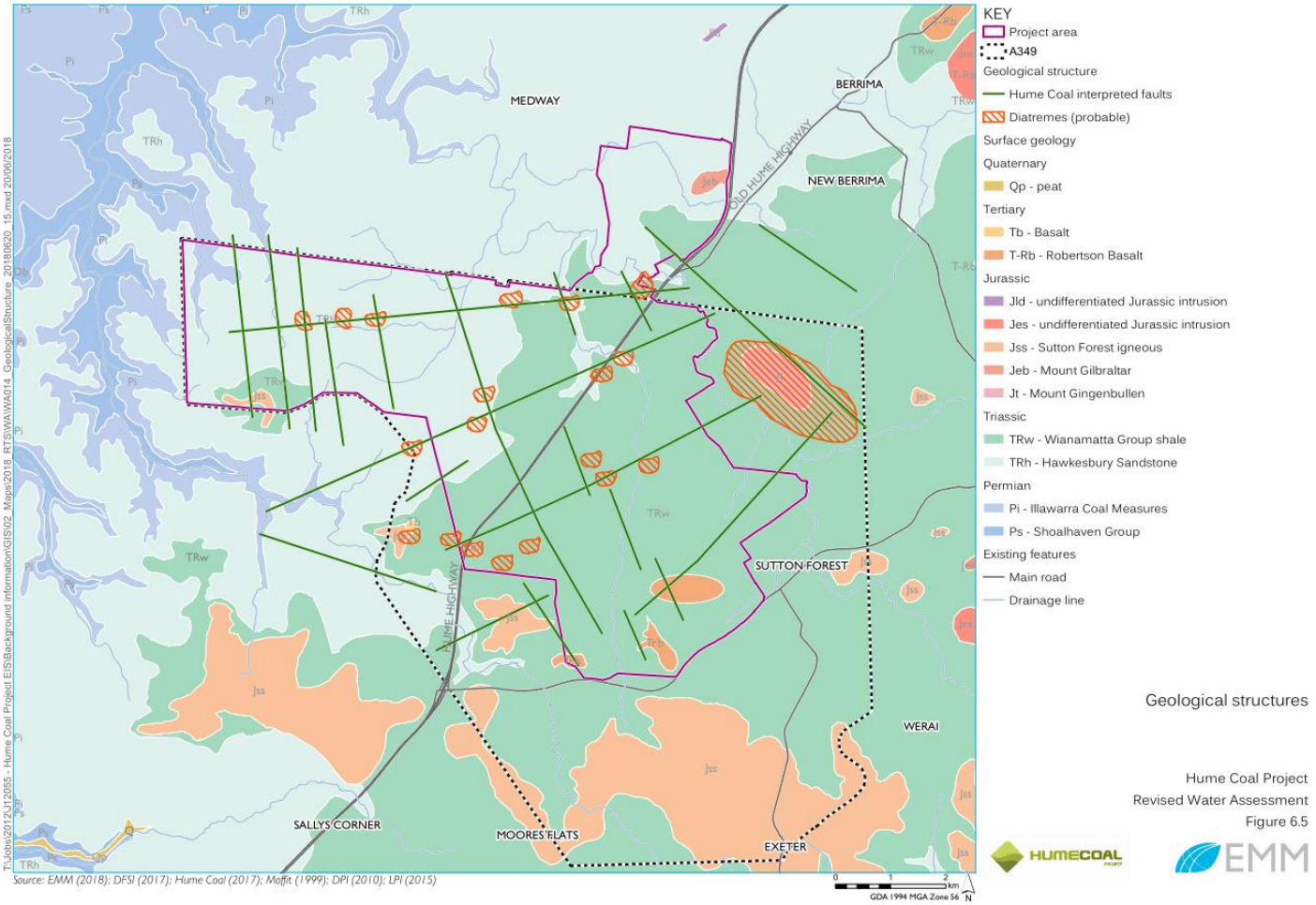
- The combination of untested mining method and unconventional method of storing water underground is likely to result in serious operational safety risks
- Unconventional mine design may result in unexpected sterilisation of coal
- Safety risks relating to the storage of water underground using Bulkheads

Exploration



- Total 345 holes
- 167 Historic holes
- 178 Exploration & GW Bores
- Total EL Area 89km²
- About 4 bores km²
- Total of 108 cored holes which have CQ lab test results.

Geological Structure



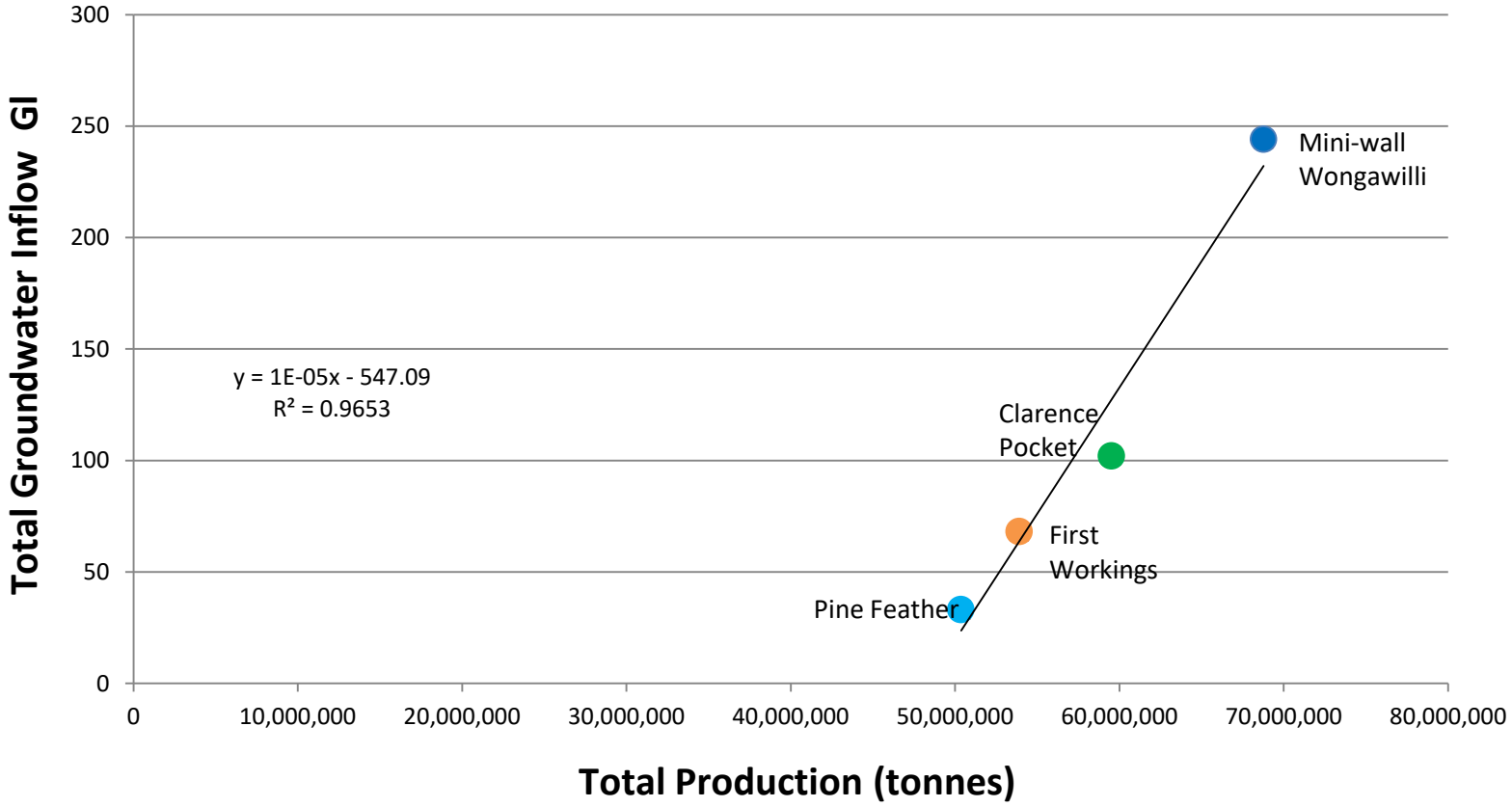
Geological structures

Hume Coal Project
Revised Water Assessment
Figure 6.5

Key Design Considerations

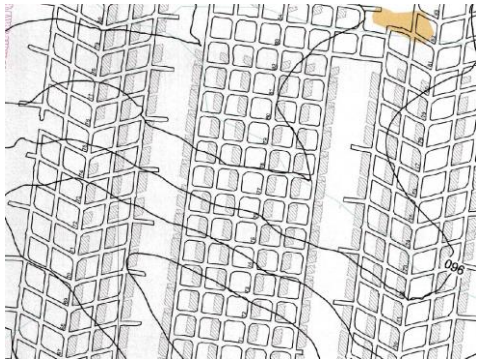
- **No en masse overburden caving** - overburden fracturing to be either prevented or at worst maintained at insignificant levels to minimise groundwater inflows.
- **Completed mine workings must remain accessible** by persons and be suitably stable for CHPP reject emplacement and disposal.
- **The mine layout can be sub-divided** into discrete mining panels that can be permanently sealed soon after mining in a panel is complete so as to allow the workings to become flooded as soon as possible.

Total Production Tonnes of Various Mining Methods Compared to their Respective Total Groundwater Inflows

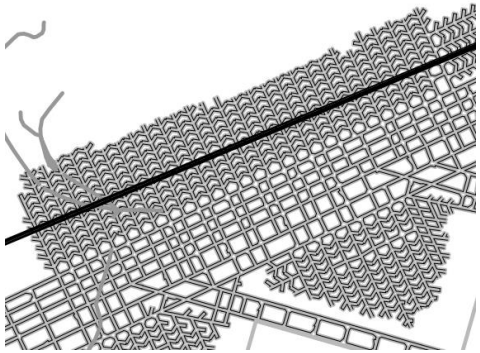


Similar mine designs

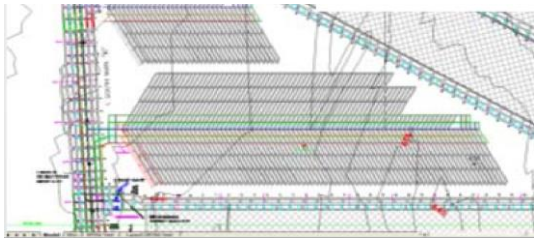
Mine A, NSW



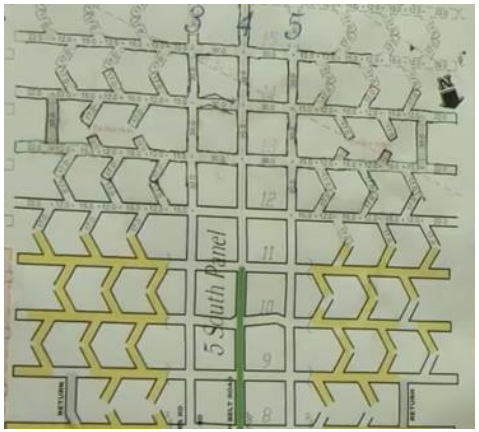
Mine B, NSW



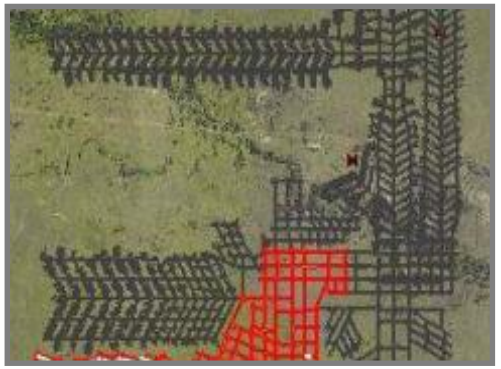
Mine C, Ohio



Mine D, NSW



Mine E, Qld



- Nearly all 70° breakaway
- Unsupported Roof

NSW Resource Regulator on innovation

NSW Resource Regulator Innovation Policy *(Published January 2019)*
We are committed to having a responsive and effective regulatory framework for work health and safety that **supports the development, trial and adoption of new technologies, systems and products.**

The purpose of this policy is to make clear how we will ensure that the regulatory framework for work health and safety at mines and petroleum sites:

- supports continuous improvement of health and safety through design, technology, product and system innovation and development
- **does not directly, or indirectly, inhibit investment in the development and adoption of improved technologies and products**.

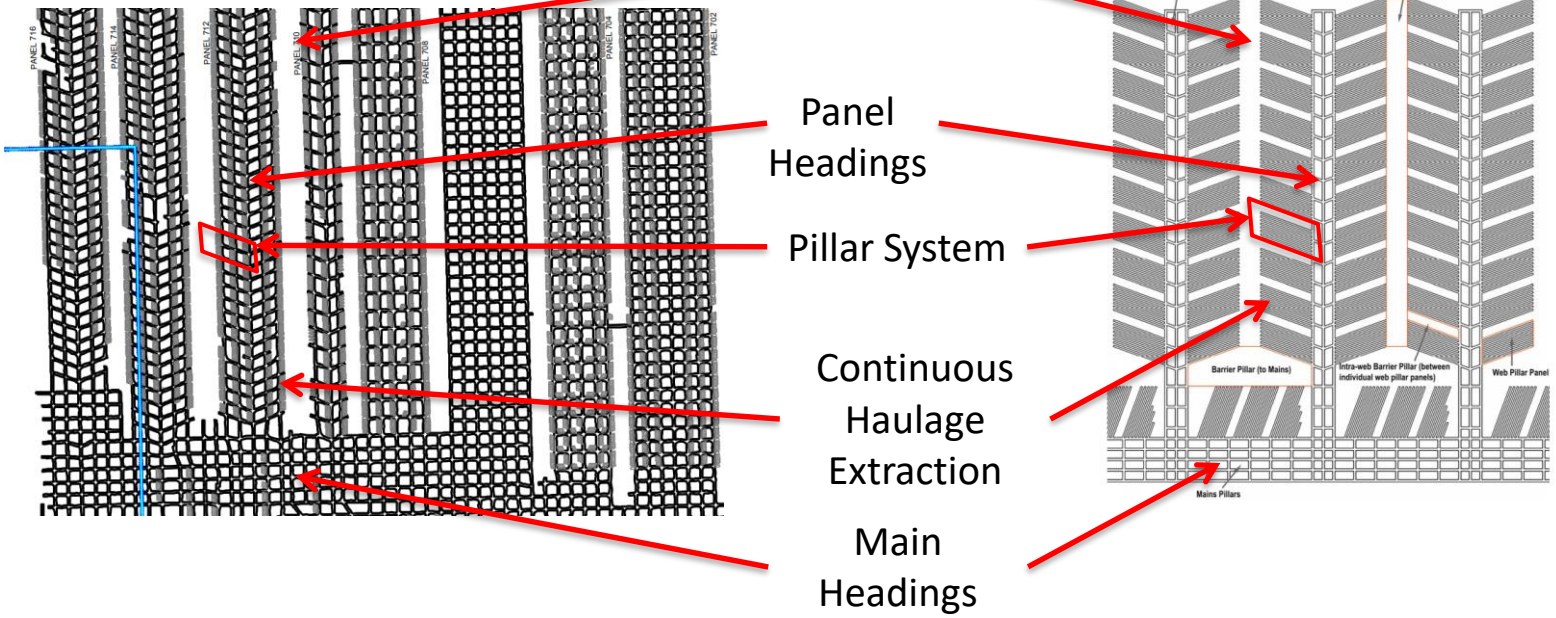
<u>An innovative Mine Design does not affect the ability for the project to be approved</u>

Mining System Design Process

- Identification of appropriate design method (ARMPS-HWM)
- Preliminary design
- **Presentation of concept to DP&E (December 2014)**
- **Conceptual project development plan review by DRE**
- Risk assessment workshops
- **Update presented to DP&E (May 2015)**
- Peer review (Dr Bruce Hebblewhite)
- **Adequacy Review of EIS by DP&E (Nov 2016)**
- Risk assessment reviews
- Numerical model scoping (Mine Advice and Dr Bruce Hebblewhite)
- **DP&E review by independent experts** (chaired by Ted Brown)
- 3D numerical modelling (validated updated design)
- **Results of 3D modelling provided to DP&E's experts**
- Peer review of numerical modelling (Dr Bruce Hebblewhite)

DP&E has been consulted about the mining system since late 2014.

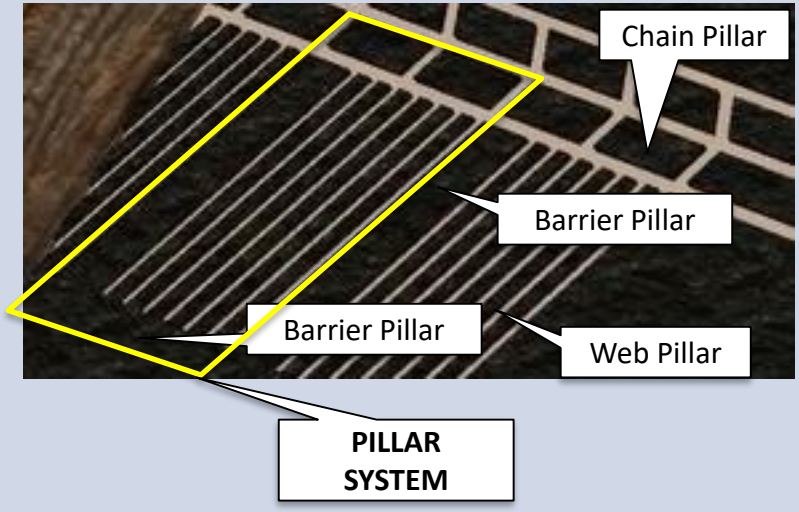
Mine design



Mine A , NSW

Hume Coal project

Response to DP&E- Design

DP&E Issue/Assertion	Response
"The proposed … mining method *relies upon* narrow web pillars … remaining stable in the long-term"  	False. This is a fundamental mischaracterisation of the assessment, the outcomes of the Experts Meeting, the numerical modelling *and* the supplementary expert reports. The stability of the **pillar system** *as a whole* is the key consideration as to whether the proposed layout designs are fit-for-purpose, and *not the strength and stability of individual web pillars.*

Response to DP&E- Design

DP&E Issue/Assertion	Evidence
"The proposed … mining method *relies upon* narrow web pillars … remaining stable in the long-term"	1. During the meeting of experts on 28 March, 2018 the experts (including DP & E experts) agreed that the stability of the system *as a whole* is the key consideration as to whether the proposed layout designs are fit-for-purpose, and *not the strength and stability of individual web pillars*. 2. The numerical modelling undertaken by Emeritus Professor Keith Heasley on behalf of Hume Coal demonstrates that the surface subsidence consequences of long-term web pillar instability (regardless of likelihood) are insignificant. 3. There are no operational safety issues associated with **long-term** instability of individual web pillars

Response to DP&E- Design

DP&E Issue/Assertion	Evidence
"The Department considers that the issue of pillar stability has not been adequately resolved by the 3D numerical modelling and that there are significant residual risks to worker health and safety"	**Dr Bruce Hebblewhite (mining expert):** DPE claim that such web pillar failures may pose a direct risk to worker health and safety as a result of roof falls and ground falls. If such falls were to occur in roadways between the web pillars, **it is highly unlikely to impact on worker safety**, since no personnel will be operating in such roadways at any time. DP&E discuss the risks posed by geological structure such as cleating, especially when such structure is parallel to the rib line orientation of the web pillars. Rib falls could then compromise the pillar stability. It is the type of issue that can be dealt with in ongoing operational management and planning where individual panels can be modified – either in direction or web pillar width, to cope with such localised issues. **It is certainly not a project-stopping issue**.

Response to DP&E- Design

DP&E Issue/Assertion	Response
"The Department considers that the issue of pillar stability has not been adequately resolved by the 3D numerical modelling and that there are significant residual risks to worker health and safety"	The risks to worker health and safety are no different from other forms of underground mining such as partial pillar extraction and full extraction bord and pillar mining. In fact, the proposed use of remotely controlled or semi-autonomous mining equipment significantly reduces worker exposure to face hazards, as compared with these methods

Remote Mining & Automation

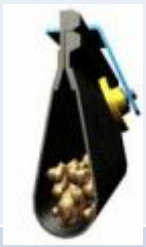
- Practiced routinely in highwall mining
- Practiced under outburst conditions in South Coast mines
- Full underground automation is currently being implemented at a new Mine in Central Queensland
- 4m wide extraction headings for improved stability (vs. 5.5m typical)
- Continuous haulage system

Continuous miner with continuous haulage, c. 1990

Inertial navigation

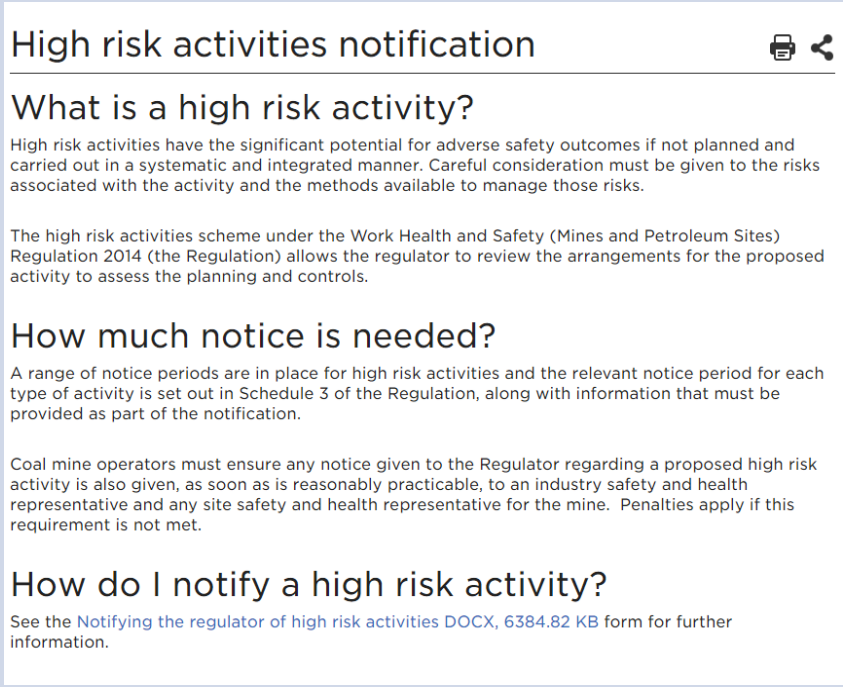
- Technology has existed for decades in highwall mining for unsupported plunges
  - Inertial navigation
  - Gamma horizon control
- Similar systems used underground at mines in Illinois and Ohio
- CSIRO has recently developed a significant upgrade to this technology
  - Will allow absolute positioning of the CM, rather than relative to last plunge
  - Measured deviation during UG trials of 3cm over 120m

Continuous haulage systems

Model	Flexvieyor	4FCT	EBS	Crawler Veyor	PMXXXF
Manufacturer	PM&P	Joy	Sandvik	A L Lee Corp	Sandvik
Image					
Type	Cascading belts	Flexible belt	Extendible belt	Chain conveyor	Teardrop conveyor
Locations (not exhaustive)	QLD	NSW	Ohio USA	Illinois USA, and Qld	South Africa
Commercially available?	Y	Y	Y	N	Y

Other systems are available also, including bridge conveyors

Response to DP&E- Design

DP&E Issue/Assertion	Evidence
Assertion: The fact that the project needs to lodge a "High risk activity notification" means that the project carries more risk than other mining projects. **Response:** High risk activity notification is required for many activities undertaken regularly at underground coal mines including: • Longwall mining • Pillar extraction • Shaft sinking • Drift development • Pillar reduction • Etc.	

High risk activities notification

What is a high risk activity?

High risk activities have the significant potential for adverse safety outcomes if not planned and carried out in a systematic and integrated manner. Careful consideration must be given to the risks associated with the activity and the methods available to manage those risks.

The high risk activities scheme under the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (the Regulation) allows the regulator to review the arrangements for the proposed activity to assess the planning and controls.

How much notice is needed?

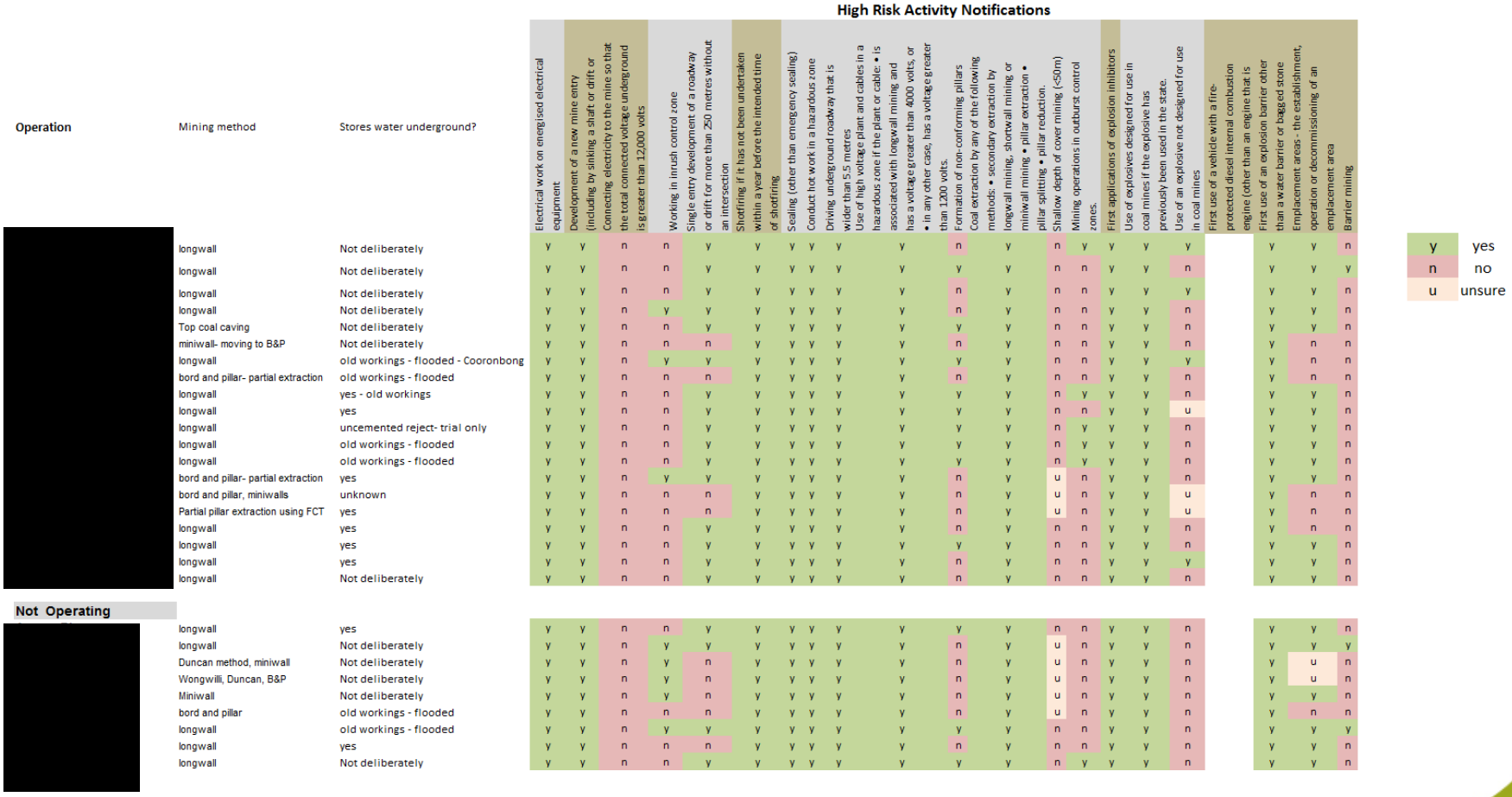
A range of notice periods are in place for high risk activities and the relevant notice period for each type of activity is set out in Schedule 3 of the Regulation, along with information that must be provided as part of the notification.

Coal mine operators must ensure any notice given to the Regulator regarding a proposed high risk activity is also given, as soon as is reasonably practicable, to an industry safety and health representative and any site safety and health representative for the mine. Penalties apply if this requirement is not met.

How do I notify a high risk activity?

See the Notifying the regulator of high risk activities DOCX, 6384.82 KB form for further information.

Response to DP&E- Design



High Risk Activity Notifications

Operation	Mining method	Stores water underground?	Electrical work on energised electrical equipment	Development of a new mine entry (including by sinking a shaft or drift or	Connecting electricity to the mine so that the total connected voltage underground is greater than 12,000 volts	Working in inrush control zone	Single entry development of a roadway or drift for more than 250 metres without an intersection	Shotfiring if it has not been undertaken within a year before the intended time of shotfiring	Sealing (other than emergency sealing)	Conduct hot work in a hazardous zone	Driving underground roadway that is wider than 5.5 metres	Use of high voltage plant and cables in a hazardous zone if the plant or cable: • is associated with longwall mining; and • has a voltage greater than 4000 volts, or • in any other case, has a voltage greater than 1200 volts.	Formation of non-conforming pillars	Coal extraction by any of the following methods: • secondary extraction by longwall mining, shortwall mining or miniwall mining, • pillar extraction • pillar splitting, • pillar reduction.	Shallow depth of cover mining (<50m)	Mining operations in outburst control zones.	First applications of explosion inhibitors	Use of explosives designed for use in coal mines if the explosive has previously been used in the state.	Use of an explosive not designed for use in coal mines	First use of a vehicle with a fire-protected diesel internal combustion engine (other than an engine that is	First use of an explosion barrier other than a water barrier or bagged stone	Emplacement areas - the establishment, operation or decommissioning of an emplacement area	Barrier mining
[redacted]	longwall	Not deliberately	y	y	n	n	y	y	y	y	y	y	n	y	n	y	y	y	y		y	y	n
	longwall	Not deliberately	y	y	n	n	y	y	y	y	y	y	y	y	n	n	y	y	n		y	y	y
	longwall	Not deliberately	y	y	n	n	y	y	y	y	y	y	n	y	n	n	y	y	y		y	y	n
	longwall	Not deliberately	y	y	n	y	y	y	y	y	y	y	n	y	n	n	y	y	n		y	y	n
	Top coal caving	Not deliberately	y	y	n	n	y	y	y	y	y	y	y	y	n	n	y	y	n		y	y	n
	miniwall- moving to B&P	Not deliberately	y	y	n	n	n	y	y	y	y	y	n	y	n	n	y	y	n		y	n	n
	longwall	old workings - flooded - Cooronbong	y	y	n	y	y	y	y	y	y	y	y	y	n	n	y	y	y		y	n	n
	bord and pillar- partial extraction	old workings - flooded	y	y	n	n	n	y	y	y	y	y	n	y	n	n	y	y	n		y	n	n
	longwall	yes - old workings	y	y	n	n	y	y	y	y	y	y	y	y	n	y	y	y	n		y	y	n
	longwall	yes	y	y	n	n	y	y	y	y	y	y	y	y	n	n	y	y	u		y	y	n
	longwall	uncemented reject- trial only	y	y	n	n	y	y	y	y	y	y	y	y	n	y	y	y	n		y	y	n
	longwall	old workings - flooded	y	y	n	n	y	y	y	y	y	y	y	y	n	y	y	y	n		y	y	n
	longwall	old workings - flooded	y	y	n	n	y	y	y	y	y	y	y	y	n	y	y	y	n		y	y	n
	bord and pillar- partial extraction	yes	y	y	n	y	y	y	y	y	y	y	n	y	u	n	y	y	n		y	y	n
	bord and pillar, miniwalls	unknown	y	y	n	n	n	y	y	y	y	y	n	y	u	n	y	y	u		y	n	n
	Partial pillar extraction using FCT	yes	y	y	n	n	n	y	y	y	y	y	n	y	u	n	y	y	u		y	n	n
	longwall	yes	y	y	n	n	y	y	y	y	y	y	n	y	n	n	y	y	n		y	n	n
	longwall	yes	y	y	n	n	y	y	y	y	y	y	y	y	n	n	y	y	n		y	y	n
	longwall	yes	y	y	n	n	y	y	y	y	y	y	n	y	n	n	y	y	y		y	y	n
	longwall	Not deliberately	y	y	n	n	y	y	y	y	y	y	n	y	n	n	y	y	n		y	y	n
Not Operating																							
[redacted]	longwall	yes	y	y	n	n	y	y	y	y	y	y	y	y	n	n	y	y	n		y	y	n
	longwall	Not deliberately	y	y	n	y	y	y	y	y	y	y	n	y	u	n	y	y	n		y	y	y
	Duncan method, miniwall	Not deliberately	y	y	n	y	n	y	y	y	y	y	n	y	u	n	y	y	n		y	u	n
	Wongwilli, Duncan, B&P	Not deliberately	y	y	n	y	n	y	y	y	y	y	n	y	u	n	y	y	n		y	u	n
	Miniwall	Not deliberately	y	y	n	y	n	y	y	y	y	y	n	y	u	n	y	y	n		y	y	n
	bord and pillar	old workings - flooded	y	y	n	n	n	y	y	y	y	y	n	y	u	n	y	y	n		y	n	n
	longwall	old workings - flooded	y	y	n	y	y	y	y	y	y	y	y	y	n	n	y	y	n		y	y	y
	longwall	yes	y	y	n	n	n	y	y	y	y	y	n	y	n	n	y	y	n		y	y	n
	longwall	Not deliberately	y	y	n	n	y	y	y	y	y	y	y	y	n	y	y	y	n		y	y	n

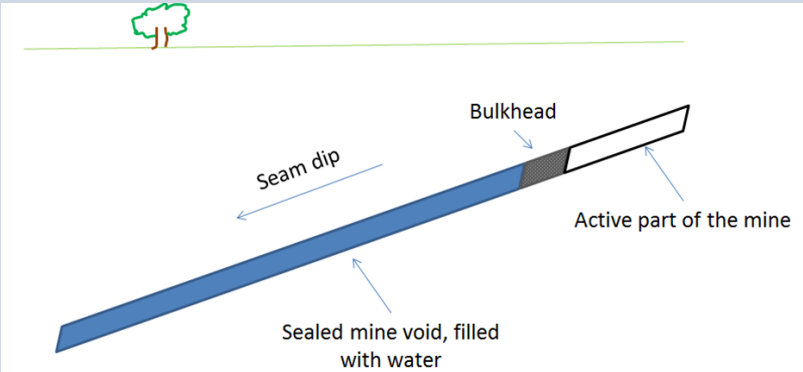
y yes
n no
u unsure

DP&E appears to have misrepresented the nature of High Risk Activities (HRA) and the potential for a HRA to impact upon approvability of the project

Response to DP&E- Bulkheads

DP&E Issue/Assertion	Response
Assertion: There are "inherent risks" associated with impoundment of groundwater underground.	The impoundment of water in underground workings is commonplace. Of the 29 mines listed in the previous slide some 16 impound water in underground workings. The remainder may inadvertently impound water in mine goafs in low-lying areas. Inrush, associated with the impoundment of water underground is classed as a Principal Mining Hazard under NSW legislation, and Hume Coal would operate under an Inrush Principal Hazard Management Plan.

Response to DP&E- Bulkheads

DP&E Issue/Assertion	Evidence
Assertion: The risks associated with the impoundment of groundwater underground may be "exacerbated by various other risks associated with pillar stability" **Response:** It is not clear how the two issues are related. The bulkheads will be installed at the start of panel headings, not near web pillars.	 Simplified panel cross section, showing bulkhead location

Response to DP&E- Bulkheads

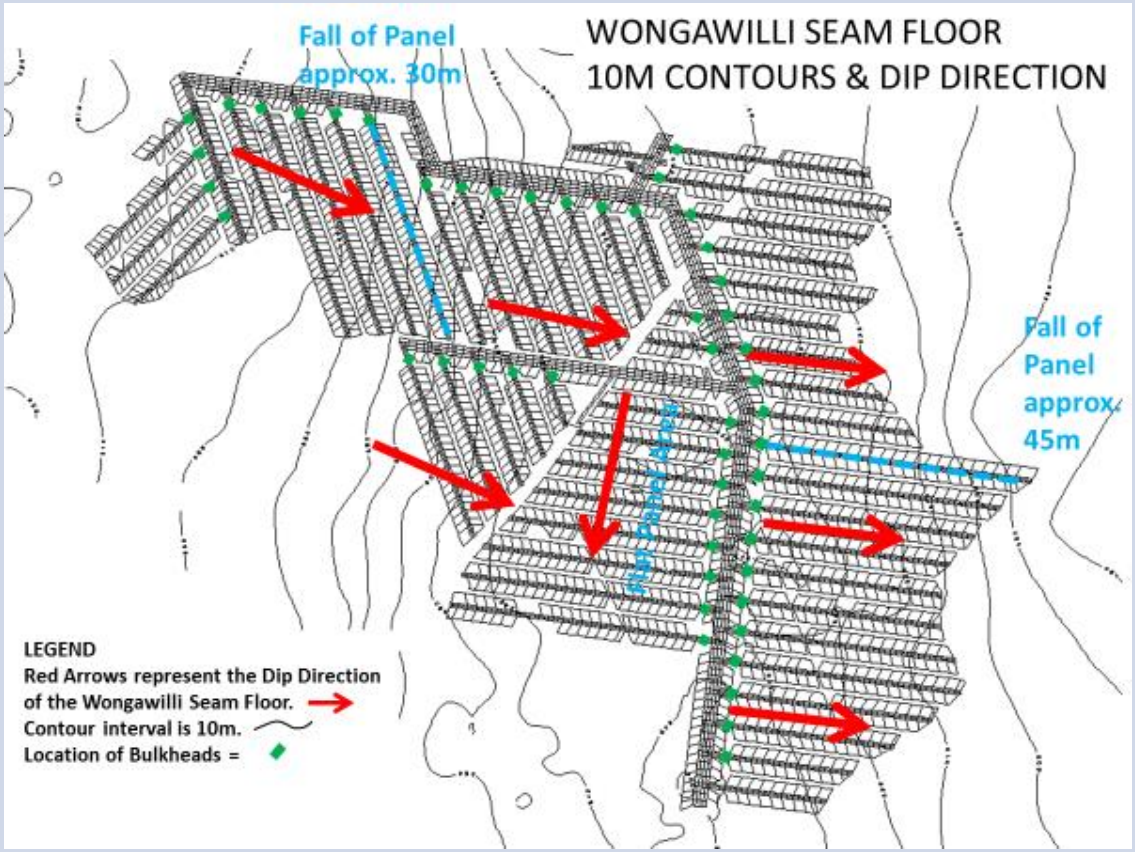
Response to DP&E- Bulkheads

DP&E Issue/Assertion	Evidence
"The timing of the proposed impoundment of water" in flat-lying parts of the mine represents a residual uncertainty	6. The central flatly dipping area of the mine will be mined last, meaning that the panels in this area are not likely to be filled with water prior to mining operations ceasing altogether. The Source: Hume Coal Response to DP&E Mining Experts' Reports, 11 July 2018, p. 41 The timing of the proposed impoundment of water in areas of the mine that are flatly lying is discussed in Hume Coal's response to the mining expert reports. This is not a residual issue and has been addressed.

Response to DP&E- Bulkheads

DP&E Issue/Assertion	Response
A bulkhead failure may lead to the need to discharge water directly into creeks	The panels are designed to be down-dip of bulkhead sites, meaning that if a bulkhead were to begin to leak, the leakage rate would be limited to the groundwater inflow to that single panel. Remedial pressure grouting would require partial or full depressurisation of the panel to the level of the bulkhead, **but not the full pumping-out of the panel.** The void behind the bulkhead would remain full during remedial works, if such works were ever required.

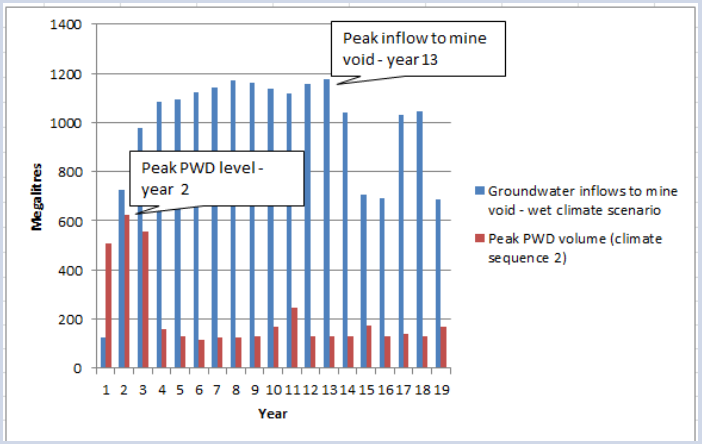
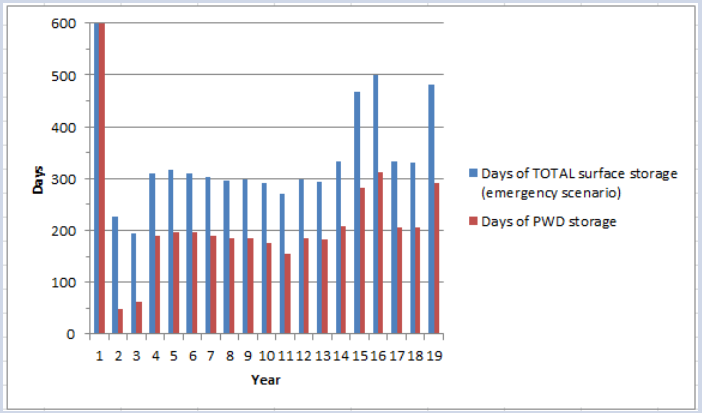
Response to DP&E- Bulkheads

DP&E Issue/Assertion	Evidence
A bulkhead failure may lead to the need to discharge water directly into creeks	

Response to DP&E- Bulkheads

DP&E Issue/Assertion	Response
"The PWD would only provide approximately 10-11 days of mine water storage"	False. The modelled scenario where the PWD reaches its peak storage of 625ML (vs. design capacity of 720ML) occurs **in only one of the 108 climate sequences modelled**. This occurs very early in the mine life when mine inflows are comparatively low. Peak mine inflows occur mid-late in the mine life, when there is a lot of spare underground storage capacity. Furthermore, the mine infrastructure has multiple water retention basins. The water modelling was undertaken on the basis that these are pumped dry after every rainfall event and the water is transferred to the PWD. Under a worst-case scenario, water could be left in these basins to provide additional surface storage.

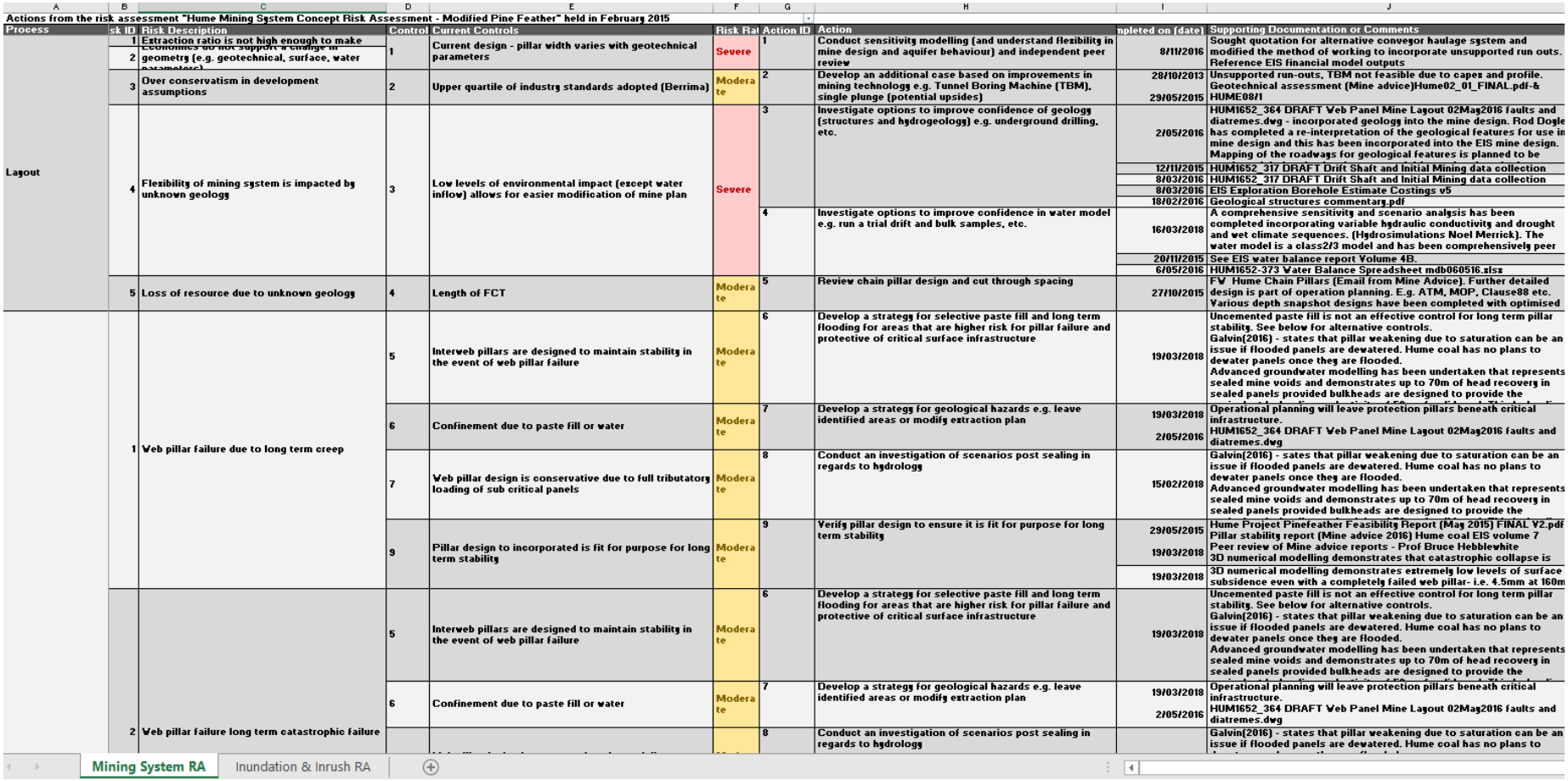
Response to DP&E- Bulkheads

DP&E Issue/Assertion	Evidence
"The PWD would only provide approximately 10-11 days of mine water storage"	 

Response to DP&E- Risk Assessment

DP&E Issue/Assertion	Evidence
Another key concern relates to the level of risk assessment undertaken: *"many of the matters raised in this report could reasonably be expected to have been evaluated by the mine owner(s) in a risk assessment of the mining concept prior to deciding to lodge a Development Application".*	*"Hume Mining System Concept Risk Assessment"* February 2015. (reviewed & updated March 2018) Included 2 subset Risk Assessments: 1. Mining Systems Risks including: • Mine Layout • Geotechnical design parameters • Mining sequence • Working section selection • Mining Equipment • Productivity Assumptions • Ventilation & Gas • Spontaneous Combustion • Reject Emplacement 2. Inundation and Inrush risks including: • Failure of the bulkhead seal or surrounding strata • Intersection of an already flooded panel • Failure of the web due to hydrostatic pressure • Geological structures • Pillar Failures (Web, interpanel etc) • Major roof fall in unventilated plunge

Response to DP&E- Risk Assessment



Actions from the risk assessment "Hume Mining System Concept Risk Assessment - Modified Pine Feather" held in February 2015

Process	sk ID	Risk Description	Control	Current Controls	Risk Rat	Action ID	Action	ppleted on (date)	Supporting Documentation or Comments
Layout	1	Extraction ratio is not high enough to make Economics do not support a change in geometry (e.g. geotechnical, surface, water parameters)	1	Current design - pillar width varies with geotechnical parameters	Severe	1	Conduct sensitivity modelling (and understand flexibility in mine design and aquifer behaviour) and independent peer review	8/11/2016	Sought quotation for alternative conveyor haulage system and modified the method of working to incorporate unsupported run outs. Reference EIS financial model outputs
	3	Over conservatism in development assumptions	2	Upper quartile of industry standards adopted (Berrima)	Moderate	2	Develop an additional case based on improvements in mining technology e.g. Tunnel Boring Machine (TBM), single plunge (potential upsides)	28/10/2013 29/05/2015	Unsupported run-outs, TBM not feasible due to capex and profile. Geotechnical assessment (Mine advice)Hume02_01_FINAL.pdf-& HUME08f1
	4	Flexibility of mining system is impacted by unknown geology	3	Low levels of environmental impact (except water inflow) allows for easier modification of mine plan	Severe	3	Investigate options to improve confidence of geology (structures and hydrogeology) e.g. underground drilling, etc.	2/05/2016 12/11/2015 8/03/2016 8/03/2016 18/02/2016	HUM1652_364 DRAFT Web Panel Mine Layout 02May2016 faults and diatremes.dwg - incorporated geology into the mine design. Rod Dogle has completed a re-interpretation of the geological features for use in mine design and this has been incorporated into the EIS mine design. Mapping of the roadways for geological features is planned to be HUM1652_317 DRAFT Drift Shaft and Initial Mining data collection HUM1652_317 DRAFT Drift Shaft and Initial Mining data collection EIS Exploration Borehole Estimate Costings v5 Geological structures commentary.pdf
						4	Investigate options to improve confidence in water model e.g. run a trial drift and bulk samples, etc.	16/03/2018 20/11/2015 6/05/2016	A comprehensive sensitivity and scenario analysis has been completed incorporating variable hydraulic conductivity and drought and wet climate sequences. (Hydrosimulations Noel Merrick). The water model is a class2i3 model and has been comprehensively peer See EIS water balance report Volume 4B. HUM1652-373 Water Balance Spreadsheet mdb060516.xlsx
	5	Loss of resource due to unknown geology	4	Length of FCT	Moderate	5	Review chain pillar design and cut through spacing	27/10/2015	FW: Hume Chain Pillars (Email from Mine Advice). Further detailed design is part of operation planning. E.g. ATM, MOP, Clause88 etc. Various depth snapshot designs have been completed with optimised
	1	Web pillar failure due to long term creep	5	Interweb pillars are designed to maintain stability in the event of web pillar failure	Moderate	6	Develop a strategy for selective paste fill and long term flooding for areas that are higher risk for pillar failure and protective of critical surface infrastructure	19/03/2018	Uncemented paste fill is not an effective control for long term pillar stability. See below for alternative controls. Galvin(2016) - states that pillar weakening due to saturation can be an issue if flooded panels are dewatered. Hume coal has no plans to dewater panels once they are flooded. Advanced groundwater modelling has been undertaken that represents sealed mine voids and demonstrates up to 70m of head recovery in sealed panels provided bulkheads are designed to provide the
			6	Confinement due to paste fill or water	Moderate	7	Develop a strategy for geological hazards e.g. leave identified areas or modify extraction plan	19/03/2018 2/05/2016	Operational planning will leave protection pillars beneath critical infrastructure. HUM1652_364 DRAFT Web Panel Mine Layout 02May2016 faults and diatremes.dwg
			7	Web pillar design is conservative due to full tributatory loading of sub critical panels	Moderate	8	Conduct an investigation of scenarios post sealing in regards to hydrology	15/02/2018	Galvin(2016) - sates that pillar weakening due to saturation can be an issue if flooded panels are dewatered. Hume coal has no plans to dewater panels once they are flooded. Advanced groundwater modelling has been undertaken that represents sealed mine voids and demonstrates up to 70m of head recovery in sealed panels provided bulkheads are designed to provide the
			9	Pillar design to incorporated is fit for purpose for long term stability	Moderate	9	Verify pillar design to ensure it is fit for purpose for long term stability	29/05/2015 19/03/2018 19/03/2018	Hume Project Pinefeather Feasibility Report (May 2015) FINAL V2.pdf Pillar stability report (Mine advice 2016) Hume coal EIS volume 7 Peer review of Mine advice reports - Prof Bruce Hebblewhite 3D numerical modelling demonstrates that catastrophic collapse is 3D numerical modelling demonstrates extremely low levels of surface subsidence even with a completely failed web pillar- i.e. 4.5mm at 160m
	2	Web pillar failure long term catastrophic failure	5	Interweb pillars are designed to maintain stability in the event of web pillar failure	Moderate	6	Develop a strategy for selective paste fill and long term flooding for areas that are higher risk for pillar failure and protective of critical surface infrastructure	19/03/2018	Uncemented paste fill is not an effective control for long term pillar stability. See below for alternative controls. Galvin(2016) - states that pillar weakening due to saturation can be an issue if flooded panels are dewatered. Hume coal has no plans to dewater panels once they are flooded. Advanced groundwater modelling has been undertaken that represents sealed mine voids and demonstrates up to 70m of head recovery in sealed panels provided bulkheads are designed to provide the
			6	Confinement due to paste fill or water	Moderate	7	Develop a strategy for geological hazards e.g. leave identified areas or modify extraction plan	19/03/2018 2/05/2016	Operational planning will leave protection pillars beneath critical infrastructure. HUM1652_364 DRAFT Web Panel Mine Layout 02May2016 faults and diatremes.dwg
						8	Conduct an investigation of scenarios post sealing in regards to hydrology		Galvin(2016) - states that pillar weakening due to saturation can be an issue if flooded panels are dewatered. Hume coal has no plans to

Mining System RA | Inundation & Inrush RA

RA originally completed in 2015, Development Application lodged 2017

Water Management & Impacts

Water overview

DPE comment	Hume response	DP&E Reviewer (Hugh Middlemis)
Residual uncertainty	One of the most comprehensive water assessment for a mining project in NSW	**'Hume Coal Model is fundamentally a good example of best practice of design and execution'**
Lack of geological data and modelling of the interburden layer	Over 360 drill holes, and interburden between Hawkesbury Sandstone and Coal correctly represented	**'The Hume Coal model has been set up with an appropriate representation of the interburden'**
Significant impacts on highly productive aquifer	Environmental Impact of the mine is modest not 'unprecedented'. Other mine impacts much greater in terms of drawdown, inflow and time to recover.	**'Dewatering of one horizon of the aquifer (ie the mined coal seam) does not preclude saturated aquifer conditions above'**
Class 2 status challenged, and therefore uncertainty of model results and adoption of conservative model results	Model is Class 2. Modelling uncertainty is world class	**'Downgrading of the model by DPI Water (2017) and Anderson (2017) to class 1 is invalid'** **'DPI Water have now agreed the model is Class 2'** **'Class 2 is justified'** **Model is 'fit for purpose'**
Make good arrangements not suitable	Make good is clearly technically feasible	**'Depressurization does not dewater an aquifer unit, it simply lowers the pressure level, which can leave areas of saturated aquifer that an support groundwater pumping'**
Make good arrangements not practical	Make good arrangements are standard administrative practice and done elsewhere **Access arrangements already with 20 landholders (step 1 in the process for make good)** 'Make Good' is a landholder entitlement – if they don't choose to exercise that right, then there is no dispute. **It is an 'opt in' arrangement**	**The strategies for make good are reasonable.**
Concerns Hume will be able to acquire necessary groundwater licences	Hume easily acquired 93% of required groundwater licences (1,909 ML) – covers inflow up until years 16 Hume very confident we can acquire additional 150ML	

Water overview- NSW DoI Water Comments

- DP&E have relied upon NSW DoI Water to provide feedback on the Hume Coal Groundwater Modelling

- On Page 2 of Attachment A in the DoI Water Response to Submission document (6 November 2018), DoI Water state that:

  "DoI Water is aware that DPE has engaged an independent groundwater expert to review the latest work. DoI Water has not had access to this document in the preparation of this advice"

- Thus, DoI Water has provided advice to DPE that doesn't take into account the DPE Independent Groundwater Expert's findings.

- Hence the disparity between the DPE Preliminary Report conclusions related to groundwater and the findings of the Hugh Middlemis Report

- The IPC should refer to the Independent Groundwater Expert Report rather than the summary provided by the DPE Report

Monitoring and data collection

DPE Comment: DPE states sufficient data, but then cites data uncertainty as a reason for adopting conservative model predictions.

Hume Response

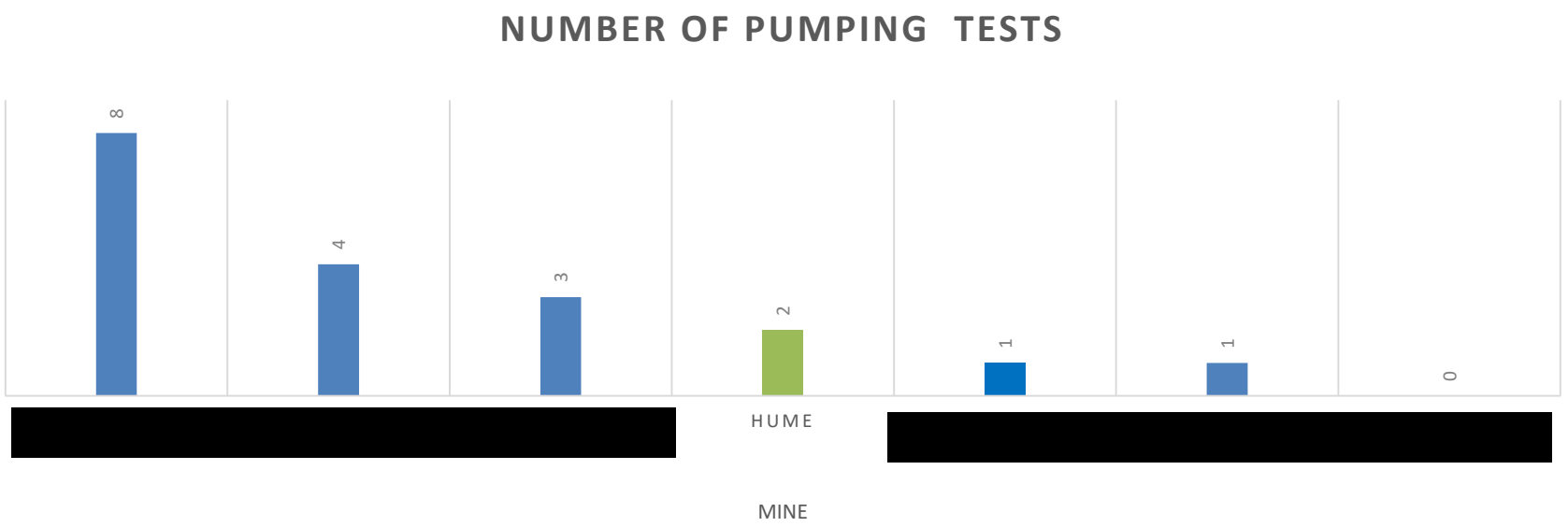
8 years of baseline data

- 24 surface water quality monitoring sites
- 11 stream gauges
- 54 monitoring bores at 22 nested locations
- 11 VWP's at 3 sites
- 3 private landholder bores

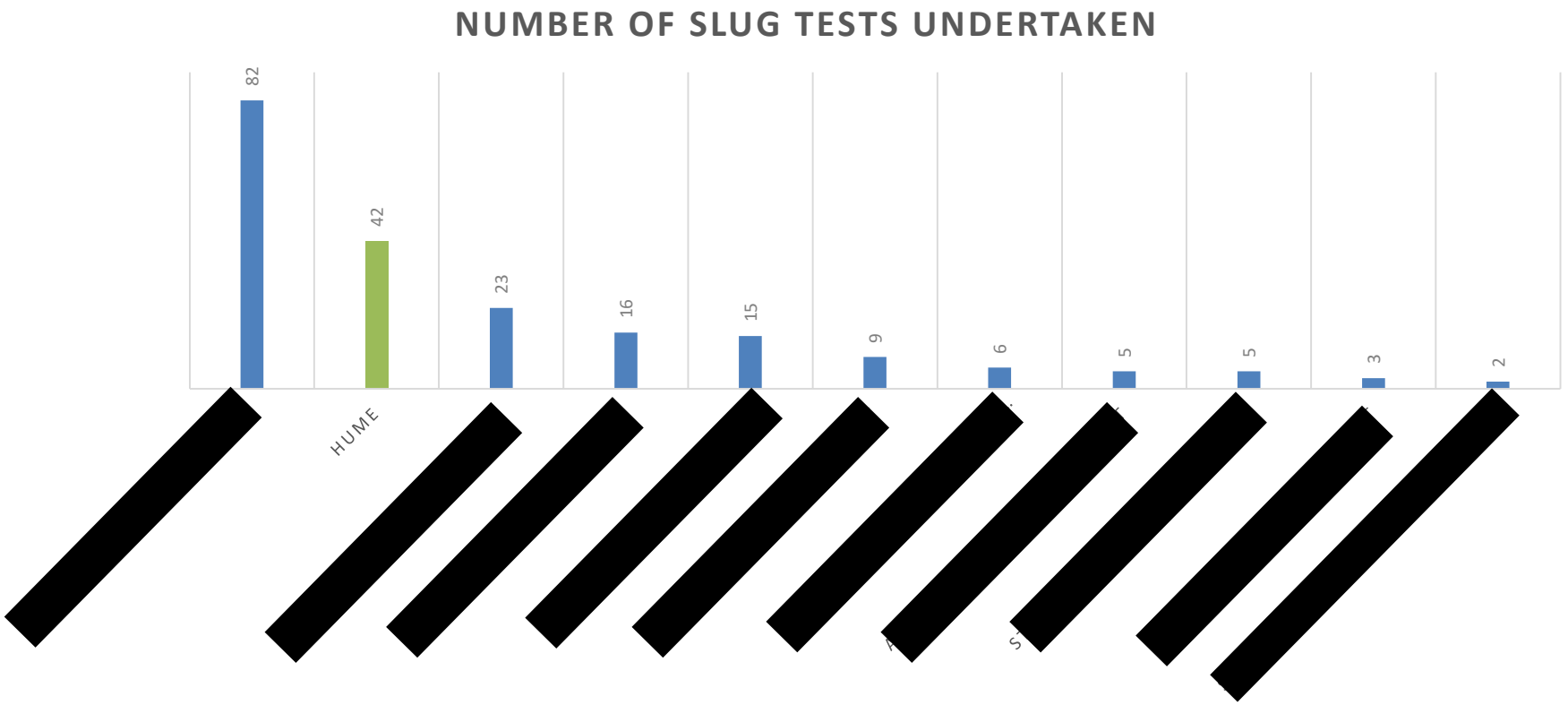
Middlemis:

Class 2 model criteria for 'data volume' and 'data coverage' confirmed

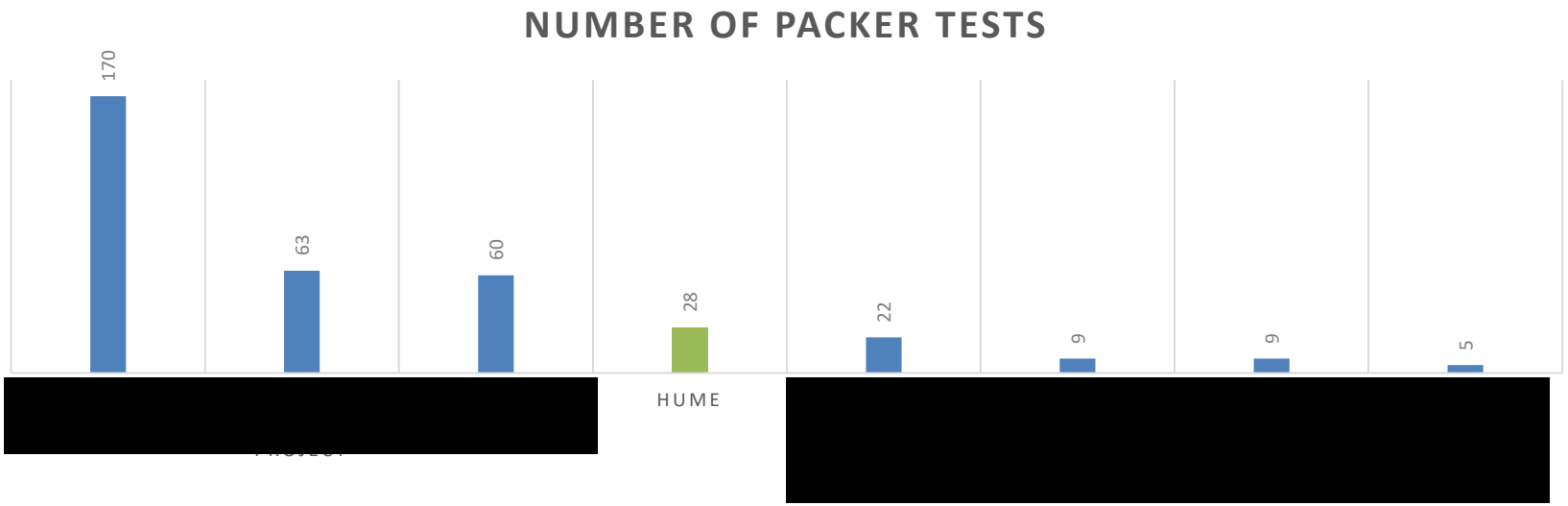
Baseline data
Comparison of site specific hydraulic data collected



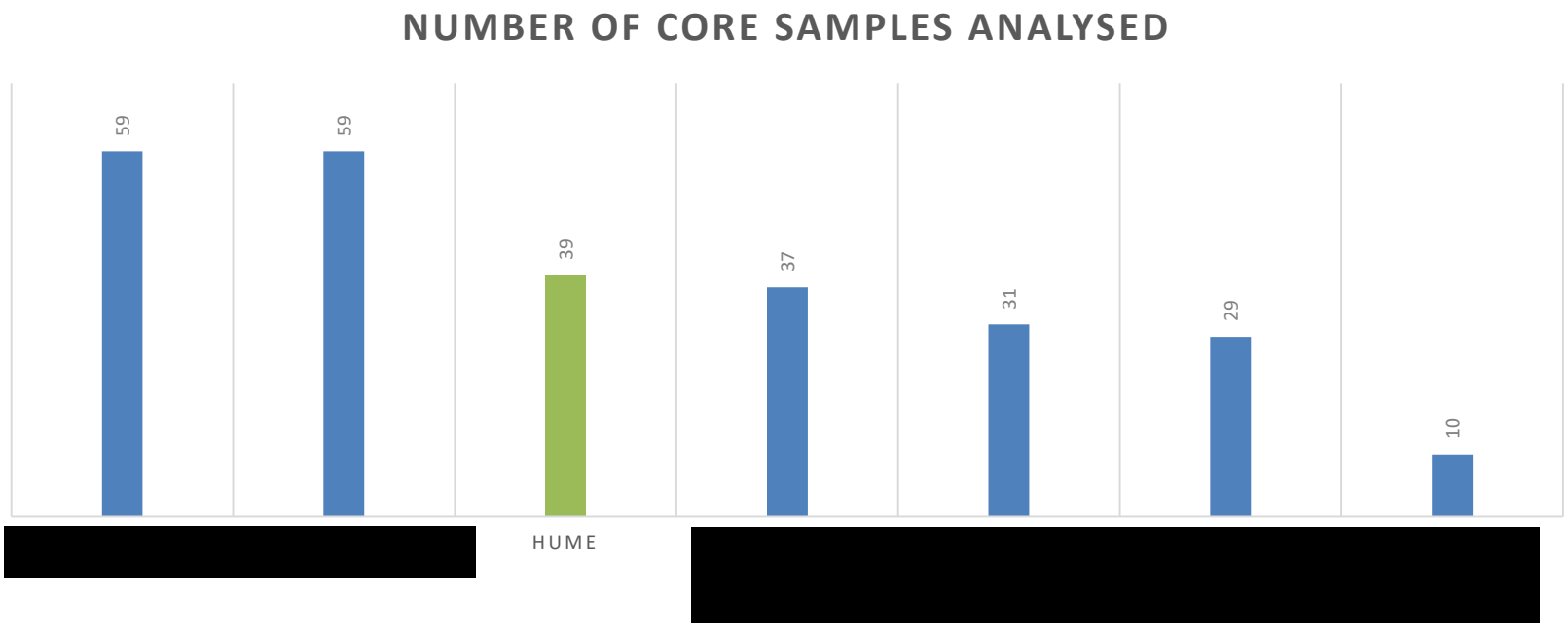
Baseline data
Comparison of site specific hydraulic data collected



Baseline data
Comparison of site specific hydraulic data collected



Baseline data
Comparison of site specific hydraulic data collected

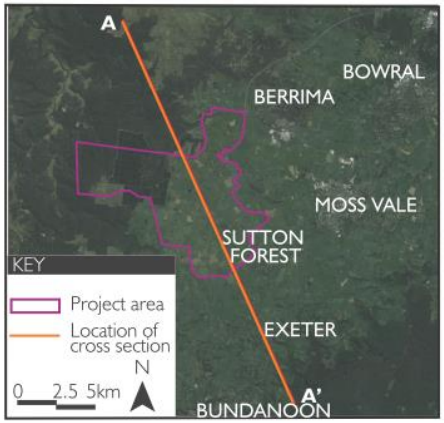


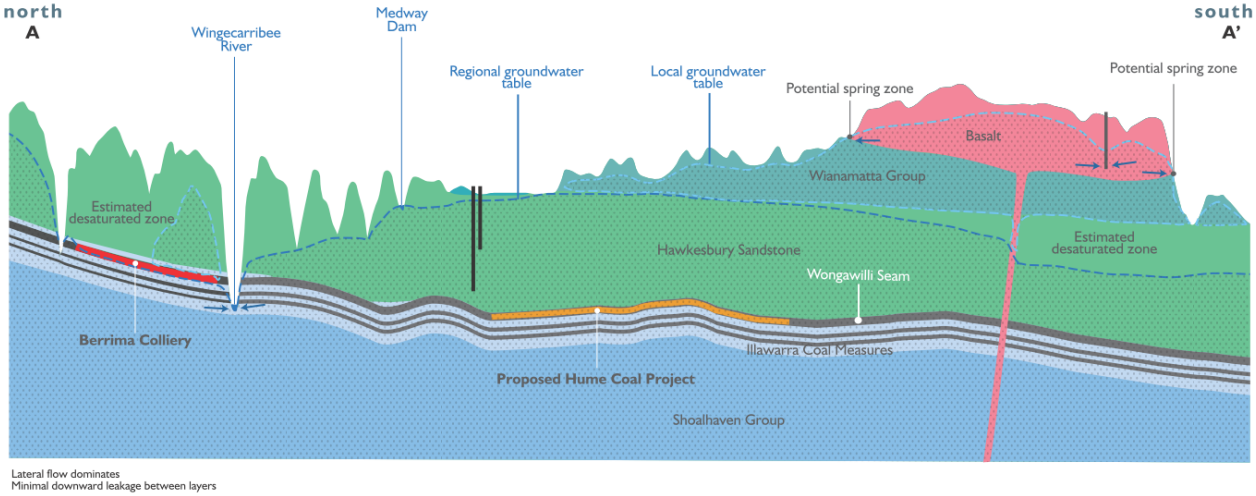
Hydrogeological conceptual model

NSW Government independent expert**, Hugh Middlemis;**

Conceptual and numerical models are in accordance with Australian Modelling Guidelines and ***'fit for purpose'***

'The model software, design, extent, grid, boundaries and parameters form a good example of best practice in design and execution.'



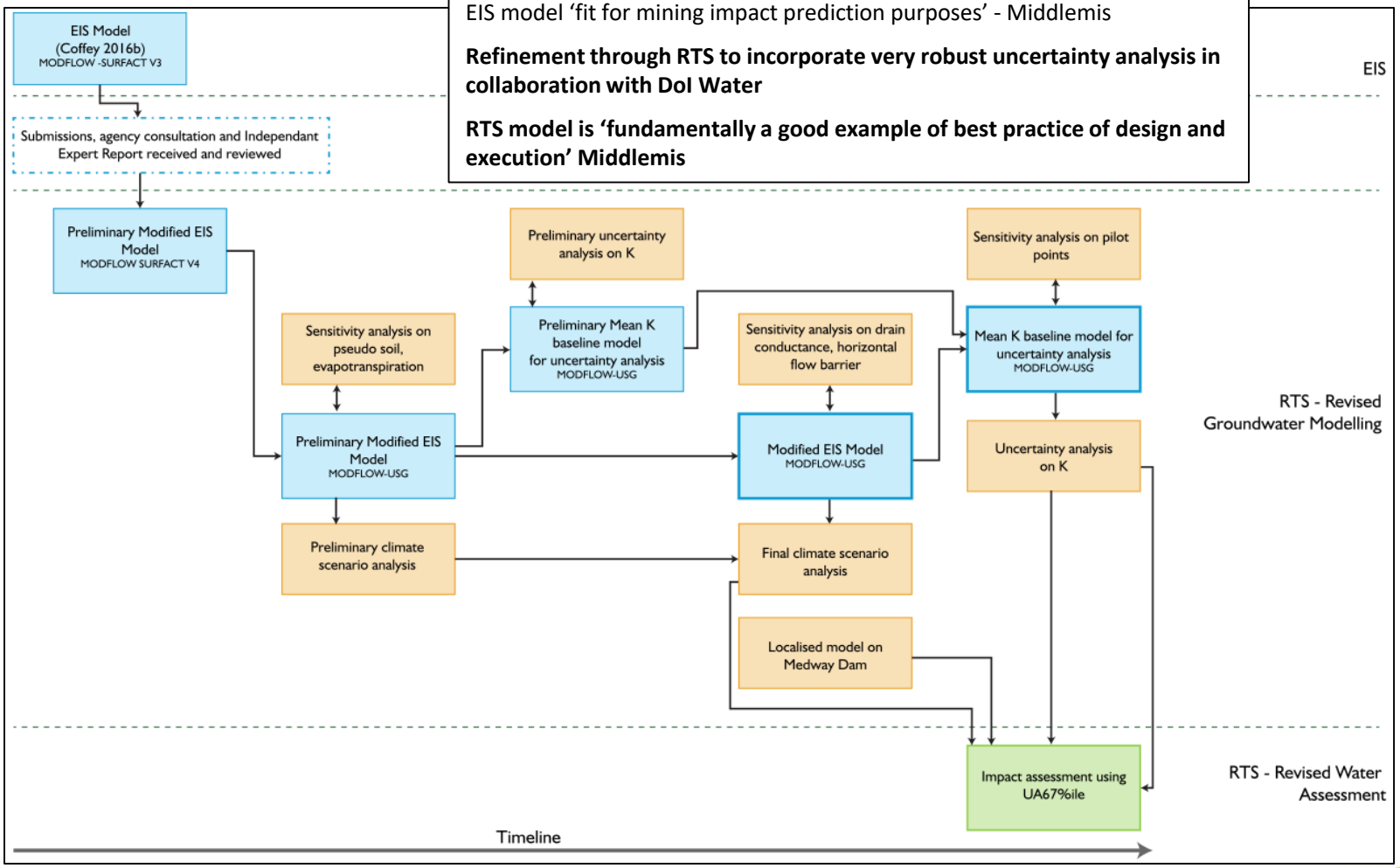


Groundwater model refinement – post RTS

EIS model 'fit for mining impact prediction purposes' - Middlemis

Refinement through RTS to incorporate very robust uncertainty analysis in collaboration with DoI Water

RTS model is 'fundamentally a good example of best practice of design and execution' Middlemis



Conceptual and numerical model - Interburden and conductance

DPE Comment: Concept and modelling of the interburden (between Hawkesbury Sandstone and the coal seam) is questioned in terns of its thickness, extent and assigned permeability in the model

Middlemis : *…the Hume Coal Model has been set up with an appropriate thicknesses and no low flow permeability parameters to limit the potential connection between the coal seams and the Hawkesbury Sandstone…*

- 345 boreholes in project area to define the interburden
- Interburden thicknesses in the model reflect actual field data
- *the model has the correct representation of the interburden data* ***does not unduly constrict groundwater flow into the workings****.*

Model class

DPE comment: critics evaluation on model class, and residual uncertainties that mean the Department should adopt a precautionary approach

In Section 6.2.4, under Model Class, DPE quote comments from Midddlemis that suggest the clarity of reporting in the EIS could be improved and that Middlemis recommended model changes.

DPE then say that DoI Water and Doug Anderson still have concerns the RTS model is still not Class 2.

Middlemis 2017 (review of the EIS model)

- *'this review finds that the Hume Coal model itself is suitable for the mining impact assessment purpose (Class 2 confidence level)'….* He then states reporting of model could be improved and suggests some model refinements. **He strongly maintains his finding that the model itself remains Class 2.**

Middlemis 2018 (final report on RTS)

- *'Downgrading of the model by DPI Water (2017) and Anderson (2017) to class 1 is invalid…. Accordingly, any criticisms based on this invalid premise are also not necessarily valid'*
- *'DPI Water and Anderson have relied heavily on the demonstrably false premise of a Class 1 model to base their initial claims of inadequate modelling for impact assessment purposes'*
- It is understood that… *'DPI Water have now agreed the model is Class 2'*

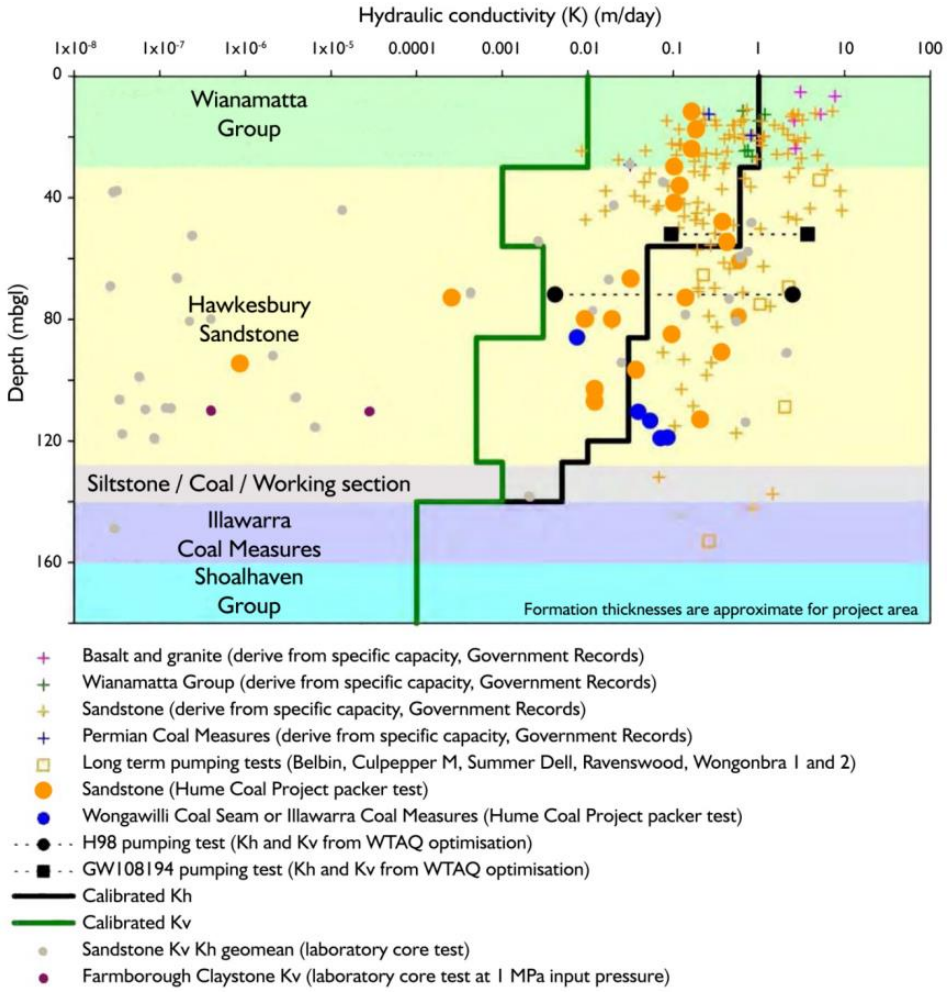
Model class

- Hume Coal confident of the detailed and extremely well considered groundwater model developed for the project
- The modelling and the uncertainty analysis undertaken through the RTS is world class and cutting edge
- The Hume Coal project was the first project to undertake uncertainty analysis at this scale and to fully adopt and implement the draft IESC uncertainty guidelines

Model confirmed as Class 2 - **suitable for impact assessment – Hugh Middlemis**

- *'cherry-picking one guideline comment rather than considering all the attributes suggested in the table does not constitute a valid agreement to support the claims by others of poor model performance'*
- *'it is my professional opinion that the Hume Coal model is fundamentally consistent with best practice in design and execution'*
- *'The model software, design, extent, grid, boundaries and parameters form a good example of best practice in design and execution'*

Impact assessment data – data uncertainty



DPE Comment: lack of drilling samples and/or consideration of available data from historical drill holes

Middlemis: ***'calibration of aquifer properties (Kh, Kv, S, Sy) have been well constrained'***

- 345 drill holes
- Hydraulic conductivity data in model calibration is extensive
- Selected model parameters within measured and accepted ranges (see graph)
- Model followed best practice - parameters bounded by measured field data

Uncertainty Analysis in Groundwater Modelling

DPE recognise the efforts to strengthen uncertainty and sensitivity analysis in the RTS model. They raise that critics, Dr Pells and Doug Anderson still have residual concerns on the uncertainty analysis.

DPE state that although they acknowledge the model provide a 'range of predictions that can be used to make a reasonable assessment of impacts', they cite residual uncertainty as the reason for adopting a 'precautionary approach' and that the models conservative results should be adopted

- IESC is increasingly focused on **uncertainty analysis** in modelling
- Uncertainty analysis for Hume was scoped with DoI Water and the method agreed upon
- As agreed, the uncertainty analysis focused on the most sensitive model parameter, hydraulic conductivity.
- Hume model uncertainty analysis tested a large range of hydraulic conductivity values from known data within the area, but produced a relatively 'tight' range of inflow volume and drawdown **this equals high confidence in model results (ie drawdown and inflow)**

Scenario and sensitivity analysis

DPE comment: 90th%ile uncertainty adopted for licensing and make good

- Standard modelling adopts 'most likely' parameters (50th%ile)
- Sensitivity analysis uses multiple model runs assess the importance of particular parameters values on model predictions
- Uncertainty analysis tests ranges of known measurements
  - allows for more robust quantification of uncertainty
  - **50th %ile** (ie median) used in most approvals
    - All standard models are 50th %ile
    - Pilabra uncertainty analysis recommended 20th%ile to 80th%ile range should be used
    - Bulga did uncertainty analysis, and confirmed the standard 'base case' model was equal to the 50th%ile so adopted the base case results for approval
  - Hume adopted **67th %ile** – conservative due to community and social concerns.
  - **90th %ile** - extremely conservative - **Not likely to occur even in extreme conditions'**

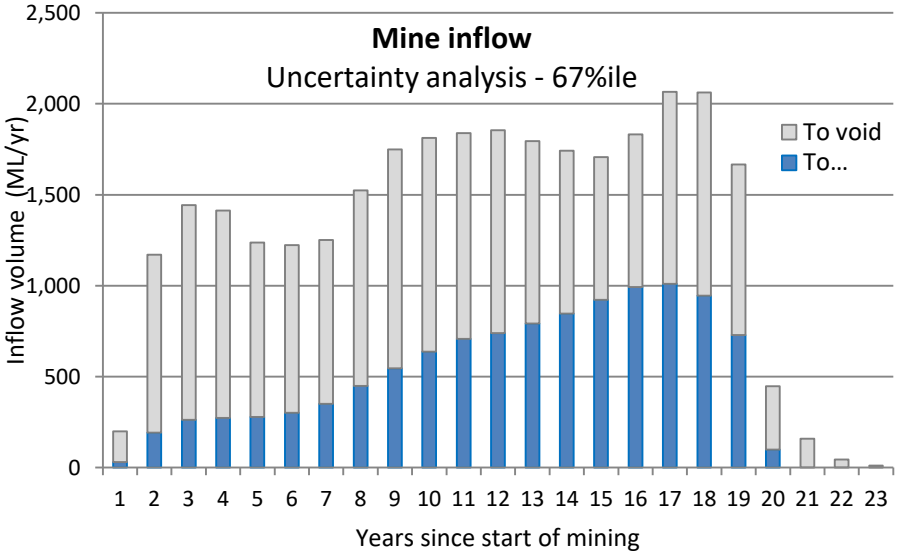
Uncertainty analysis – Hume

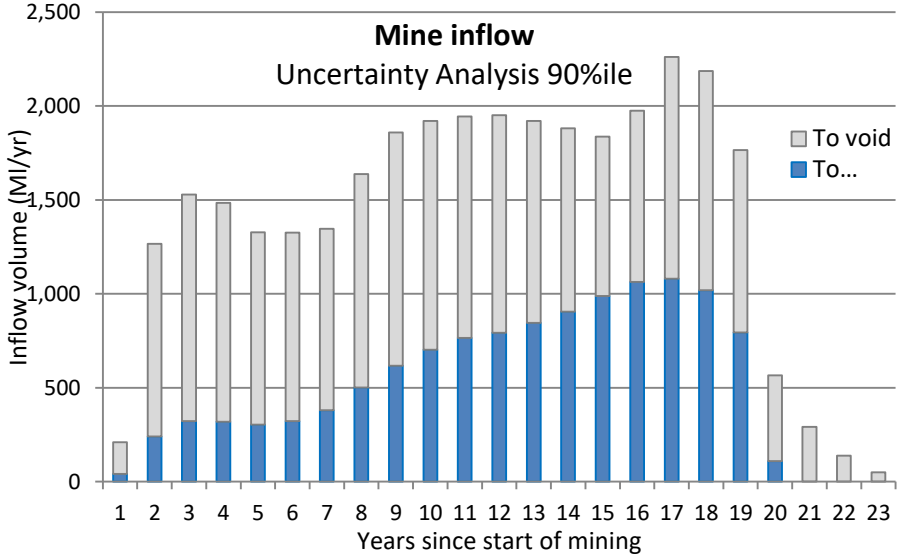
DPE comment: 90th%ile uncertainty adopted for licensing and make good

Narrative Descriptor	Probability Class	HydroSimulations Percentile Class	Description	Colour Code
Very likely	90-100%	0-10%	Likely to occur even in extreme conditions	
Likely	67-90%	10-33%	Expected to occur in normal conditions	
About as likely as not	33-67%	33-67%	About an equal chance of occurring as not	
Unlikely	10-33%	67-90%	Not expected to occur in normal conditions	
Very unlikely	0-10%	90-100%	Not likely to occur even in extreme conditions	

- Uncertainty communicated consistent with methods outlined in the *IESC Draft Explanatory Note on uncertainty analysis in groundwater modelling*
- Descriptors on the likelihood of key impacts directly linked with probability classes and uncertainty.

Comparison of percentiles (67th v 90th)





	67%ile			
	Sydney Basin South	Nepean Management Zone 2	Nepean Management Zone 1	Medway Dam
Max (ML/year)	6.5	7.1	**2,059**	0.0
Time (years)	74	25	17	

	90%ile			
	Sydney Basin South	Nepean Management Zone 2	Nepean Management Zone 1	Medway Dam
Max (ML/year)	6.5	7.1	**2,255**	5.5
Time (years)	74	25	17	19

- Minimal difference
- Demonstrates model certainty
- Main differences
  - inflow increases by 196 ML/yr in the peak year (<10% increase)
  - Losses from Medway Dam increase from 0ML to a peak of 5.5 ML/yr

Level of impact

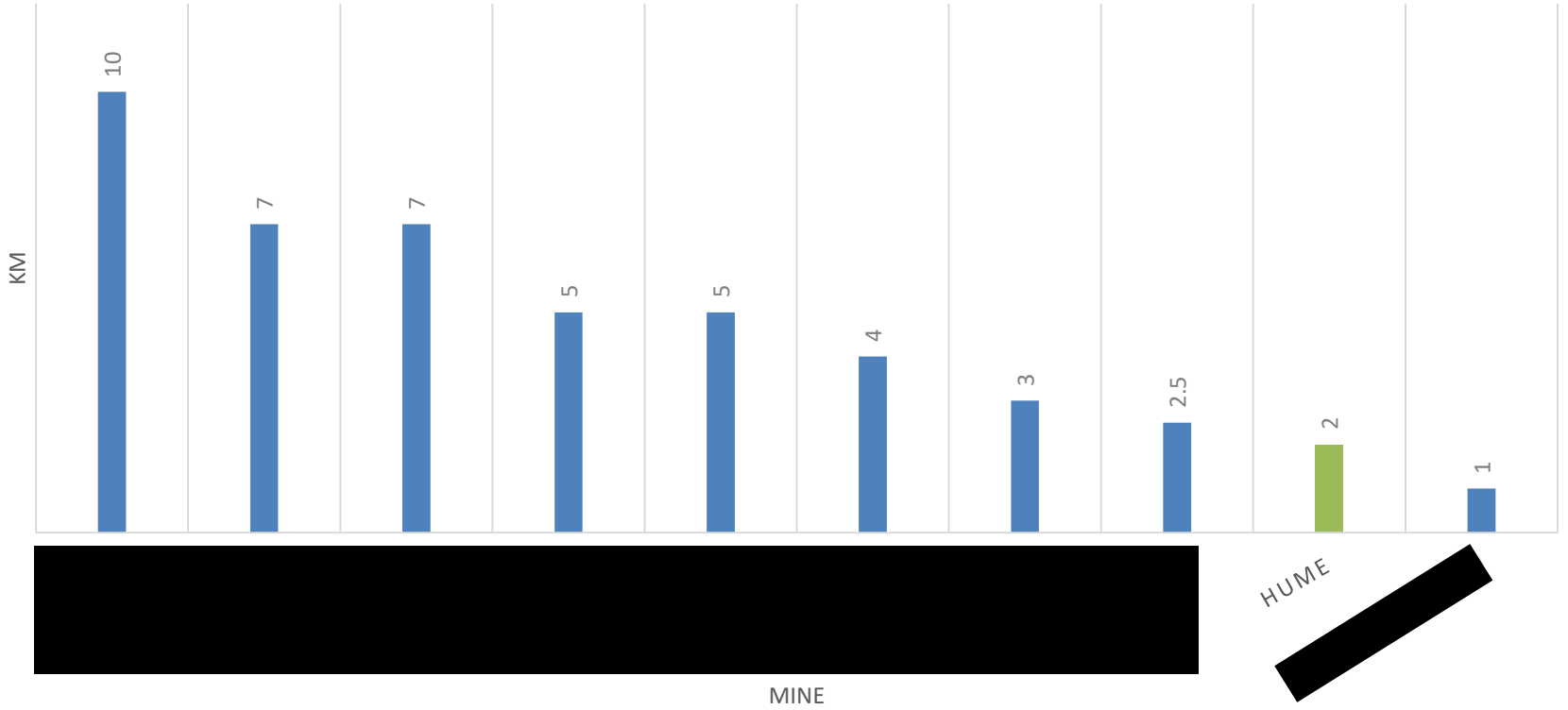
DPE state that:

…'the project is predicted to have significant impacts in a highly productive groundwater aquifer'…

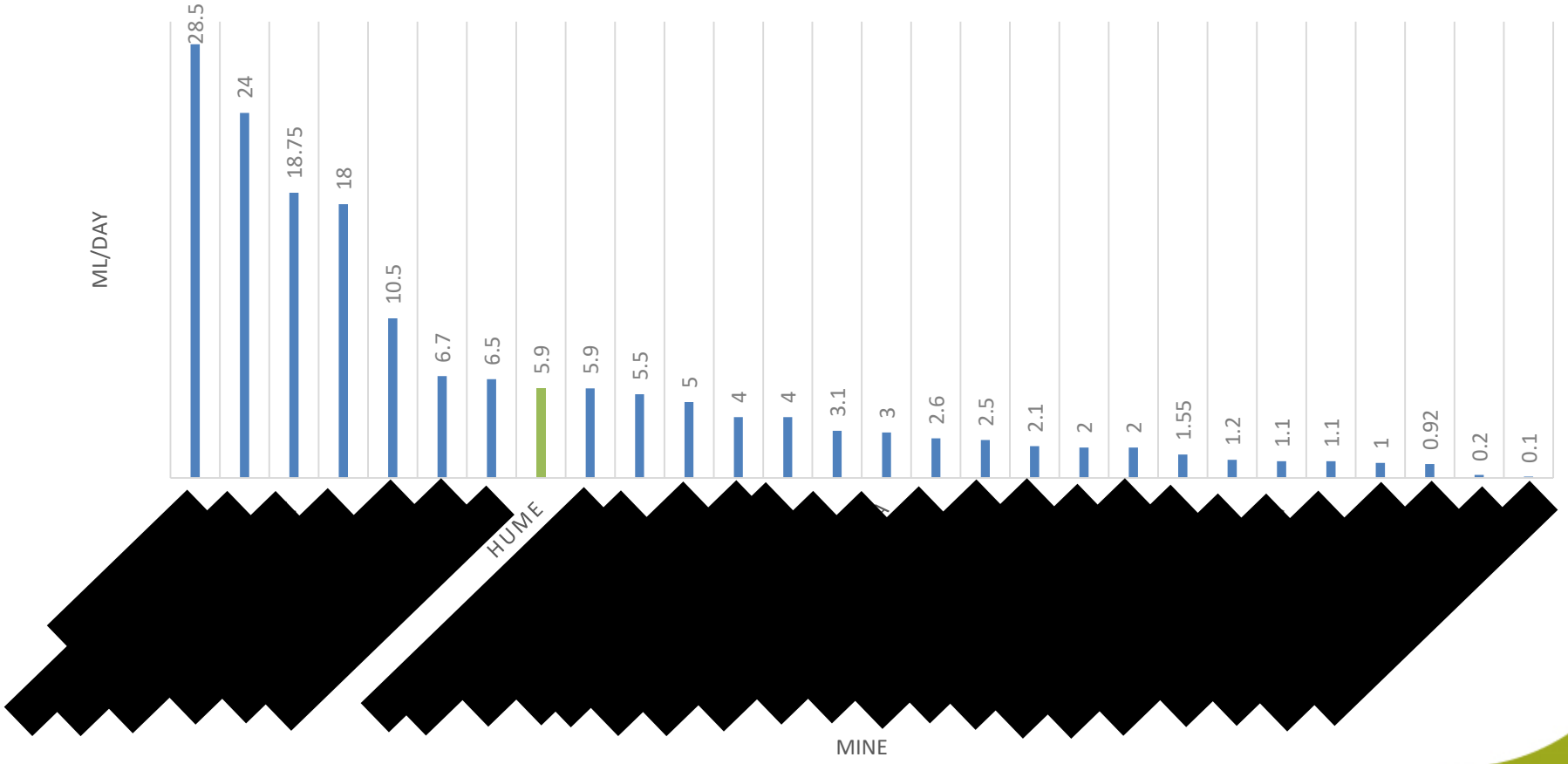
…'drawdown impacts on this aquifer would be the most significant for any mining project that has ever been assessed in NSW'…

- The depressurisation and drawdown extent from Hume is modest compared to many other assessed mining projects in NSW (following slides show examples)
- The Aquifer Interference Policy defines highly productive aquifers as those that yield in excess of 5L/sec
  - The NSW Government database reports the average yield of bores within 9km of the Hume project having a yield of 2L/sec

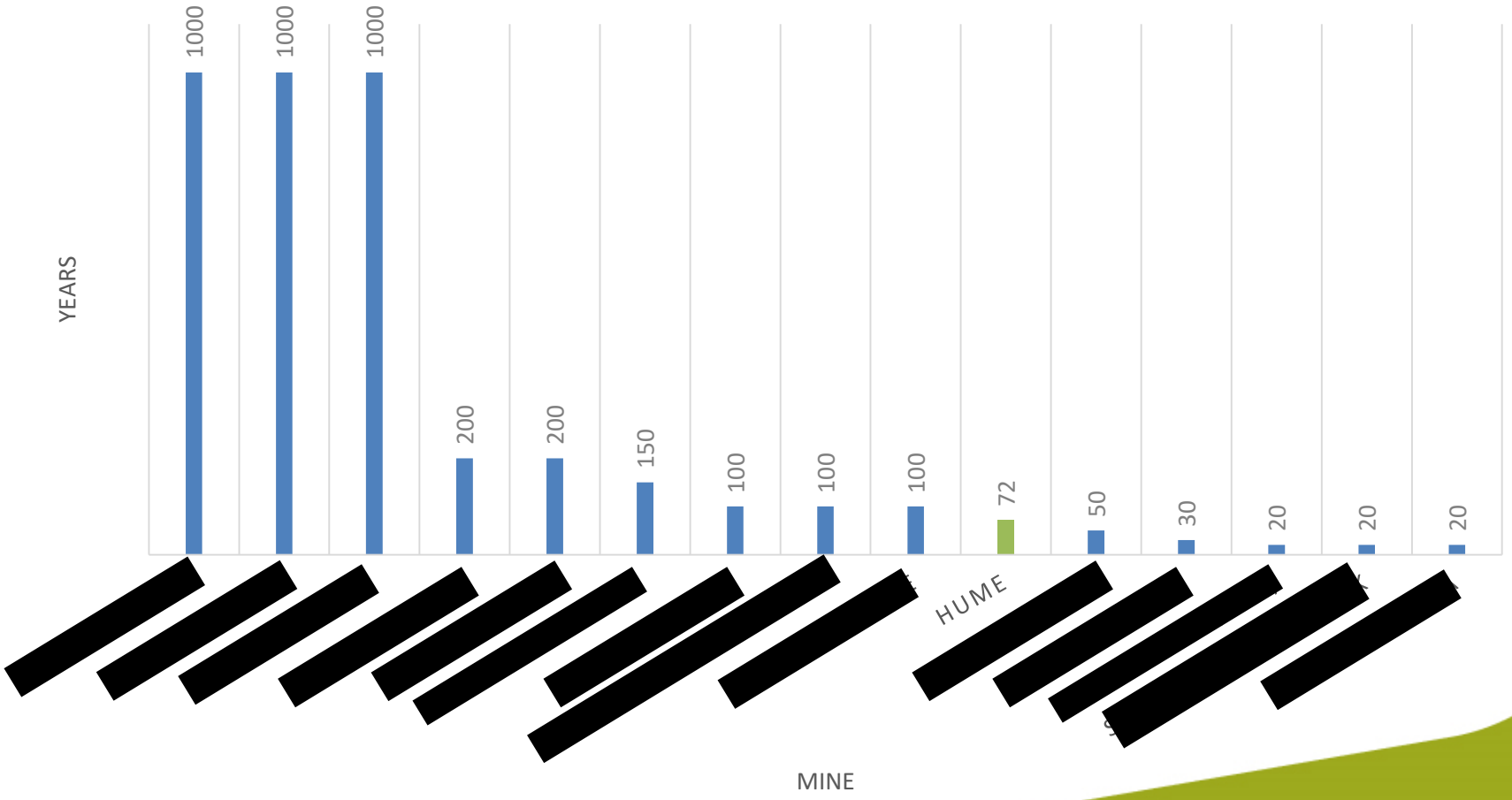
Comparison to other mines
Distance to 2m drawdown from edge of mine workings



Comparison to other mines
Groundwater inflow to open cut or underground workings



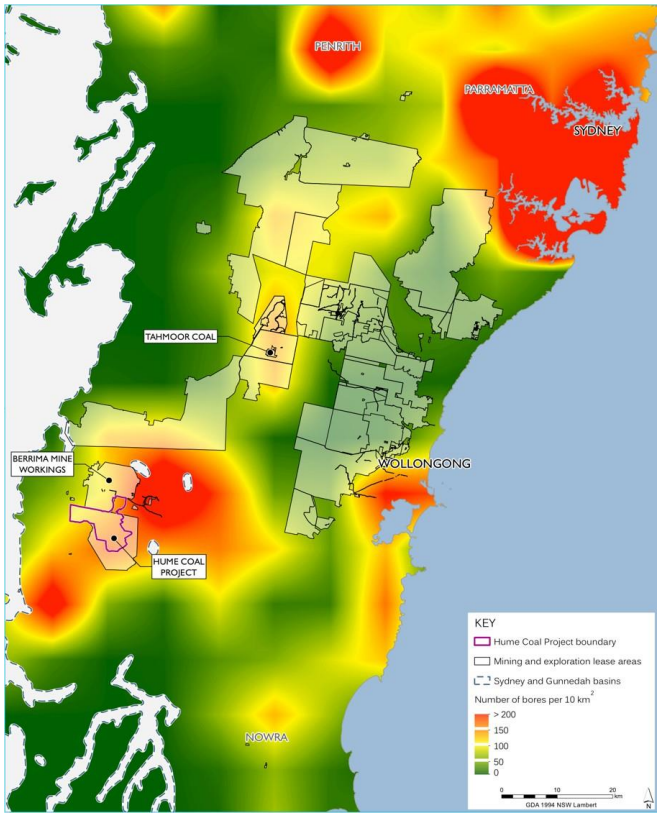
Comparison to other mines
Time to groundwater recovery years from commencement of mining



Impact Assessment - Make good strategy

DPE comment

…'the project is predicted to have significant impacts on a highly productive groundwater aquifer, including drawdown impacts on up to 118 bores'… (90th%ile)'



- Environmental impacts are small in comparison to other projects (refer to previous slides)
- The number of bores to experience drawdown is high
  - 94 bores at 67th %ile and
  - 118 at 90th%ile
- The high number of bores is due mainly to:
  - high density of bores (see map)
  - most bores for gardens and lawns

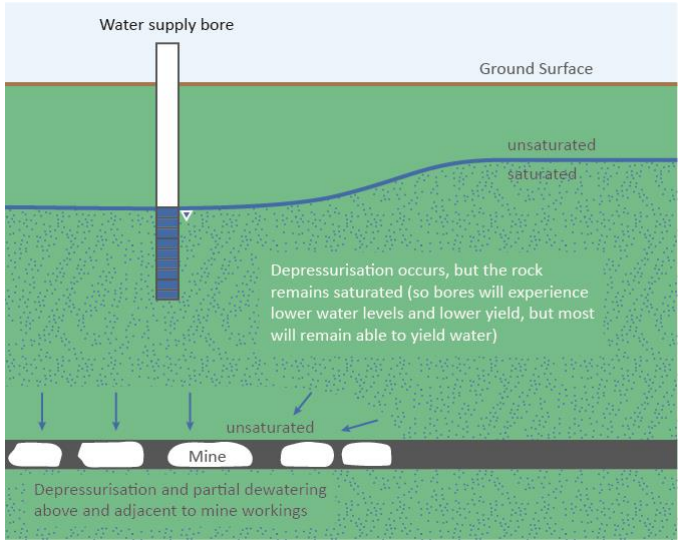
Make Good – practical and feasible

DPE comment: '*make good arrangements for 118 bores not suitable or practical*'

DPE state that ..'*DoI Water did not raise many major concerns with technical feasibility of the proposed options*'

DPE then state that the '*Department generally accepts that the Applicants proposed make good options are technically feasible'.*

Middlemis : Make good ….*'arrangements are reasonable in principle and are consistent with make good arrangement guidelines in QLD'*….



Middlemis states….

- Dewatering of one horizon (the mined coal seam), does not preclude the occurrence of saturated aquifer conditions above
- Depressurisation does not dewater an aquifer unit; it simply lowers the groundwater pressure level

Hume Coal, DPE, DoI Water and Middlemis all agree that make good arrangements are technically feasible – hence 'suitable' and 'practical' to physically undertake

Hume Coal question why, despite the above agreement, that DPE continue to state that make good is not '*suitable or practical*'

Make Good - staged strategy

DPE comment: *'make good arrangements for 118 bores not suitable or practical' – page 40*

Hume proposed a detailed make good assessment and approach that is

- Make good staged in 5 years lots (Tahmoor does this in line with extraction management plans)
- Strategy is flexible and suitable arrangements made for each individual landholder
- 'Make Good' arrangements will be **suitable and practical**' where all parties act reasonably
- Only 16 bores in first 5 years
- **64 bores (68% of all affected bores) made good with minor strategies such as increased pumping costs and lowering pumps**

Hume contest that DPE comments 'not suitable or practical' are inaccurate

DPE comments undermine the ability for a fair assessment of the project

Time when bore first impacted by 2 m drawdown	0-5 yrs	5-10 yrs	10-15 yrs	15-20 yrs	20-25 yrs	+25 years	Total
1. increased pumping costs	-	3	7	9	5	7	31
2. deepen pump	6	9	13	3	2	-	33
3a. replace stock / domestic bore	5	4	2	2	1	1	15
3b. replace an irrigation bore	5	8	1	1	-	-	15
Totals	16	24	23	15	8	8	94

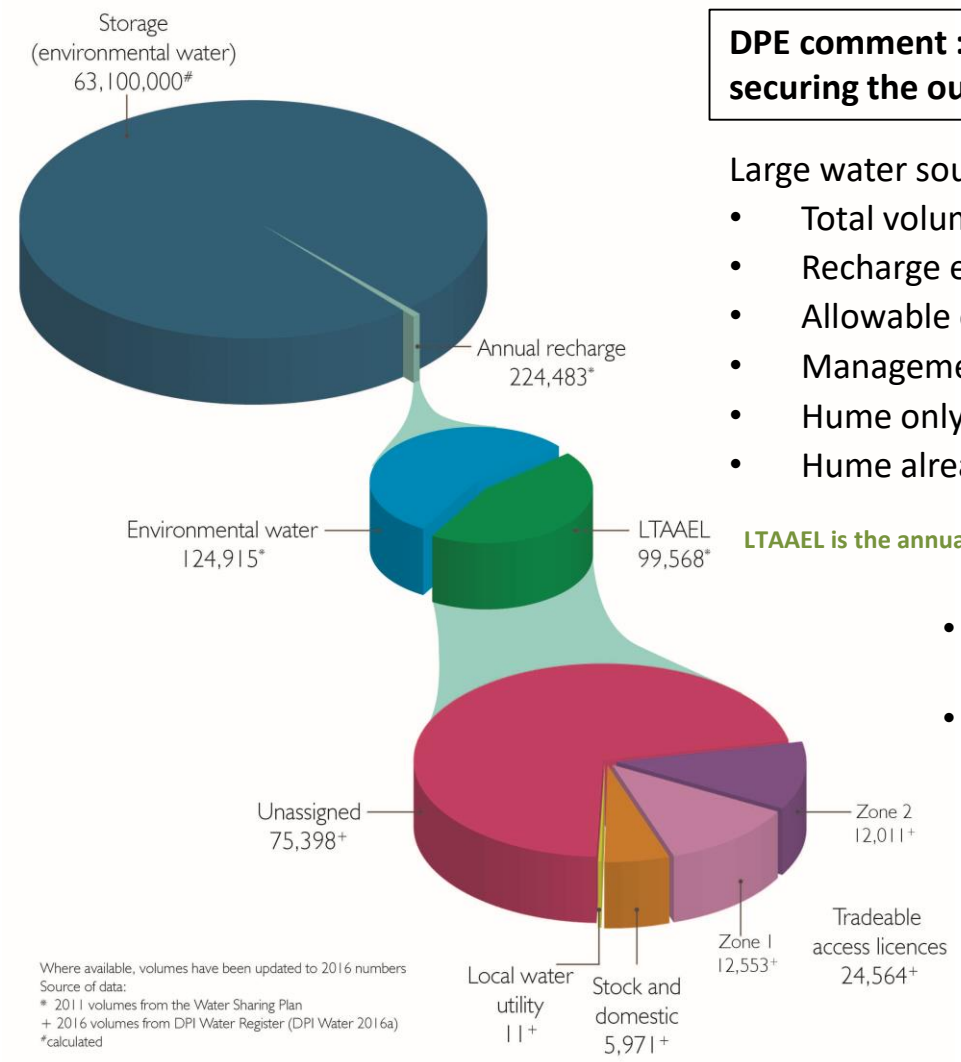
Make Good – administration

DPE comment :

- **substantial level of disruption to the community**
- **considerable disagreement between actual drawdown impacts and proposed make good options**
- **Process will rely heavily on dispute resolution**
- **Extensive time delays and lengthy dispute resolution**

- These DPE comments are subjective and administrative in nature
- Median drawdown only 6m
- 68% of bores made good with minor measures
- Step 1 of make good is site visit – and access arrangements already exist with over 20 landholders
- Only 16 negotiations needed in first 5 years
- 'Make Good' is a landholder entitlement – if they don't choose to exercise that right, then there is no dispute. **It is an 'opt in' arrangement**

Groundwater licensing



DPE comment : DPE have residual concerns about Hume securing the outstanding groundwater licence volume

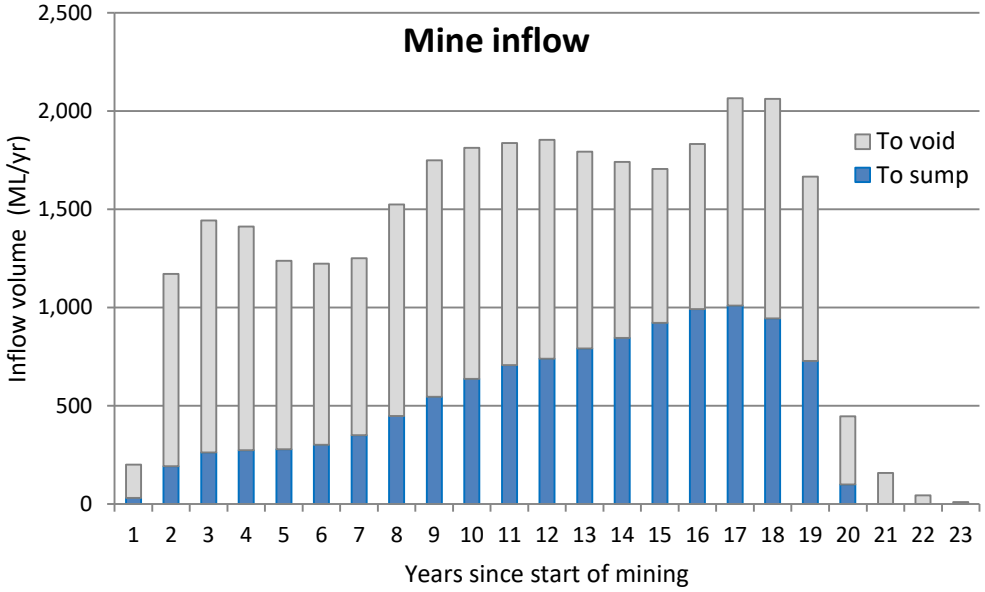
Large water source (Sydney Basin – Nepean):

- Total volume in storage is **63,000 GL**;
- Recharge each year is **224 GL**
- Allowable extraction <50% of recharge and is **99 GL**
- Management Zone 1 available shares is **12 GL**
- Hume only need **2·059GL** (or 2·336 GL for 90$^{th\%ile}$)
- Hume already have **1·909 GL (93%)**

LTAAEL is the annual allowable extraction (sustainable yield

- The Sydney Basin Nepean Groundwater Source is under allocated
- Additional shares are made available each year in the water source within Zone 2 (which is approximately 3km from the mine boundary)

Groundwater Licensing



DPE comment : DPE have residual concerns about Hume securing the outstanding groundwater licence volume

Hume have already secured 1·909GL

- This is 93% of peak
- This covers all but the 3 peaks years of mining (ie yrs 16, 17 and 18)
- Licences were easily secured within 12 months
- Currently have additional options on the table
- Projects can be approved without 100% of peak requirement
- DPE advised Hume to secure 'a majority' of required licence volume with a pathway for remaining (Hume conclude this requirement has been met)

Hume conservative approach to licensing

- Total inflow to workings is licensed
  - Water extracted (to sump) **PLUS**
  - **Water inflow to sealed voids (to void) - NOTE this 'to void' water is into mined downdip panels and is never removed from the water source**
- Peak annual water extracted (to sump) is less than **1GL (year 17)**

Economics

Economics

Original EIS assessment by BAEconomics based on forecast prices at the bottom of the cycle:

- NPV_7 to:
  - NSW (direct) of $295 million; plus
  - NSW (indirect) of $73-76 million
  - Local area (direct) of $84 million; plus
  - Local area (indirect) of $44 million
  - Total external costs of $21 million

Economics

October 2018 revised assessment based on latest Federal Office of Chief Economist forecast prices plus updated 2018 mining costs

- NPV_7 to:
  - NSW (direct) of $373 million
  - NSW (indirect) of $119-149 million
  - Local area (direct) of $107 million
  - Local area (indirect) of $54 million
  - Total external costs of $2 million*

Key DP&E Issues- Economics

"The applicant's net estimated economics benefits of $373million is relatively low in comparison to many other coal mining projects in the southern coalfields and across NSW"

"the Applicant's intention to export coal [is] likely to reduce economic benefits to the state"

"the Department does not consider that there is any existing shortage in coking or thermal coal that needs to be filled"… "the state of NSW produces up to 175 million tonnes of thermal coal per year"

Response to DP&E- Economics

DP&E Issue/Assertion	Response
NSW Treasury guidelines "make it clear that … labour should be considered as a cost rather than a benefit"	False. The NSW Treasury guidelines state that "the cost of labour is its opportunity cost" (excerpt below): **Labour** **The cost of labour in a CBA is its opportunity cost, which is the reservation wage** – i.e. the lowest wage rate that a worker would be willing to accept for doing a particular job. This is not the same as saying that labour should be treated as a cost rather than a benefit. This means that NET benefits should be counted by subtracting the opportunity cost, consistent with the general approach of CBAs to present only NET benefits. This is completely consistent with the approach taken by BAEconomics

Response to DP&E- Economics

DP&E Issue/Assertion	Response
"the Applicant's intention to export coal [is] likely to reduce economic benefits to the state"	It is false to suggest that exporting coal could reduce the economic benefits to NSW, compared to the net benefits assessed in Hume Coal's EIS and RTS. The economic analysis has been undertaken under the assumption that the coal is exported. The stated benefits are therefore entirely consistent with the intention to export coal.

Response to DP&E- Economics

DP&E Issue/Assertion	Response
Residual uncertainties could "substantially reduce the economic case" for the project.	False. DP&E fail to consider several areas of potential considerable up-side (particularly price and volume). These are likely to more than offset any potential residual uncertainties. Furthermore, sterilisation of coal due to geological structure has already been allowed for in the mine's production schedule and economic model. Coal sterilisation due to geological structure acts to shorten the mine life, not reduce annual production volume as assumed by DP&E, thereby limiting its NPV impact. There are no residual uncertainties that could act individually or in combination to materially reduce the net economic benefits.

Response to DP&E- Economics

DP&E Issue/Assertion	Response
Assertion: "the Department does not consider that there is any existing shortage in coking or thermal coal that needs to be filled"… "the state of NSW produces up to 175 million tonnes of thermal coal per year"	**Response:** The "state of NSW" does not produce any thermal coal. Private enterprise does, and sells it on the free market. The NSW Government has no place dictating production volumes in a market economy.

Response to DP&E- Economics

DP&E Issue/Assertion	Evidence		
Assertion: "Even the Applicant's estimated net economic benefits of $373 million is relatively low in comparison to many other coal mining projects in the Southern Coalfield and across NSW". **Response:** False. Analysis of a range of other projects recently assessed by DP&E shows that the estimated net economic benefits of $373 million are quite high compared to other coal mining projects.	**Mine**	**Net direct benefits (A$M)**	**DP&E Comments**
	Hume	$373 million	"relatively low" economic benefits
	Mine A	$200 million	"major" economic benefits
	Mine b	$311 million	"extensive" benefits
	Mine C	$125 million	"significant" economic benefits
	Mine D	$23 million*	"significant" economic benefits
	Mine E	$57 million*	"significant" economic benefits
	Mine F	$436 million	"The Department is satisfied"

**Gross royalties, not net economic benefits. CBAs not completed*

Local Economic Benefits

- **400** full-time-equivalent jobs during construction
- **300** full-time-equivalent jobs during operations
- **60** flow on jobs during life of mine
- Over 600 businesses & individuals have registered expressions of interest to work with Hume Coal
- **$9,000** in discounted net direct and indirect benefits per household to the Southern Highlands region over the life of the mine

Statistical Area (SA3 level)	Median total employee income (2015-16)
Southern Highlands	$44,250
Wollondilly	$52,092
Goulburn-Mulwaree	$46,597