In a letter dated April 1st 2019 to the DPE, IPC Panel Chair Professor Chris Fell requested additional information in regard to the Hume Coal mine design, referencing both its safety and water drawdown issues.

Additionally, the letter of April 12th 2019 by Mr. Derek White to the Independent Planning Commission NSW regarding the Hume Coal and Berrima Rail Projects' EIS and Response to Submissions raises pragmatic issues which were not disclosed or included in these documents prepared by Hume Coal and EMM consultants.
Hume Coal's EIS was on display for three months to allow for public discussion of both EMM consultants' and other Hume Coal consultants' statements upon the proposed coal mine.
Mr White has expertly identified that neither Hume Coal nor the EMM consultants have adequately addressed the critical issues he puts to the Independent Planning Commission.

Lending weight to the stated letter, The Scientific Symposium of Water Hydrologists' Management Committee and The International Association of Scientific Hydrologists agree with Mr White's concerns over the Hume Coal proposal. Notables from these organisations (Dr Ian Acworth, Dr Boydt Dent, Dr Derek Eames, Dr Jersy Jankowski, Dr Colin Mackie, Dr Rob Mclaughlan, Dr Ian Wright, Dr Wendy Timms) as well as consultants Dan McCubbin and Ian Woodley, brought up similar issues in their symposium paper 2009-2011 prepared for the CSIRO and Sydney Water. This paper explored impacts of coal and mineral mining upon Sydney drinking water quality.

An outline of these potential concerns follows:

(a) Negative impacts of coal tailing waste on aquifer water – pollution of Sydney drinking water

(b) Backfilling of empty coal voids and negative impacts on groundwater and land subsidence due to the overburden.

(c) That the distance multiple pipelines on backfilling coal voids travelling 10 kilometres or more will cause a high probability ratio of hazard breakage of pipelines. In Hume Coal's case, 46 square kilometres is the minimum travel distance - a combination of 12ks of pipeline.

(d) Spacial management of emplacement rejects within the coal mine and upon the coal mine site and their negative impacts on land subsidence, groundwater and the local environment.

(e) Chemical rejects placed underground, with toxic impacts – this will be the first mine in Australia where 100% of rejects will go underground into empty coal voids. 70 million tons of backfill and rejects are needed to backfill all empty coal voids to replace the 70 million tons of coal removed.
EMM consultants state that the Helensberg mine north of Wollongong is an excellent example of successful underground backfilling works with mine waste rejects, as stated within their letter dated 19 April 2019. This is misleading as it's not supported by Evidence of the same mining model as pine feather (Helensburgh is a long wall coal mine),

nor is this mine a prime example of safe practice – it has in fact a history of mining issues since its inception, with 37 fatalities to date. Additionally, on March 27th 2019 management closed the mine, all workers evacuated due to extreme levels of carbon dioxide and methane gas escaping from toxic reject waste causing possibilities of explosions within the mine.

The Hume Coal mine will have over one thousand empty coal voids to be filled 100 metres underground, all are exposed to toxic water and methane gas.

The potential for connecting mine explosions occurring on a scale so much greater than the Helensburgh mine and other long wall mines worldwide is of high probability. In that the 1,000 empty coal voids from pine feather mining are all interconnected sharing the same geophysical conditions and gaseous environment.

(f) Time emplacement of rejects causing air pollution and water impacts. EMM references coal mine locations where forward emplacement of coal rejects will occur but neglects to give site names, site times rejects will be placed and emplacement processes in use. What is to cover the emplacements in high wind occurrences?

EMM access data used as evidence for their statements cannot be substantiated with empiric evidence - they can only be assumptions which mislead the Independent Planning Commission and the public.

(g) EMM and Hume Coal have not addressed system failures associated potentially with mining computerisation and software data used in the mining process.

EMM and Hume Coal have indicated there would be fewer coal mine workers required with the pine feather method as the coal mining process is mostly automated. (They state there would be more than 300 mining jobs, but these figures contradict their own facts that the pine feather mining process uses less labour - which admittedly could be seen as misleading in the overall argument of jobs creation.)

It still however exposes all and any mining personnel to hazards associated with remote control system failures.

To illustrate these automated mining processes and their associated dangers, I cite the proposed Polaris AHTM drilling rigs, the automated conveyors for coal movements underground, and the machinery for pipeline pumping of toxic slurry into empty coal voids.

Breakages occur regularly due to coal load weights and pressure ratios of slurry content, causing work safety issues. Drilling rigs with high-speed density tungsten carbide cutting blades are also potential explosive ignitors within methane gas enclosed environments and require constant cold water cooling.

EMM and Hume Coal clearly state in all documentation within the EIS and the EMM letter, that all machinery will be computer controlled remotely. If this is the modus of work operations, then this untried high-risk coal project must have requisite work practices in place.

Quality assurance codes of 1S09000 must become obligatory before any consideration of the Hume coal proposal can be explored by the Independent Planning Commission.

This was the considered conclusion reached by the State Government and Department of Planning and Environment when it refused approval of this Hume coal mine proposal.

Hume Coal and EMM cannot adhere to safety and work regulations without requisite safety back up to computerized systems on site. This is essential within coal Voids where human workers, not robots, breathe and work. Because when automated computerisation fails, ventilation fails, and workers are at risk of toxic methane mine gas – this becomes a hazardous work environment. OH&S issues arise There is no independent data supporting OH&S issues in the EIS or EMM letter. The building industry this last month lost a 17-year-old building worker when scaffolding fell upon the person. The CFMEU want independent OH&S inspections.

(h) Surface, underground and aquifer water impact from the mine has not been addressed in the Hume EMM letter. Derek White refers to the use of water from coal voids and how this is proposed to be accessed once bulkheads are in place.
Dr Fell sees the incumbent, Hume Coal has a binding imperative and mandatory obligation to discuss this process of water storage in coal voids and also how much water would be used in filling coal voids once mixed with the toxic backfill of fly ash, river sand, lime, coal waste chemicals and or cement.
Without access to water in coal voids, high Co2 and methane gas levels can ignite, making combustible atmospheres highly probable in the Hume Coal mine.
EMM state in their letter that water will not be needed within coal voids in their pine feather mining process. Yet in all longwall coal mining worldwide water access is critically important and seen as vital for damping coal seam walls and keeping all machinery cool. Once again EMM is unclear in their water process, as pointed out by Mr White.

(i) The water symposium has identified fractures in the Hawkesbury sandstone membrane. Acid leakage from coal mine slurry will therefore pour into the pristine Sydney drinking water aquifer. What are the chemical toxin impacts? Once again this is not disclosed or addressed by EMM or the Hume coals EIS.

(j) Water is proposed to be extracted from 300 bores. Drawdowns to underground coal voids would lead to the toxic diffusion of chemical rejects into drinking water.
Backfilled coal voids are noted by EMM in China and described by Chang et al., Xu Xuan and He Xuan, Jialin and Zhu Zhang et al, and Yang et al in 2014. They all noted that cement, fly ash, and granular material are used as a backfill with a mix of water producing a paste to backfill these Chinese mines.
However, the several mines quoted are longwall mines with a horizontal distance of less than two or three kilometres. Many have above ground Tailing Dams for toxic waste not underground waste going into in empty coal voids.
The Hume coal mine is a pine feather mining process and has 1000 x 100-metre underground coal mine voids with hundreds being 90-degree vertical coal voids requiring paste backfill.
The complexity of filling 46 square kilometres made up of 1,000 empty coal voids is an entirely different proposition to one single wall tunnel of a Chinese longwall mine. Cement as a back-filling product also suffers from toxic acid rot and its porosity becomes elevated with time.

(k) Mr White’s mining expertise suggests that EMM should be recommending the construction of tailings waste dams for toxic waste and best practice process for system failure.
All mines in Australia and the United States have waste tailing dams that can be monitored, tested, filtered, and come under the control of a regulatory government body, the EPA and or local council inspection in Australia.
Hume Coal will have no regulatory or statutory processes in place for the treatment of toxic coal waste tailings (estimated at over two million tons) which are exposed to our pristine water aquifers, and no inspection reports or remediation reporting once coal voids are filled.
What government regulatory authority is going to inspect and test the security of bulk-headed coal voids 100 meters underground from toxic leakage?
EMM and Hume Coal have rejected Mr Derek White’s expert advice, gained over 40 years as a mining engineer, as well as the all-important concerns made within submissions in response to the Hume Coal EIS by the Coal Free Southern Highlands and Battle for Berrima organisations. These entities are striving to retain clean water for the five million residents of Sydney. The hazards associated with pumping tailings waste into coal voids is a prime example of lack of best practice from Hume Coal and when such a dangerous process occurs, failures result. Non-disclosure of available corresponding data for tailing waste dams for coal mines, workers' safety OH&S and the public interest by EMM and Hume Coal is not in keeping with Australian standards. EMM, however, state in their letter dated April 19th, 2019 that tailing waste dams are not necessary for the Hume coal mine.

(l) Mr White's concerns were commensurate with that of the scientists and water hydrologists within the International and Australian Symposium.
Consensus data researched and proven in 2011 by the above academic hydrologists and in field scientists including Dr Ian Wright states that there is a definite interconnection between the Hawkesbury sandstone membrane fractures, groundwater, and aquifer and surface water. All three sources of water as well as the sandstone membrane fractures will be impacted below and above ground by the Hume Coal mining operations. Dr Wright found evidence of this at Medway in the Southern Highlands resulting from the Boral mine and the Lithgow Clarence colliery in the Blue Mountains National Park. Coal waste toxins mix with all water sources, when sandstone membranes have fractures in them this will increase the viscosity and porosity of water and the toxin chemical mix.

(m) The mine will impact 300 private bores and drop water levels below three metres, and further due to drought and climate change, according to the Pell Consulting Group who researched the mining proposal for Coal Free Southern Highlands in 2015/2016.

(n) This reduction in underground water may reach one hundred times this depth over 200 square kilometres. (Pells Consulting Group).

(o) Sydney's future drinking water is in the Southern Highland’s aquifers, and the Scientific Symposium of Hydrologists have evidenced this hydrology data. There is no hydrology data or evaporation data of water use in the Hume Coal EIS or EMM letter.

(p) The Botany Bay desalination plant will only produce 15 % of Sydney's drinking water. Warragamba Nepean Dam is down to 50 % and will reduce with future climate change. Sydney and Australian townships are running out of available water, and the Government buy-back position will not resolve the Murray Darling water issue. The Southern Highlands aquifer water can produce 100 % of Sydney's drinking water, a vital necessitous resource which cannot be ignored by the IPC and the Public interest .Should we want clean drinkable water as we know it today we must regulate, protect and save our water to preserve it for future generations.

(q) Modern society needs to interface sustainably with the natural environment, if it is to survive. We need to be exponents and protagonists of science, allowing empiric and documented evidence to inform our best practices. To ignore the science is to invite potential environmental and ecological disasters which will be irreversible.

The coal mining lobby, however, endeavors to align humanity principally with its immediate economy, refusing to acknowledge the environmental perils of continuing to rely upon fossil fuels as an energy source. It disparages alternative sources such as renewables, uses scare mongering rhetoric threatening that our lights will go out should we not use coal as the primary source of energy production.

Having Melissa Price and Scott Morrison sign approval to the Adani coal mine plus a significant Australian uranium mine near Kalgoorlie to a Canadian company will not keep Australian lights on.

Though uranium produces cleaner electricity and will reduce Co2 emission with more reliability, both Russia and Japan have had their disasters with this atomic material. The department of industry and water with the Independent planning commission recognize sensible and visionary policy for future energy production in Australia – a strictly determined coal fired transition period (from existing mines, not new ones), whilst funds and technology are simultaneously poured into the creation of clean energy production. The technology behind renewable energy is already here and will improve in the future in ways not yet envisaged. Moreover, corporate profit and jobs creation will exceed expectations new energy grids are not an automated, remote controlled Hume coal feather mine they require investment, production materials and man labour - a win for the economy and our environment.

Renewable energy is well on the way to establishing new grids for the future supply of electricity. Whyalla in South Australia and Broken Hill in NSW are leading the way in Australia. Most of the OECD countries as well as China and the USA realise the benefits of transition to clean energy. Three hundred billion dollars have been spent since 2016, and eight million jobs have been created with solar, wind, hydro, biomass and geothermal technologies in OECD countries, and these are just a few. Over the next ten years, this will quadruple in dollar investment - reference the Swedish bureau of science.

Coal mining with its hazards of burning fossil fuel is coming to an end of life. New and cheaper technologies are rapidly being developed. Electric cars and electric buses will become prevalent by 2021 and electricity storage in high capacity battery technology will provide complete household electricity.

Steelmaking is now employing new processes to manufacture from recycled steel, using less raw materials, a more significant and economical method of production

preserving the minerals of the earth most large mining/engineering companies are acknowledging this transition moving into the largest recycling plants in the world.
E-Waste mining and recycle mining is the new E mining technology. Here are some of the largest mining companies who see E-mining technology as surpassing any other method of excavation mineral mining now and in the future.
Vandanta Resources, Newmont Gold corp, Freeport Mc Morrow, Barrick Gold, Anglo American PLC, Rio Tinto, Coal India, Glencore, BHP, Whitehaven, ale, Cloud Peak Energy, Blackham resources Limited, Oklo resources Limited, Northern minerals Limited.
Due to the fact that the mineral products are already unearthed, manmade and exist without re manufacture of new metals and or new resources.
Such minerals as Gold, Copper, Zinc, Lithium, Nickle, Platinum, Iron, Bauxite, Uranium, oil is all produced.
As E-metals transportation by shipping, rail and motor vehicle is far more efficient, faster, cheaper and value added. It is 60 % cheaper in dollar terms to produce E-Factories producing metals and minerals.
As it requires less labour, less machinery, less minerals and less land clearing sites.
E-Mining is the Future Environment for the production minerals and goods.
(Professor Veena Sahajurallas The Urban Mine University NSW Sydney and Beijing's Tsinghua University and Macquarie University Sydney joint venture into E-mining and Suez UK and Rec-Eol) new jobs new revenues.
Our water is needed for new E-technology digital hydropower, a future technology currently used in Sweden, Demark and Israel uses water for electricity production - Renewable and with no pollution or toxic chemicals. Israel has the largest hydropower/desalination plants in the western OECD world and irrigates millions of acres of dry land for food production. Australia must follow suit and not continue to destroy its natural water resources with coal mining toxins.
If we do not do this, it is highly probable that we will import foodstuffs in the future from countries like Israel. If we continue to lose our water to coal mining, it can never be replaced.
Should climate change therefore continue in the path it is moving in today? Judge Preston's recent verdict recognises this issue and was evidenced by his decision on the Rocky Hill coal mine not to proceed.
Ultimately, a progressive society is one that allows freedom of dialogue and discussion. The Australian sense of Fair Go understands that, and our unique sense of humour gives perspective to life's issues. As Paul Hogan once demonstrated – there's more than one way to sizzle a prawn on the Barbie.
It logically follows then, that there's more than one way to produce energy.

(r) Mr Derek White, with 40 years of experience as a mining engineer with experience in the Mount Isa Qld and Cobar NSW coal mines, acknowledges that 20 years of coal excavation at 3.5 million tons per year, producing 70 million tons of coal over the Hume Coal mine's life and with 3% of this amount being toxic chemical rejects totaling 2.1 million tons of sulphuric acid, pirates, cadmium, methane gas, tin, lead, mercury, methyl mercury, nitrates vanadium, thorium and strontium, is environmentally and socially detrimental it will vandalize the future E-mining strategies and mineral production strategies .

This ultimate reality is not an unprovoked conspiracy theory of denial by the public interest or environmental groups to stop the Hume Coal mine, but a scientifically based fact of indisputably documented and endorsed science.
Academic scientific thought from the for mentioned scientists above undeniably support the co-relation of this evidence on inadequate coal mining procedures poisoning our pristine water.

(s) Derek White raised concerns associated with the emplacement of reject toxic material waste within bulkheads requiring the use of a D bulldozer to ensure that empty coal voids are adequately filled and bulk headed permanently.
This operational work engages hazardous work and safety issues previously mentioned and disastrous environmental consequences to the mine itself and its workers.
The backfill process implemented by Hume coal will consist of a slurry paste made up of unique materials of fly ash, limestone, clay, soil, river sand or limestone additives to neutralise and cement, using megatons of water in the process.
Paste slurry cannot be bulldozed with safety and effectiveness because of its plasticity and viscosity; slurry fill needs to be contained and solidified in order to move it, and this detailed process is not disclosed by EMM in their letter nor in the Hume coal EIS.

(t) Pipeline pumping operations to fill empty coal voids would be the only method available; however, this has hazards of its own within procedure.
Principally, the paste slurry backfilling of pine feather coal mining has never been tried or tested before in Australia. Coal mines elsewhere in the world and China, have collapsed with land subsidence having thousands of people displaced by longwall coal mining.
The vertical uphill 90 degrees pipeline pumping into 1000 cross gridded coal voids is a complicated and expensive procedure requiring a pumping plant to be constructed independently of the coal extraction machinery plant.
Is it reasonable to ask, where will this pumping plant be built on the coal site? It will require a new DA and EIS on the impacts of plants negligence, wear and tear, pumping failures, pipeline fractures and pipeline dis – jointing. These issues need regulatory clearance before any work procedure can be endorsed.

(u) It will also use megacities of diesel fuel, requiring on-site storage and pumping and mega quantities of electricity to pump exhaustive paste backfill quantities over vast distances via pipelines joined together into coal voids 46 square kilometres in the distance.

(v) Lightening/Electricity procedures becomes imperative and computerisation and remote-control censoring does not work with Diesel fuel. So, then the requirement for electricity power is indisputably a prerequisite for the mining operations. Should failures result and thinking the situation out, should be documented and presented to the IPC and public interest up front in documents and dialogue.

(w) The false assumption that states we can present work procedures without thinking the process out and fix as we go, because we do not think we have a problem is a nonsense. Mr Derek White stated this a nonsense by Hume Coal in his letter and Professor Fell states why is the data not presented and clear is it rather being withheld.

(x) Non leakage of bulkheads will never be guaranteed as excess leakage of paste backfill from voids is highly probable; therefore, methane gas as one of the mixes of toxin gases in the backfill presents itself as a further explosive hazard since it predominates in open areas within voids, just as it did in the Helensberg longwall coal mine. Extreme levels of carbon monoxide, carbon dioxide and methane gases make for a highly flammable explosive environment within the mine.
EMM has not addressed appropriate safety procedures in the probable event of this happening within the Hume coal mine.
EMM state that there would be a requirement to recover drill rigs in the event of a malfunction and that these rigs would be recovered by remote technological control units, without requiring mine workers into the voids while backfilling is taking place. This is not the case, however.
This is an admission that safety issues OH&S do exist for mine workers, even if not acknowledged. Recovery straps to the mining rigs are susceptible to breakage with wear and tear, and do, in all probability require human intervention, so mine workers would have to be exposed to critical and unsafe situations within the mine rigs for a mining operation to continue.
The modification of the AHTM drill rigs by the manufacturer for Hume Coal's drill rigs have not been tested under coal feather mining conditions, and modifications to use umbilical hydraulic lines extending from the front of the drill rigs to the end of the coal void loses its credibility in work practice in that coal voids vary in length and diameter and will be all drilled at certain inward distances depending on the length of the coal seams.
So, the umbilical lines cannot be of standard length for all mining rigs. Hydraulic engineers will be required to enter coal voids to extend the hydraulic lines dependent on the length required for each coal void. Workers will not be in control of the drill rigs remotely, and as a result, they will be at the AHTM drill rigs at most times.OH&S.
Should a hydraulic hose snap at a coupling joint or tear on a main hose no remote repair is possible outside of the mine, a misleading argument. Hume coal and EMM fail to address such disasters.

(y) As our drinking water is of paramount importance, it is a vital resource for our survival. Drinking water for intergenerational need must be addressed under existing Australian Quality Assurance regulations and Government Environment Acts of Parliament.
Is it not unreasonable that the Independent Planning Commission will ensure that a coal mine development adheres to proper process to protect the health of its people and safety regulations for its workers with the appropriate facilities in place to allow the project to operate?
Mr White and Professor Fell have identified that the Hume coal EIS does not adequately address the management of underground rejects, moreover, they were not identified in the EIS that was on public exhibition in 2018 and to now to have EMM make statements outside the EIS timeframe is far too late in the fairness of the procedural process.
This should have been made available to the public on the exhibition of the EIS in 2018. The public interest could then have engaged in discussion and have had their findings acknowledged by the Department of Planning and environment and the State Government before they rejected the Hume coal Proposal, which we congratulate them on.

(z) Regarding Mr White's and Professor Fell's concerns of backfilling 70 million tons of empty coal voids with an associated 2.I million tons of highly toxic chemical rejects and water to be used the EMM and Hume coal have not addressed it.
Hume Coal's EIS, and EMM, have failed in procedure, and it was not on public display therefore, the clear conclusion can be, that the Hume Coal EIS is fundamentally misleading. Such critical imperative and necessity of data on toxic rejects, surface land subsidence, removal of coal producing overburden on 1000 redistribution coal voids should be addressed with environmental impacts within the EIS up front and this was not.
EMM has not addressed this to adequately respond to Mr White's question, which highlights the physical constraints on backfill preparation plants and the availability of seventy million tons of backfill from where is it coming from - which location? - Moreover, will these truck movements mentioned earlier not add havoc to existing traffic conditions and rail transport conditions of the local area?

(aa) A mining engineer would undoubtedly know that the flushing of paste slurry will not support the overburden in coal voids - overlaying rock will fall into the voids and crush any supporting infrastructure without roof structures or pillars - their breakage can proceed upwards as far as the surface, in this coal mine's case it would be 100 metres above ground, causing fragmented potholes vertically to the core and floor of the void. In the United States, Rock Springs, Wyoming, and many other American states have experienced this overburden crushing with slurry paste backfilling. 84 % of all land subsidence in the United States has occurred from backfilling of coal mining voids, and this has resulted in mammoth economic loss for state revenues with the differential movement of buildings settling inadequately, with pavements destroyed, highways cracked and overcrossing bridges collapsing. The similar situation has occurred in China. The Hume Coal 1000 coal voids are under the economic corridor of the Sydney, Canberra and Melbourne and the economical transport trading zone - The Hume Highway.
The Hume Highway, a piece of national infrastructure, is the main artery of the primary link. Should subsurface pipeline buckle due to land subsidence, it would affect transport, electricity infrastructure and financial trading zone of vehicle movements: the cost of repair ratios would be unattainable for any state government to control within overall monetary budgets. This could be a potentially disastrous impact of the Hume Coal Project coal proposal!

(bb) The backfilling proposed to be used by Hume coal in its mining process has fundamentally failed in the United States and China. The data on water availability and slurry ratios changes according to the location and timing of hard settling of the paste slurry however existing water boreholes will be drained by the backfilling process in the Posco mine due to the large quantity of water needed to form the backfill paste that fills the coal voids. Feather mining process uses twice the amount of water than longwall mining.
Tungsten Carbide tip blades must be continuously kept cool by cold water therefore, substantially more water is required with the pine feather automated method of mining than in longwall mining.
Rock Springs USA and surface structure damage declared by the Yaojie Mining Bureau of Gansu Province in China indicate that over 1000,000 ha of land subsidence situated in the provinces of Henan, Hebel and Shandong, Anhui and Jiangsu have occurred, and over

4,000 people are being moved from land subsidence destruction.
Moreover, for every 10,000 tons of coal excavated in the USA, people have to leave their home location.
These statistics have come from the Henan Polytechnic University in China, and the analytical data have been researched and presented by Dr Webing Guo, Dr Youfeng Zou and Dr Yixin Liu. All three of these men are associated with the department of mining and metallurgy within the University of Wollongong NSW.
Their research is within the current period of the Posco evaluation by the Independent Planning Commission - years 2015 to 2019. The same scenario is occurring in the United States. The Wollongong department of mining and metallurgy is noted as one of
Australia’s most recognized scholarships in mining as coal mines are predominantly in the southern districts.
The Geohot piston pump for paste slurry pipeline pumping used by EMM consultants for Humes coal proposal is based on figures and dates shown on page 3 of their letter, where they indicate the dates of 1986,1990,1997,1999. Pilarski reported tailings as backfill in Poland in 1883 and Germany goaf (paste) backfilling in 1924,1970 1983. Fly ash, with river sand or limestone as backfilling in Chinese and Polish mines, do not state the acid leaching of chemical toxins into the groundwater, the landscape, the surface water and in our case the pristine water aquifer of the Southern Highlands.
EMM tell only part of this compelling story - obligatory requisite data is indisputably required. Misleading the IPC and the public interest is no reason for non-disclosure of scientific fact.
They also do not mention the water drawdowns upon landowners' bores and its effects on commercial /agribusiness and the sociology of the Southern Highlands.
The data and statistics for EMM and Hume coal are out of date and are not within the current culture of today's technological advances in the coal mining industry.
EMM data does not apply references with validity as those stated by Derek White, the mining engineer. He indicated Hume Coal's 'blithey' statements within its EIS as a method of common practice was nonsense in his speech delivery on 26 February to the IPC at Moss Vale NSW. Although EMM concluded in their letter that they have answered the questions of Mr Derek white and the IPC .I think it is fair to say that Posco is out of date, uninformed and not a reliable role model as a Corporate Mining Citizen.
For EMM to tell the IPC and the Public interest that they will in the first stage place 500,000 tons of rejecting backfill on the coal mine site at this late stage of evaluation is belligerent. Derek White's expertise in mining, evidenced in his delivery on 26th of February at the IPC meeting at Moss Vale NSW, says he is more of an expert about backfilling/coal mining than anyone else currently associated with the Hume Coal Project coal proposal.
Why does Hume Coal/ EMM hold back the data from the Independent Planning Commission and the public interest? Data that they are surely well aware of and all importantly as professional mining consultants...

(cc) The IPC must act, following Mr Derek White's findings and dismiss the Hume Coal project. Insufficient data relating to the possible outcomes for the coal mine proposal as it would not operate within obligatory certified ISO9000 regulations would surely compel a negative approval; it is non-compliant. The State government has acknowledged this by not giving Hume coal the approval for their proposal.
The public interest, the State Government and Independent Planning Commission all have been denied procedural fairness in the evaluation of the Hume Coal proposal.
Quality assurance compliance on pine feather mining and
Inspection regulations on tailings waste and rejects need to be of paramount integrity for the evaluation of The Hume coal proposal.
The Hume Coal EIS does not address where the 70 million tons of coal void fill will come from nor does it say what the structure of the backfill will be. Fly ash, River sand, limestone, crushed stone, clay, Coal waste chemicals or just water. If this is the scenario, it needs to be brought into the coal site area by double axel loading trucks and at 12 tons per truckload that amounts to 5,833,3333.3 loadings of backfill and truck movements. How many remote robots will Posco employ to move and load these trucks as there are not enough hours in the working days to complete these truck movements over the life of the mine?

(dd) EMM state in their letter that 500,000 tons will be the initial stockpile of toxic rejects in the mine's initial life - where will this stockpile of waste be located is not shown in the EIS and how is this stockpile to be covered from high wind velocity polluting air over Southern Highlands Townships and the public health, it is not disclosed. How will Posco protect school children from health hazards associated with toxins form this this stockpile? To introduce this 500,000 tons stockpile at this late stage of the evaluation process is disingenuous to the evaluation process.
The coal site is not large enough to take such massive stockpiles nor house the necessary earth moving equipment to engage the work. The truck drivers required will have no sleep, a considerable OH&S risk and the cost of backfill should it be water, limestone or fly ash and electricity from electricity plants will be cost prohibitive. The current cost of poor quality fly ash or road base is sixty dollars a ton - multiply this by seventy million tons plus the cost of the trucks, loading excavators, electricity, diesel fuel and man labour, making this mine epigrammatically an uncommercial enterprise.
The transfer plant for the backfill operation is not built yet, and a cost has not been disclosed; it needs a separate DA and EIS to accommodate another development application.
To be facilitated to take such massive loads, and stockpiles that could not be accommodated without large quantities of heavy earth moving equipment and coverage tarps over stockpiles is unprecedented by any coal facility in the world. Derek White states that backfill will require tailing dams to accommodate the tailings in the first 18 months of operation - this has not been addressed in the Hume coal EIS, and there is no space for such a dam on the site.
Mr White also addresses the concern of pipelines slurry handling, knowing that paste fill will not travel more than ten km or more without failure. The area underground at 100 meters minimum is 46 square kilometres with 1000 empty coal voids in a grid-like feather design. 50% all vertical.

(ee) The movement of this backfill for 1,000 grid crossed empty coal voids 100 meters vertically underground is logistically impossible as there would be no space for movement on the external coal roads or internal coal roads to carry the backfill quantities on trucks in and out simultaneously.

With truckload movements and pipeline load movements fracturing, workers' safety is at high risk. The cautionary consideration of safety work repair procedure of a pipeline is uncontrollable within coal voids as a gas explosion, and toxic poisoning can occur anytime.

Breakdowns in pipelines increase gas exposure within coal cavities, and chemical contamination will occur inside and outside the coal voids on human work force. Helensburgh's 37 fatalities speak of this, as do worldwide fatalities in the thousands.

If pump piping is the proposed method of moving a paste liquid, it must be prepared in a Transfer mix Wash box before being pumped into coal voids. This Wash box and mix transfer is a technological plant that also requires a DA and EIS and the infrastructure to control safety and quantities of backfill material.

Moreover, the mega quantities of water to be used in the mix, where will the backfill and water come from? They are both not on site and this has never been done before in Australia.

Should backfill come in via rail there would not be enough time in a day to start filling coal voids nor space .Due to new coal being railed out filling coal rail carriages to Port Kembla Wollongong the DA proposing the new Berrima loop becomes non-usable should backfill operations of Hume coal intend to use it.

A new rail line would be required to support the workings of a backfilling rail line from the mix Transfer site. Where are the distance ratios accommodating a new rail line for the back filling work procedure, no evidence has been provided by Hume coal or EMM consultants .

For the proper backfilling operation to take place, a secondary DA and EIS are required for a Mix transfer plant and wash box for chemical exposure of tooling and machinery and should be submitted to the DP&E and the IPC in their report. This EIS must show the development of a loadable backfilling plant wash box and mixer for backfill slurry and storage backfill material with the necessary coverage of reject emplacements piles for the spacial landscape and air pollution guidelines. Seventy million tons of backfill should it be a mix of river sand, clay, fly ash coal rejects, or lime and water will incur a cost blowout on the viability of the mine, and a non-viability condition of coal operations for Hume coal will result in closure before its term, a disaster, subjecting the Southern Highlands to unprecedented sociological and economic impacts.

Risk management assessment on workers' safety and equipment with failures, especially in that pine feather mining procedures, require more equipment dominance than longwall coal mining is a reality.

Coal cutting and machinery compliances for feather mining with high-speed steel tungsten carbide blades require 50 % more cold water to cool down cutting machinery than conventional longwall coal mining. All sidewalls of the feather tunnels need to be dampened with extra water to keep the internal voids cooler than longwall mining.

No QA regulation is assuring the safety of workers in the Hume coal mining voids and mining facilities, including computer and software technology driving remote mining processes and systems There are no backup systems noted within the EIS as to what happens when machinery goes down, or software fails.

(ff) QA codes needed to be certified IS09000 series ISO31000, IS014001 and AS/NZS4804. The Hume Coal EIS does not comply with existing Australian Acts of Parliament. The Hume Coal proposal breaks the Water Trigger Act and The National Parks act of 2012.
The State Significant component of the proposal breaks all the regulations of the Biodiversity Act 2007 as the project is within 100 meters of a natural water source, a wildlife source; it encroaches on a national park environment, Crown land and vital ecosystems sources.
This Hume Coal mine is a designated development of the highest degree which requires an independent EIS and SIS by Hume Coal that includes all prevalent data associated with the mine this has not occurred therefore the state government and the department of planning and environment have rejected the Hume coal project.
The Independent Planning Commissioner should place all data received on public exhibition for discussion and dialogue by the relevant public interest groups showing the impacts of this coal proposal on the environment and Sydney's drinking water, and the methane gas imposition on conditions of climate change.
The Environment Protection and Biodiversity Act of 2007 have been disregarded.
Judge Preston who ruled on the Rocky Hill coal mine In Gloucester NSW was faced with the same questions raised by Mr White and Professor Fell and the Public interest on the Hume proposal. Judge Preston answered, and he decided to reject the Rocky Hill coal proposal.
Hume coal poses the same disastrous impacts on the Southern Highlands as that of Gloucester NSW and in fact, more so as it holds 100 % of Sydney's Future drinking water.
The hazardous waste act of 2000 has not been adhered to like two million tons of toxic waste produced by the coal mine would be placed into empty coal voids containing sulphuric acid, leaching into pristine Sydney drinking water. Mr White states no mine in Australia places all 100% of it toxic rejects underground.
The Water Act 2007 has also not been adhered to in order to cover the quantity of water licensed required for the Hume coal mine.
Over 50 % of licensed water for the mine will be used for a toxic paste backfill of 1000 coal voids, and large quantities of water would be lost to evaporation - if 40 % is lost to evaporation where does Hume coal intend to replace the lost water from?
No evaporation data is showing in the EIS - where or how the water is being used and where it will come from and how much will be lost to evaporation.
Surface and groundwater will not provide the required amount of water needed to mix seventy million tons of slurry back fill chemical toxic paste and remove seventy million tons of coal water licenses for Hume coal will most importantly be broken hence the draw down on hundreds of private water bores will result in the economic loss for agriculture, business and the local society. The devastation to the land surface is a critical undeniable notion of mass destruction of land use and requires urgent rejection of the Hume coal mine by the Independent Planning Commission.

Four thousand hectares in the Pilbara region have been declared critically threatened landscape due to water drawdowns of water by coal mining local vegetation is dying from acid rot. Menindee Lakes fish are dying from acid rot by the poisoned water, overuse of water licensed by agriculture and mining. The Shenhua Chinese group coal mine for the Liverpool plains is another great concern for landscape destruction and water spoilage .The Adani coal mine has been overtaken by the liberal ideology of Melissa Price favouring toxic water over clean underground water that has been supported by 60,000 years of intergenerational indigenous aboriginal people of Australia. If we keep recklessly polluting our water reserves, we will not have what our indigenous people have protected.

The Greenhouse Energy Standards Act of 2012 put there by our democratic governments to save our water for future energy will have no legal impact or meaning for the protection and production of electric hydro power should the Hume Coal Project be allowed to poison our water.

Regards
Danny Pullicin
12/05/2019

**INDEPENDENT PLANNING COMMISSION NSW DATE 6/05/2019**

**Level 3, 201 Elizabeth Street**

**SYDNEY NSW 2000.**

**Re SSD 7172 Hume Coal Project and SSD 7171 Berrima Rail Project –**

**Response to submission by Mr Derek White, mining engineer, to the Independent Planning Commission, and Hume Coal EIS and EMM consultants acting for Hume Coal/ Posco Corporation.**

**The document dated 6/05/2019 provides additional reporting and research data on the issues raised in the response to the project design:**

**Its capacity to follow procedural fairness in the DA and EIS procedure and adequacy of data supporting the DA and EIS, the management of coal chemical waste rejects and chemical waste water impacts and disposal, and the economics of the Hume Coal mine during the subsequent assessment phase on the project in 2019.**

**The document report to go to and include the following panel:**

**Professor Chris Fell AM, Professor Alice Clark, Professor Snow Barlow**

**Professor Richard Makay AM ,Professor Garry Willgoose,**

**Professor Zada Lipman**

**Professor Helen Lochhead and Mary O'Kane AC Chair.**

**George Gates, Ross Carter, Wendy Lewin, DR Ian Levering, Russel Miller AM**

**Ilona Millard Peter Williams, Steve O'Conner, Tony Precisen, Bret Whelan, Adrian Pilton, Dianne Leeson, Andrew Hutton, Gordon Kirkby,**

**Alan Coutts, Peter Cochrane, Catherine Herd, John Hann, Soo-Tee Cheong**

**Annalise Tuor and Geoff Sharrock**

**Assisting Panel: David Koppers and Brad James.**

TO NEW SOUTH WALES PARLIAMENTARY MINISTERS

Parliament House Macquarie street Sydney 2000.

DATED 6/05/2019

Re: The Hume Coal Project and the Berrima Rail Project - Southern Highlands NSW.

Response re: SSD 7172 Hume Coal Project & SSD 7171 Berrima Rail Project

Response to Submissions by Mr Derek White, mining engineer and

Professor Chris Fell AM, Panel Chair of Independent Planning Commission NSW

This project has not received the endorsement of the State Government and the Department of Planning and Environment, the basis being that the mine is not in the public interest.

The following document to be received by the following NSW Ministers online and hard copy:

The Premier of NSW Gladys Berejiklian

[redacted]

The deputy Premier of NSW John Barilo

Monaro@parliament house .nsw.gov.au

The Minister for Innovation and Better Regulation

Kevin Anderson

[redacted]

The Minister for Tourism and Investment

Stuart Ayres

[redacted]

The Farmers Party

Robert Borsak

[redacted]

[redacted]

**Greens Member**

**Abigail Boyd**

[redacted]

**Shadow Minister for Innovation and Better Regulation**

**Yasmin Cattey**

[redacted]

**The Greens Member**

[redacted]

**Secretary for the Environment**

**James Griffin**

[redacted]

**Member for the South Coast**

[redacted]

**Minister for Health**

**Brad hazard**

[redacted]

**Parliamentary Secretary for Agriculture**

**Michael Johnson**

[redacted]

**Minister for Energy and Environment**

**Matt Kean**

[redacted]

**Greens Member**

**Jenny Leong**

[redacted]

**The Minister for Water**

**Mr Oxley**

[redacted]

**Shadow Minister for Climate Change and Energy**

**Adam Searle**

[redacted]

**The Minister for Planning**

**Rob Stokes**

[redacted]

**Local member Goulburn NSW**

**Wendy Tuckerman**

[redacted]

**Secretary to the Premier Gladys Berejiklian**

**Gabrielle Upton**

[redacted]

**Shadow Minister Rural Affairs**

**Mick Veitch**

[redacted]

**Wingecarribee Councillors** **dated 6/05/2019**

**Wingecarribee Council Civic Centre 68 Elizabeth street Moss Vale**

**NSW 2577.**

**Re: SSD 7172 Hume Coal Project & SSD 7171 Berrima Rail Project**

**Response to submissions by Mr Derek White, Professor Fell (IPC Panel Chair), and EMM consultants for the Hume Coal Project .**

**The Mayor Clr Duncan Gair**

[redacted]

**Deputy Mayor Clr Gary Turland**

[redacted] **gov.au**

**Clr Grahame Andrews**

[redacted]

**Clr Ken Halstead**

[redacted]

**Clr Graham Mclaughlin**

[redacted]

**Clr Gordon Markwart**

[redacted]

**Clr Peter Nelson**

[redacted]

**Clr Ian Scandrett**

[redacted]

**Clr Larry Whipper**

[redacted]

**NSW Department Planning and Environment**

**320 Pitt street Sydney NSW 2000**

**GPO box 39 Sydney 2001 Planning Division~~division~~ .**

**Attention: Marcus Ray**

[redacted]

**Deputy Secretary Planning~~planning~~ Services**

**Attention: Stephen O'Donoghue**

**Assistant Director~~director~~ for Resources~~resources~~ and Energy Assessments~~energy assessments~~**

[redacted]

**Letter dated 24/04/2019**

**To the attention of:**

**Professor Mary O'Kane~~O'kane~~**

**Chair**

**Independent Planning Commission~~commission~~**

**Level 3, ~~,~~201 Elizabeth Street~~ELizabeth street~~**
**SYDNEY NSW 2000**

Ground floor, Suite 01, 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590

T 02 9493 9500
F 02 9493 9599
E info@emmconsulting.com.au

www.emmconsulting.com.au

12 April 2019

Independent Planning Commission NSW
Level 3, 201 Elizabeth Street
SYDNEY NSW 2000

**Re: SSD 7172 Hume Coal Project & SSD 7171 Berrima Rail Project – Response to submission by Mr Derek White**

# 1 Introduction

This submission seeks to clarify a number of technical aspects that have been raised by Mr Derek White during the IPC Public Hearing for the Hume Coal Project and Berrima Rail Project, and in two subsequent written submissions.

Most of the issues raised by Mr White are already addressed by information provided within the Hume Coal Project Environmental Impact Statement (EIS) and/or in the Hume Coal Response to Submissions Report (RTS). In addition to the EIS and RTS, this submission references additional reports which have been prepared by Hume Coal's technical experts, including Palaris (2019a), Palaris (2019b) and QPS (2019), to further explain the studies undertaken by Hume Coal during the project design and subsequent assessment phase.

# 2 Issues raised

## 2.1 Rejects Management

Mr White raises a number of concerns regarding Hume Coal's intention to use underground reject emplacement to dispose of coal washery wastes. These issues are summarised below along with a response from Hume Coal's technical experts.

*Mr White makes the statement that 'No mine in Australia places 100% of its rejects material underground as soon as it is produced'.*

Underground coal backfill pumping systems are in successful operation in many places, both in Australia and overseas. It is also noted that, as described in the EIS for the Hume Coal Project (EMM 2017), emplacement of rejects underground will not commence until 12-18 months after mining commences. This will allow sufficient time to effectively establish the underground emplacement system.

While backfill systems are not common in Australian coal mines, globally there are a large number of coal mines that pump 100 per cent of their waste products underground soon after they are produced. Pumping backfill into operating coal mines has been practiced all over the world in locations as diverse as Germany, Poland, USA and China. China, as the largest coal-producer in the world, has a large number of backfill applications.

An Australia based example of underground reject emplacement is the Metropolitan Coal Mine near Helensburgh in NSW. The placement of coal rejects in underground workings was successfully developed to pilot phase at the mine (Tarrant et al, 2012), and was expected to advance to full scale emplacement of all coal rejects underground. The main driver for the work was to reduce and eventually eliminate the number of coal reject trucks passing through Helensburgh. The intention was to further develop the technology to potentially reduce subsidence by emplacement behind the longwall face.

Underground emplacement into unused workings commenced at Metropolitan in May 2011. The range of pumping distances required was between 0.5 – 8 km. Subsequent testwork was conducted (Worsley et al 2015) using a 100 mm NB pipe loop connected to the backfill pilot plant. Coal rejects used for the demonstration were comprised of a typical mix of ultra-fine, fine and coarse particles ranging to ~15 mm with the percent solids and process water adjusted to a target range of 74-76% w/w. It is noted that at Metropolitan, pumping rejects into a goaf environment competes with a collapsed goaf, whereas at Hume Coal emplacement will be into open and downdip roadways.

Palarski (1994) reported that tailings have been used as backfill in Polish coal mines since 1893. In 1924, Germany developed a goaf filling method, and from 1970 the pneumatic goaf stowing method was widely used (Anon, 1988) and the filling rate reached 57% (Voss, 1983).

Mez and Schauenburg (1998) provide a detailed description of the backfilling of caved-in goafs with pastes at Walsum Colliery in Germany.

An improved goaf stowing method was developed in China in 1980 and by 2016 was used in more than 60 mines. As of Feb 2016, the mines utilising the goaf slurry backfill method included:

- Shandong Provence (38 coal mines including FeiCheng, Zaozhunag, Zhibi, Jining and Linyi)
- Heibei Provence (10 coal mines including Jizhing Energy Group and Feng Feng)
- Henan Provence (No. 12 coal mine in Ping Ding Shan area)
- Anshui Provence (Yang Zhuang)

There has been extensive research on this topic for a considerable period. For example, in 1990, Wollongong University awarded a PhD (Hii, 1990) on using coal washery refuse for underground strata control. Internationally, a large number of papers have been published on emplacing rejects slurry backfill into operating underground coal mines. The following is a very brief summary of some of the papers identified from a basic literature search.

- Chang et al (2014) gave a general overview of the implementation of paste backfill technology in Chinese coal mines, including the common practice of including fly ash in the mixture of crushed coarse, fines and tailings.
- Xu, Xuan and He (2014) reported that the Fengfeng, Jiaozuo, Zibo, Xinwen, Zaozhuang, Feicheng and other mining bureaus have applied the pumped backfill technique.
- Xuan, Jialin and Zhu (2013) gave a more detailed review of backfill mining practice in China coal mines, including providing the details of 11 mines disposing of coarse waste rock as backfill.
- Zhang et al (2019) gave considerable detail on the properties and application of backfill materials in coal mines in China, including 60 coal mines using either high water content or cemented backfill. The authors gave a number of case studies and noted that that the coal rejects are crushed finer than at least 20 mm.
- Yang et al (2015) investigated the influence of fly ash on the performance of high concentration cemented backfill material in coal mine. A concrete pump with a capacity of 80 $m^3$/hr, along with a general seamless steel pipe with an inner diameter of 150 mm, was used.

- Yang (2015) reported on the pumping characteristic of coal ash slurry in high concentration cemented backfilling. The frictional resistance loss for the conversion of unit length loss was 3.77 kPa/m.

- Basu (1997) completed a feasibility of hydraulic backfill pumping into a thin seam coal mine.

*Mr White stated that "Hume Coal will require a tailings dam to manage reject material in the event of a system failure". This is described by White as a 'safety net'.*

Chapter 2 of the Hume Coal Project EIS (Volume 1) (EMM 2017) provides a detailed project description of the proposal. Table 2.1 within Chapter 2 provides a project overview, and the following is an extract from the Coal Reject Management section of this table:

> "The Coarse and fine rejects from the CPP will be processed and then pumped underground to voids in the mine.
>
> Initially, while underground void space is being created, coal rejects will be stored in one or more temporary surface emplacements which, when full, will be top dressed and re-vegetated.
>
> There will also be an emergency reject stockpile near the CPP to allow coal processing to continue if there is an interruption to underground emplacement, such as during maintenance of the pumping plant."

As is evidence above, the Hume Coal Project design includes an emergency reject stockpile to manage reject material in the event of a system failure. A tailings dam, as claimed by Mr White, will not be required.

*Mr White questioned whether the fill can successfully be pumped for up to 10 km.*

The longest pump distance required for the Hume Coal Project will be about 12 km. There are numerous examples around the world of pastes and slurries being pumped long distances, and significantly over 10 km and in several examples in excess of 100 kms. For medium to long paste pumping distances, piston pumps are preferred (QPS 2019). Two companies dominate the medium to long distance paste pumping market (MW Wirth and Geho). Geho pumps have been included in the conceptual design of the underground emplacement system for Hume Coal.

Some examples of Geho installations for pipelines greater than 10 km long are shown in the table below. The number of examples indicate that pumping a high-density slurry as part of the Hume Coal Project is feasible.

### Table 2.1 Geoho piston pump >10 km long pipeline installations (QPS 2019)

| Location | Mine | Company | Application | Type | Length (km) | Year |
|---|---|---|---|---|---|---|
| Argentina | Alumbrera | Minera Alumbrera | Concentrate | copper | 310 | 1997 |
| Indonesia | Batu Hijau | Newmont | Concentrate | copper | 18 | 1999 |
| China | Da Shong | Kunming Iron and Steel | Slurry | Iron ore | 171 | 2007 |
| Indonesia | Grasberg | Freeport | Concentrate | copper | 120 | 2004 |
| India | Hy-GradePellets | | Slurry | iron ore | 268 | |
| China | Jianshan | | Slurry | Iron ore | 100 | |
| Chile | Los Pelambres | Minera Los Pelambres | Concentrate | Copper | 120 | 1996 |
| Brazil | Minas Rio | Anglo American | Slurry | Iron ore | 529 | 2014 |
| Chile | Collahuasi | Minera Dona Inés Collahuasi | Concentrate | copper | 203 | 1998 |
| NZ | Glenbrook | New Zealand Steel | Slurry | Iron sand | 18 | 1986 |
| Brazil | Paragominas | Mineracão Bauxita Paragominas | Slurry | Bauxite | 244 | 2007 |
| Brazil | Samarco | Vale | Slurry | Iron ore | 396 | 2008 |
| USA | Smoky Canyon | Simplot | Concentrate | Phosphate | 100 | 1990 |

*Mr White raised concerns that the pumping rejects material poses significant risk of pipe blockages or failures in the system creating safety hazards.*

It is acknowledged there is some risk of blockage occurring within the reject emplacement pipelines, particularly in the early stages as experience is gained with the piping system interactions and operational processes are refined. A robust instrumentation and control system will therefore be implemented.

If a pressure drop within the reject emplacement line is identified, then the pumping speed will be increased, the reject material slurry will be made more dilute or the feed will be isolated from the pipe experiencing pressure drop and water will be introduced. Production will continue if a blockage occurs via alternative (redundant) pipes.

The system to be used for the project has been designed with one piston pump per pipeline and an extra on-line backup pump and pipeline. In addition, there will be one surface recycle pipe per pipeline. The redundancy built into the system will require three pipelines to allow reticulation if and as required for delays or breakdowns, or placement on the surface emergency stockpile.

By measuring the flow rate, density, and pressure loss across and along the horizontal length of pipe, an indication of the backfill properties can be determined. This allows corrective measures to be implemented at the backfill plant or, if necessary, to take pre-emptive action to avoid a blockage of the distribution system.

The risk of pipe failure is controlled by 'factors of safety' in the piping specification. In sensitive areas the reject emplacement pipe will be encased for further protection in the case of rupture. The pipeline wall thickness will also be regularly measured.

*Mr White raised concerns that the pumping rejects material poses significant engineering and safety challenges associated with the emplacement of reject within the headings. This included potential for the placement of rejects to require the use of a bulldozer to ensure panels are adequately filled.*

In order to emplace the reject material underground, it is necessary to develop a method that will allow personnel to safely deliver reject material to the furthest point of each plunge created as part of the proposed mining method. This delivery method will have to be remotely operated as plunges will remain unsupported (ie no roof support devices such as roof bolts will be installed) and it is therefore not possible for personnel to enter these areas.

Hume Coal plan to utilise a modified air/hydraulic track mounted (AHTM) drill rig to carry out the process of reject emplacement (refer to Figure 2.1). An AHTM drill rig is a piece of machinery commonly used underground for the installation of rock bolts in the underground roadways. These machines comprise a track mounted drilling mast where all motors are driven by compressed air (rotational motor, feed motor and tram motor). The rotational and feed motors are used for drilling and installing the rock bolts whilst the tram motor drives the tracks which are used for manoeuvring the machine.

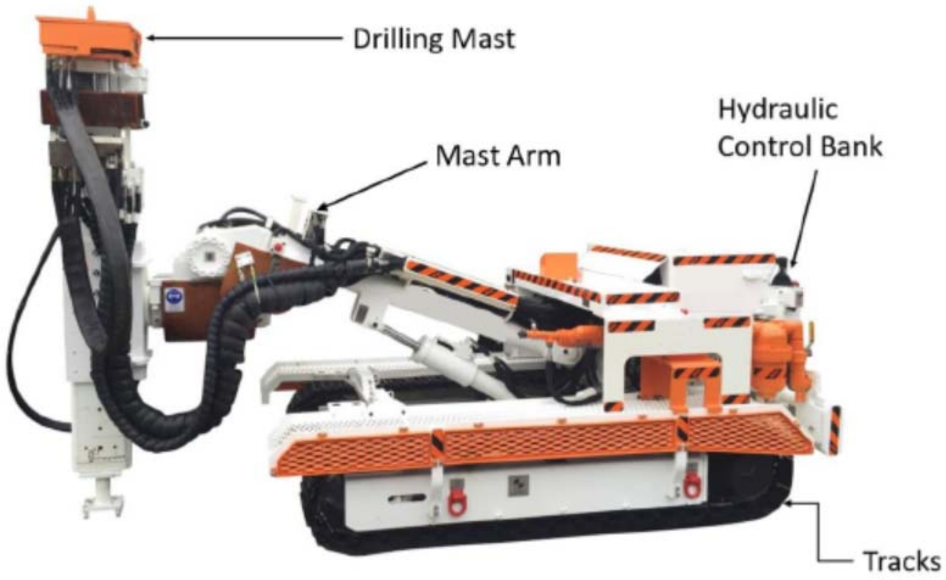


**Figure 2.1 Example of AHTM Drill Rig (Palaris 2019)**

Hume Coal will collaborate with the equipment manufacturer (OEM) to modify the AHTM rig in order to remove the drilling mast and replace it with a discharge nozzle that will mount onto the mast arm. This nozzle will be used as a discharge point to distribute and emplace the reject material. A discharge line of 90 mm internal diameter transporting the reject material would then be connected to the nozzle as a means of feeding the reject to the discharge point.

Additionally, Hume Coal will collaborate with the equipment manufacturer (OEM) to remove the hydraulic control bank that operates the tracks and mast from the body of the machine by the use of umbilical hydraulic lines extending from the rig to the entrance of each plunge. By doing this, the equipment operator will be able to activate all functions of the rig remotely.

A further requirement to be addressed will be the ability to recover the rig remotely in the event of an equipment malfunction when pumping in the plunges. As plunges are unsupported, a remote recovery device is mandatory to avoid personnel having to enter unsupported roof areas. This will be achieved by the use of a recovery strap attached to the AHTM rig and deployed as the AHTM rig enters each plunge. In the event of a breakdown, the strap can be attached to an underground tractor type machine (LHD) and recovered from the plunge so it can be repaired.

*Mr White stated that Hume Coal will be unable to extract water from sealed panels once filled with rejects.*

Hume Coal does not need or intend to extract water from sealed panels once filled with rejects.

In times of low rainfall, Hume can either extract water from sealed and unsealed downdip panels that do not have reject emplaced or can access water supply from bores nearby the mine. Hume hold almost 2 GL of groundwater shares in the Upper Nepean Zone 1 Management Zone, and only need to licence the maximum take in one year of mining, year 17. At year 17 there will be many panels without reject emplacement that are full of water that could be used for supply if required.

*Mr White provided commentary on a study conducted for the Tahmoor Coking Coal Project (Tahmoor), which evaluated options for disposal of coal reject material. Mr White drew comparison between the Hume Coal Project and Tahmoor. Specifically, Mr White highlighted that the Tahmoor study concluded that placement of 100% of rejects underground was not feasible due to physical constraints and the lack of availability of fill preparation plants.*

Backfill disposal at Tahmoor Coal was considered in an options study (Appendix U of the Tahmoor South Coal EIS (AECOM 2018) "*Rejects Disposal Study Report*").

For underground coal rejects emplacement, the use of additives was envisaged to improve the slurry rheology. No details were provided within the report on the modifier selected. The backfill produced had to be able to permeate through collapsed goaf and be resistant to re-fluidization. Both the options of pumping low density (30-50% solids w/w) and high-density slurry (75-85% solids w/w) were investigated. The addition of a paste thickening plant was required to thicken the tailings for the high-density pumping option.

Within the options report, a capital and operating Cost-Benefit Analysis (CBA) was provided. This CBA was used to assess the rejects disposal options and the continued surface emplacement at the mine was selected, primarily due to it being the lowest capital and operating cost option.

This reinforces the point that the main constraint to the use of underground emplacement in the Australian coal industry has been the higher cost. However, environmental considerations will lead to increasing use of the technology in Australia.

It also needs to be noted that the situation at Tahmoor Mine is different to Hume, in that Tahmoor is an operating, longwall mining operation. The mine has been operating for 40 years and was constructed without the infrastructure to enable underground emplacement. Further, there is limited void space available for underground emplacement in a longwall mine due to the caving in of overburden material following coal extraction (ie the goaf), as illustrated in Figure 2.2. This is different, and more challenging than Hume Coal's proposal, where roadways will remain intact and be able to accept the emplacement methodology.

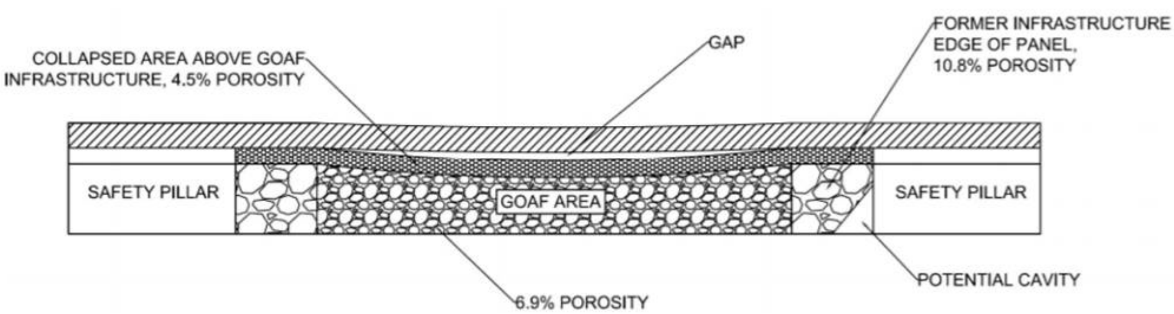


**Figure 2.2 Theoretical porosities in and along the goaf (AECOM 2018)**

## 2.2 EIS Adequacy

Mr White raises a number of concerns in both his presentation to the IPC Public Hearing and in his supplementary submission relating to the level of detail relating to rejects management that Hume Coal have provided within the EIS. These issues are summarised below along with a response from Hume Coal's technical experts.

*Mr White states that the management of rejects underground has not been adequately addressed in the EIS.*

The management of coal reject material is detailed in the following section of the EIS (EMM 2017):

- Section 2.8: Coal Washing and Progressing within Volume 1 of the EIS;
- Section 6.4: Rejects Emplacement within the Project Evolution and Alternatives chapter of Volume 1 of the EIS;
- Section 8.7.2: “Water Quality Effects of Co-disposed Reject” within Volume 4A of the EIS.

Further information was also provided within Chapter 10: Rejects Management of the RTS Report. This chapter included additional information on the method of rejects emplacement, the management of the temporary rejects stockpile and the interaction of rejects material with groundwater and surface waters.

In addition to the work undertake for the EIS (EMM 2017) and RTS (EMM 2018) reports, Hume Coal commissioned Palaris Australia to produce two reports that provide further detailed descriptions of the proposed reject emplacement process and schedule:

- Hume Coal Reject Emplacement Schedule (2019) and;
- Hume Coal Reject Emplacement Methodology (2019).

A summary of the key elements and findings of these reports are provided below.

As stated in the EIS (EMM 2017), rejects initially generated by the project from the first panel in the western area of the mine will be stored on the surface in the temporary surface reject stockpile. This will equate to approximately 500,000 tonnes of rejects. This reject will be scheduled for eventual underground delivery during the life of the project.

The indicative schedule of reject emplacement is shown in Figure 2.3. The first panel to be emplaced is circled in red.

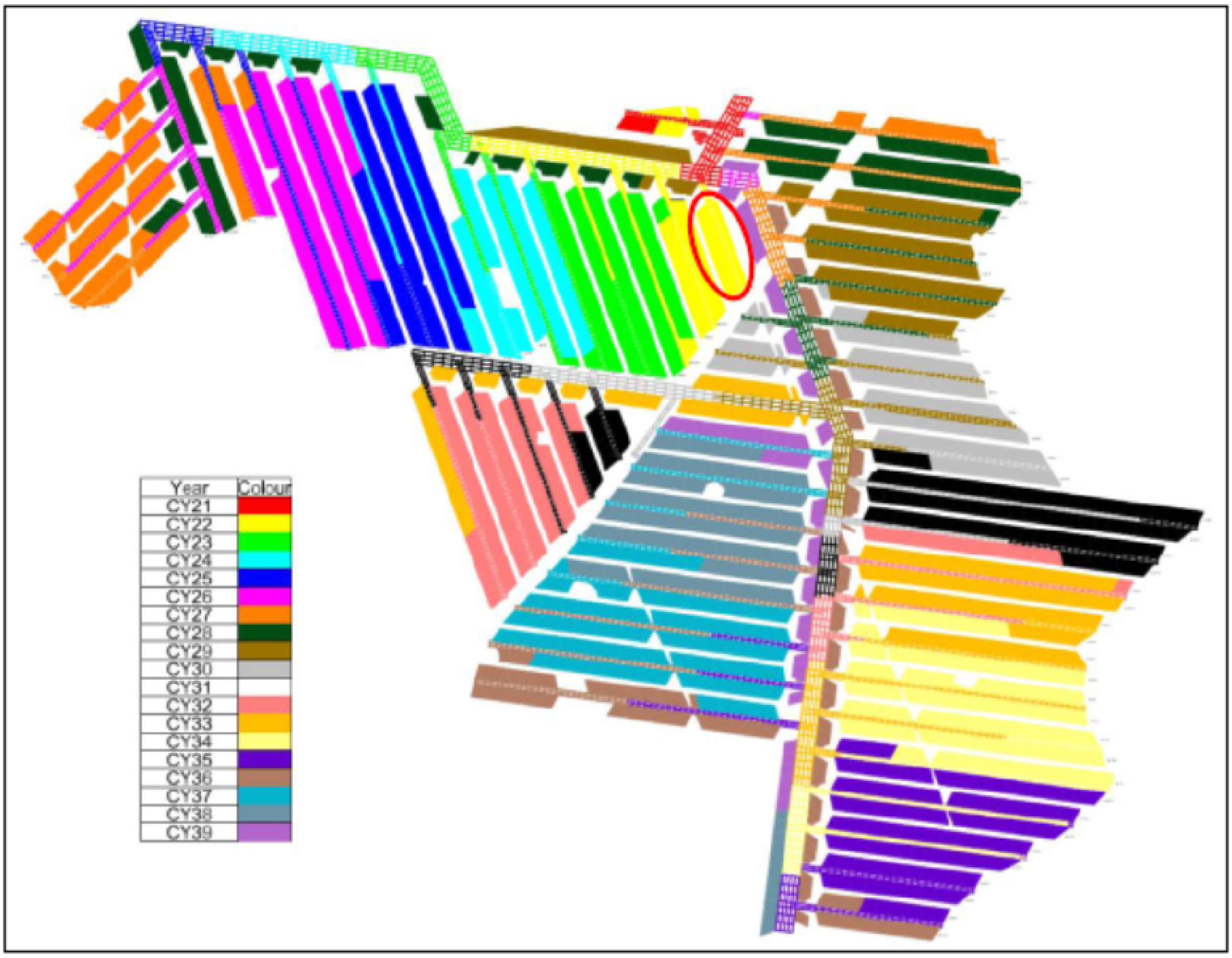


**Figure 2.3 Indicative rejects emplacement schedule**

This schedule was developed by Palaris using the Deswick mine planning software, which is a well-known mining simulation software package.

For the process to be continuous, it will be necessary to have multiple sites set up simultaneously within a panel. This will allow for one drill rig (refer Figure 2.1) to be mobilised and set up whilst at least two rigs are working (1 pumping and 1 backup). The process for reject emplacement is described below and illustrated in figures 2.4 to 2.11. This process is based on a typical panel found on the Eastern Domain of the mine where both sides of the gateroad can be filled.

The process is as follows:

i) Rig#1 is trammed to the end of the penultimate plunge of the web panel to 10m from the face (approximately 110m from the start of the plunge). This fill be site #1 as shown in Figure 2.4 below.

ii) Rig#2 is trammed to the end of the last plunge to 10m from the face. This will be site #2, a backup and then the active site once site #1 is filled.

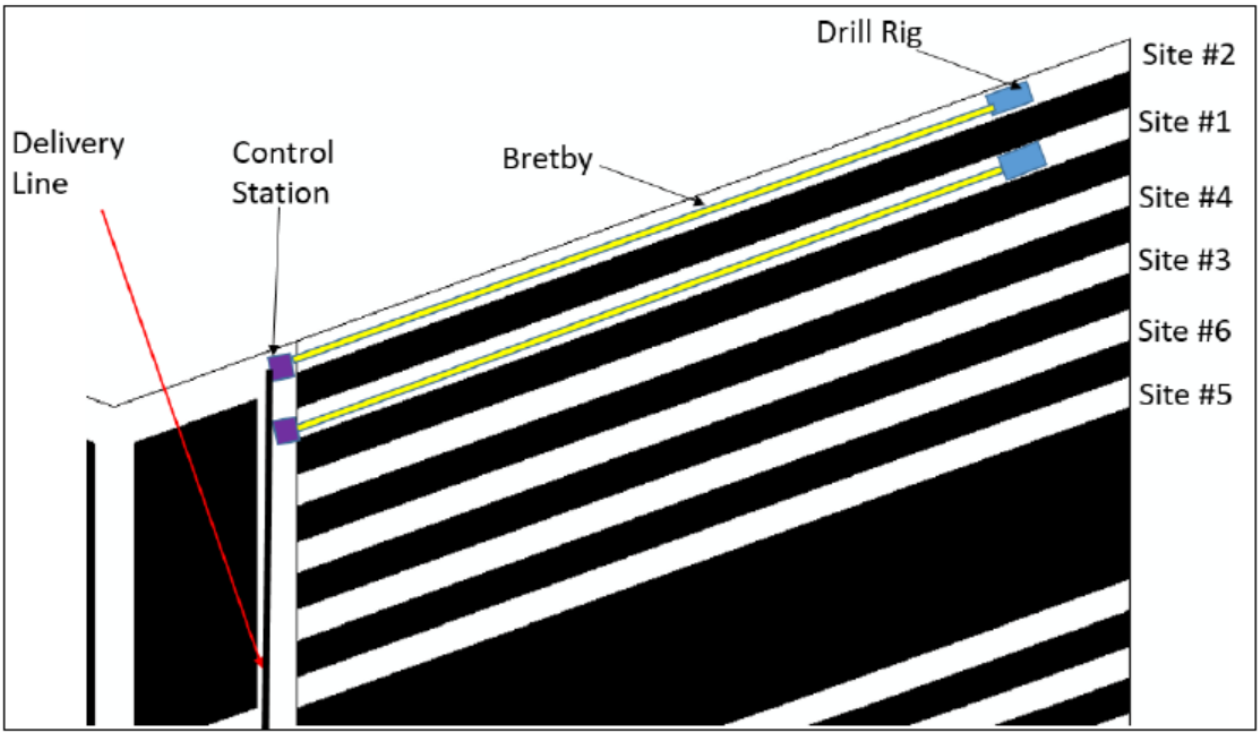


**Figure 2.4 Drill rig set up**

iii) A dumping line will need to be set up on the opposite side of the panel where Rig#3 is set up as shown in Figure 2.5 below.

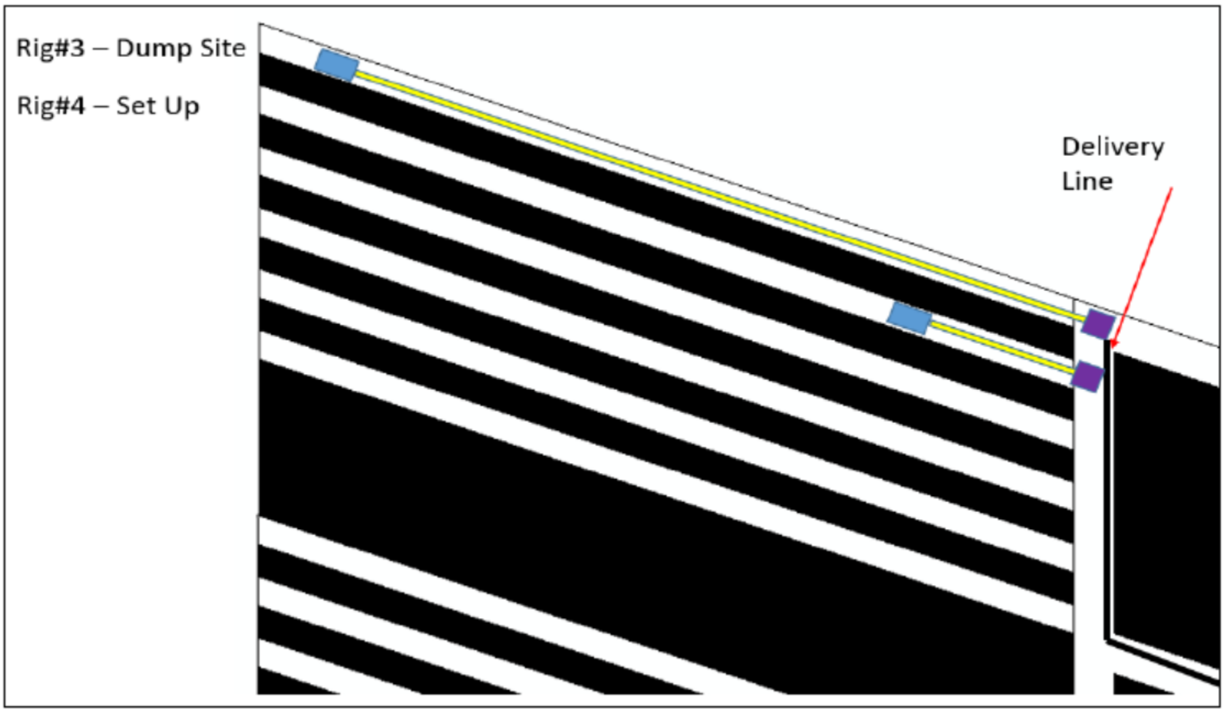


**Figure 2.5 Opposite side – Dump site and set up of next site**

iv) Rig#1 completes Pours 1 – 8 in Site #1 as it retracts out of the plunge (Figure 2.6).

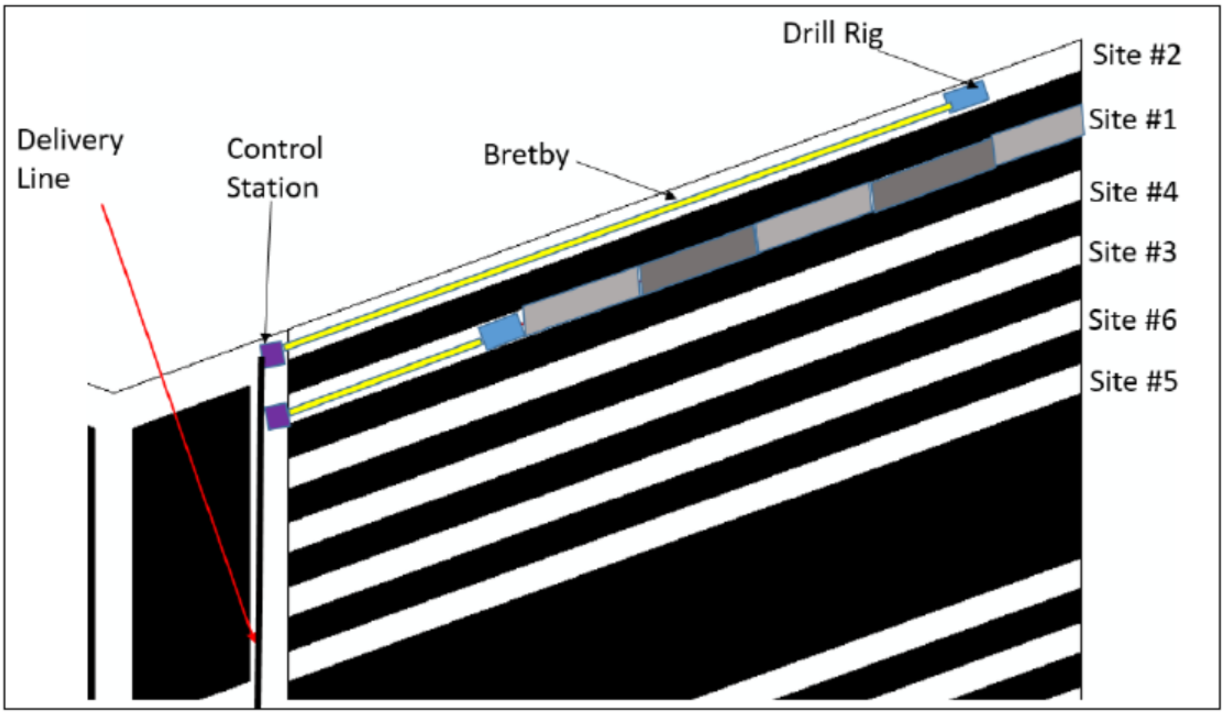


**Figure 2.6 Filling plunges**

v) Once the last pour is completed, the delivery line is switched to Rig #2 so it can start pumping as Rig #1 is set up in the following site (Figure 2.7). By this point in the process, 2 x rigs are set up on the opposite side of the panel, Rig#3 becomes the backup rig and Rig#4 will be the dumping site.

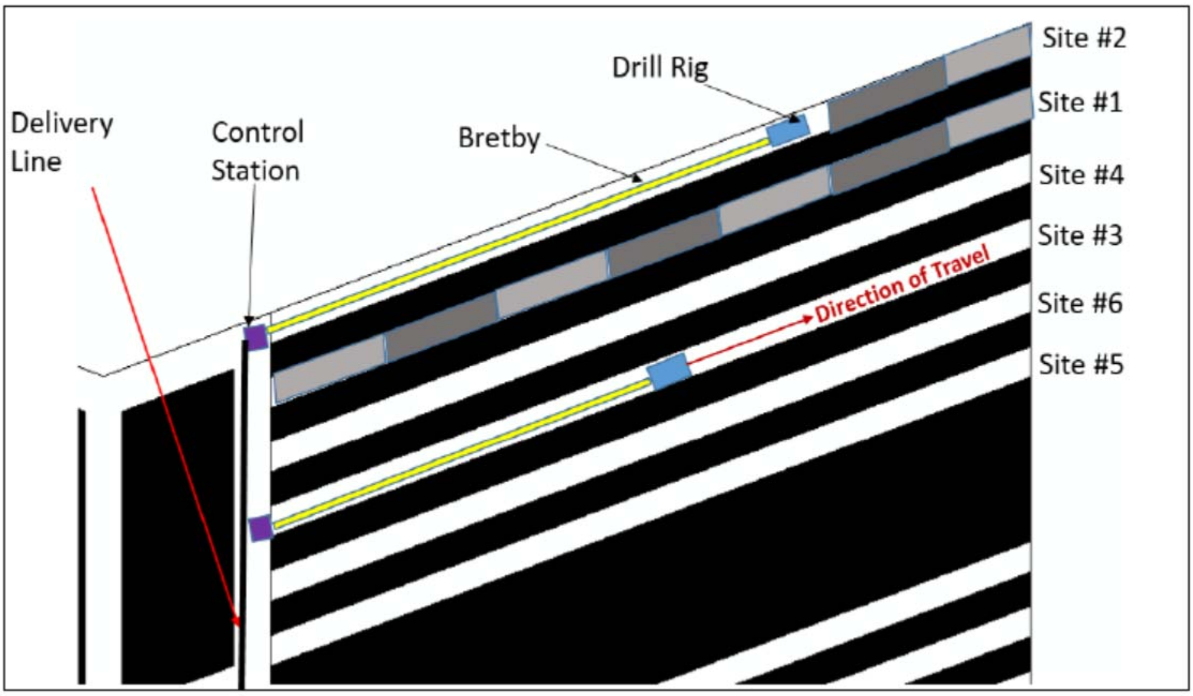


**Figure 2.7 Subsequent site setup**

vi) Rig#2 will complete all 8 pours in the plunge and it will also complete an additional pour on the gateroad is it retracts back to site #4. This is shown in Figure 2.8. The process is then repeated until all sites are filled.

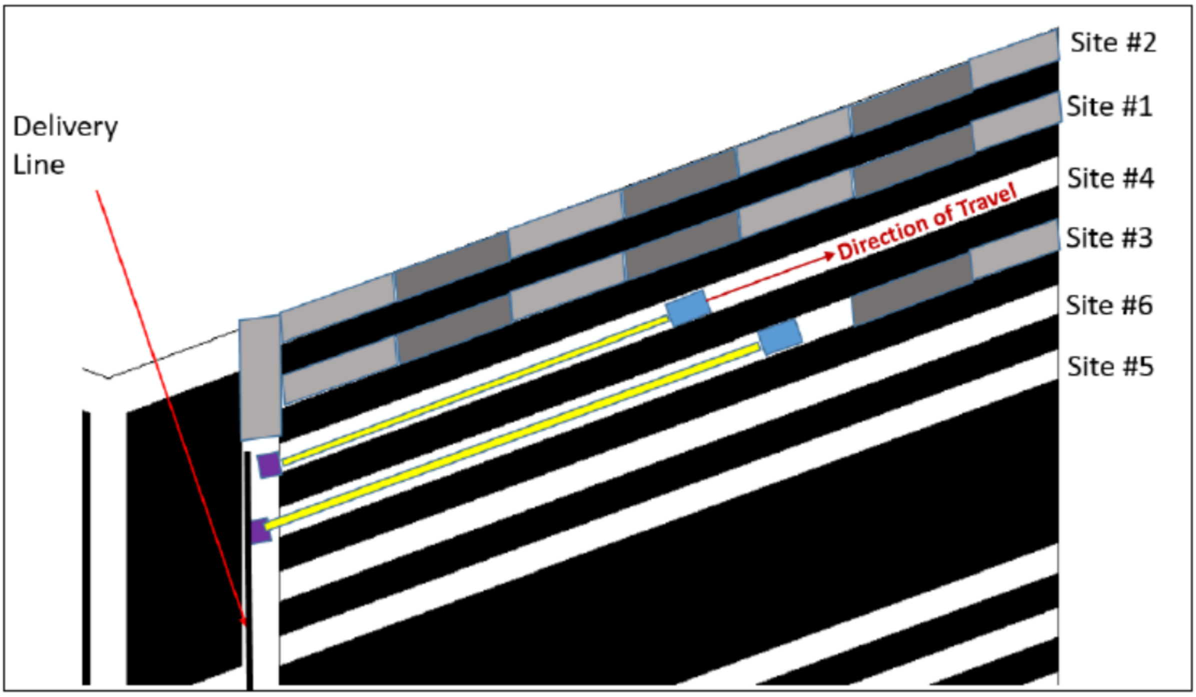


Figure 2.8 Gateroad pour on extraction

vii) After Rig#1 completes site #5 it will move to be set up into site#1 of the next web panel. This site then becomes the dumping site as Rig#3 and Rig#4 commence the same process on the opposite side of the panel as shown below in Figure 2.9.

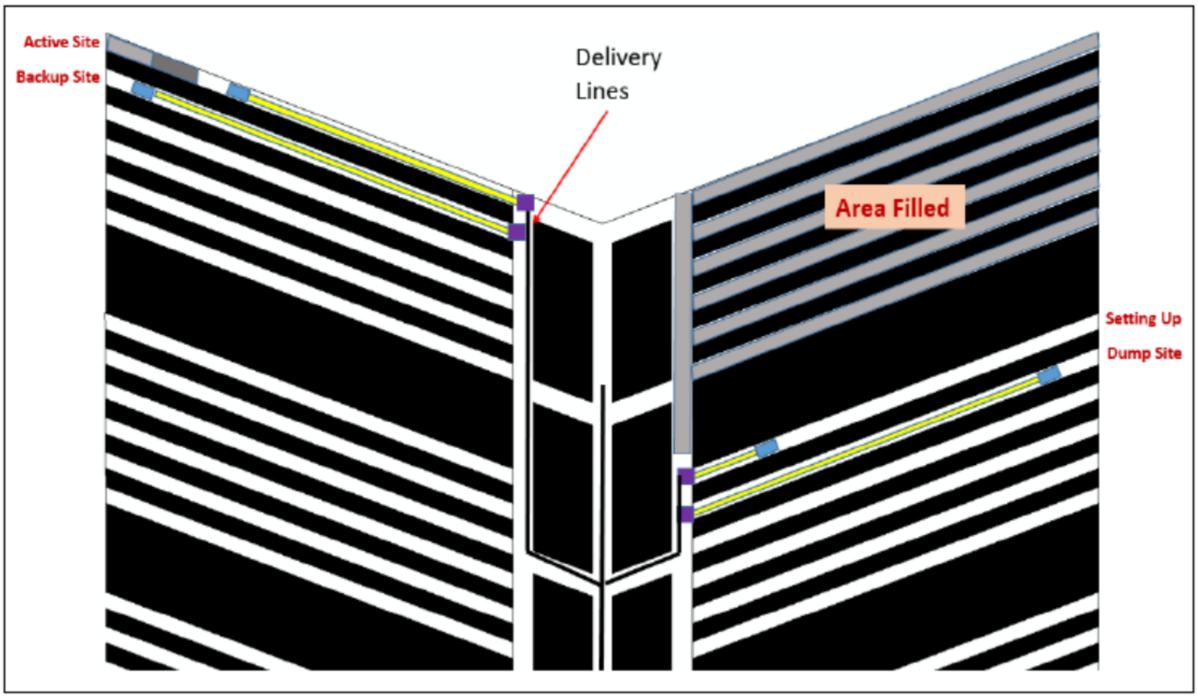


Figure 2.9 Full panel view

viii) Rig#3 will fill the left hand side (LHS) of the gateroad on retreat as Rig#2 did on the right hand side (RHS). This can be seen in Figure 2.10.

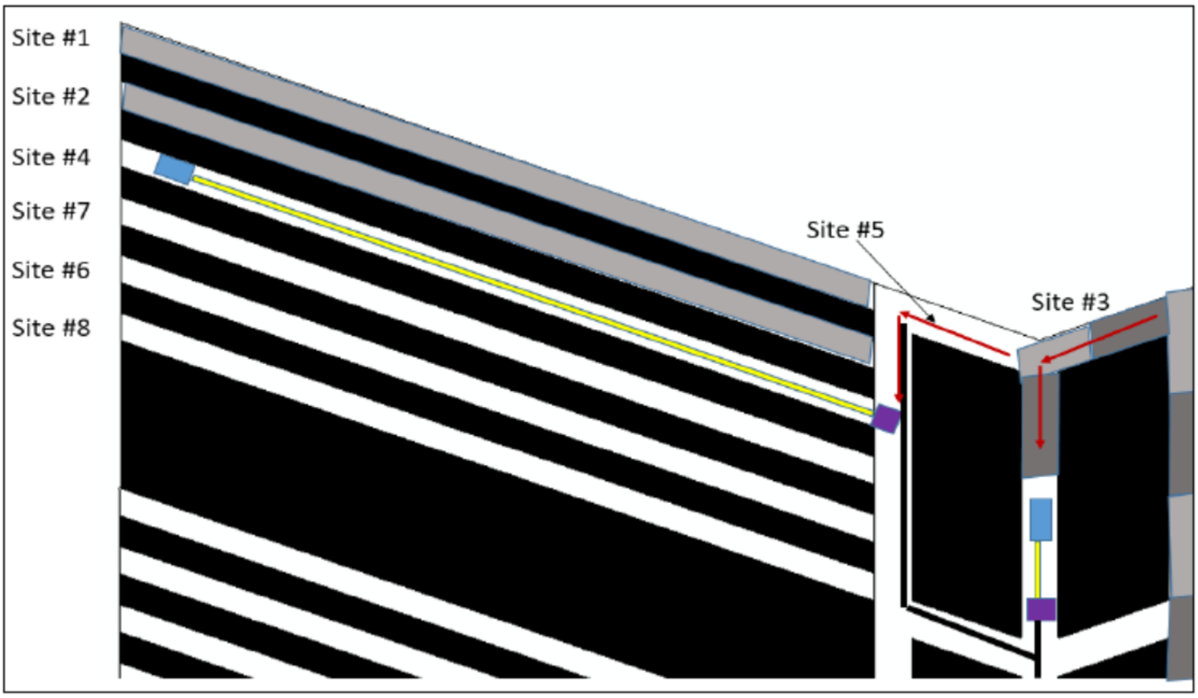


**Figure 2.10 LHS Gateroad filling**

ix) This left and right fill process is then repeated on all individual web panels as the process retreats out of the gateroad, towards the Main Headings (entrance to panel). When all the plunges and the gateroads are filled, bulkhead seals will be installed at the entrance of the panel as shown in Figure 2.11 below.

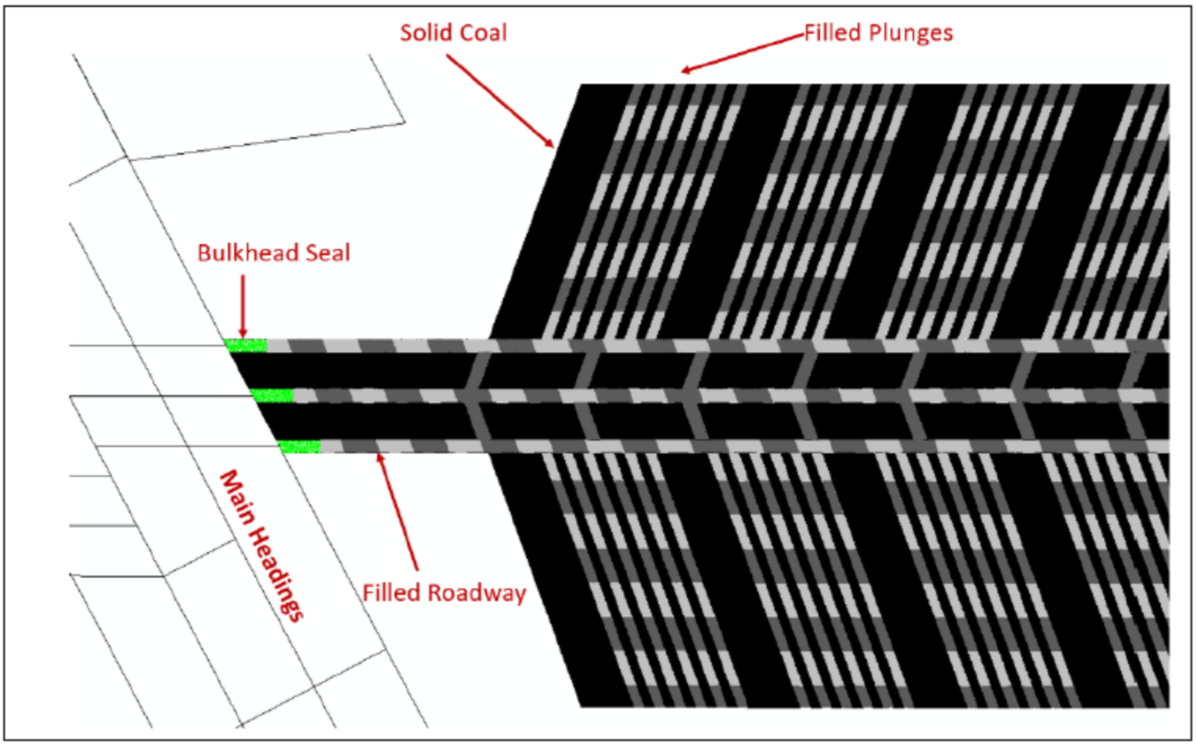


**Figure 2.11 Sealed panel**

It is important to note that the backfill process will commence once mining has been completed in each panel. When multiple panels are being separately mined there will be opportunity to expand the system to be available to be used in several different areas concurrently. The system has a high degree of flexibility and scalability and therefore can be changed to match any production profile for the mine.

In addition to the Palaris report, Hume Coal commissioned Quality Process Solutions (QPS) to prepare a concept deign report for the proposed reject emplacement (QPS 2019). This report included a literature review of where rejects have been, and are, disposed of underground (the results of which are detailed in the first response in Section 2.1 of this submission). This report found that many mineral processing plants dispose of reject as paste fill (a substance that behaves as a solid until a sufficiently large load or stress is applied, at which point it flows like a fluid). A paste also requires a reasonably high fines content and must have at least 15% of the particles finer than 0.02 mm. The Hume Coal backfill will be extremely variable, ranging from 100% coarse (-50 mm) to 100% thickener underflow (-700um). This essentially discounts the use of a paste backfill which requires a reasonably consistent size distribution. A high-density slurry will therefore be used at Hume Coal.

QPS (2019) investigated the possibility of using either centrifugal pumps or positive displacement pumps to move the rejects underground, with the centrifugal pump option rejected due to the high number of booster pumps required. A high-density slurry disposal using piston pumps was found to be the most appropriate way of emplacing the rejects underground. The design backfill solids concentration is 60-70% w/w, which was selected to give an acceptable compromise between the risk of blockage at higher % solids, and the high wear at lower % solids.

A minimum pipeline velocity of approximately 2 m/s will be used to reduce the risk of particle setting of the 8 mm slurry, and a maximum velocity of approximately 3 m/s to limit the pressure loss due to friction.

*Mr White was concerned that Hume Coal's mining experts lack of experience in "underground fill systems".*

The Hume Coal Project utilised technical experts from multiple fields to design its reject emplacement system. A summary of the experts involved is provided in the response to the next point below. All reports are also listed in the reference list to this submission.

*Mr White stated that Hume Coal has not undertaken studies to investigate the process of transporting the materials via the pipeline.*

Extensive investigations have been completed to confirm that the process of transporting the materials via the pipeline is a viable option for the project.

In early 2014, QCC Resources completed a high-level concept design report titled “Hume Coal Project Paste Disposal of Reject” and provided a cost estimate for the disposal of rejects as pumped backfill with a topsize of 8 mm.

Following this report, borecore reject and tailings samples were sent to Golder Associates (Golder) Research and Development Facility in Melbourne for testing.

In December 2014, Golder issued report “Hume Coal: XRD – Mineralogical Assessment” within which Golder reported the results of X-ray Diffraction (XRD) of each rejects sample. The Hume coal reject samples were gathered from different laboratories having been subjected to other test work. The coal reject samples were separated into different size and density ranges. These samples, for each borehole, were blended together to form a composite sample that was considered representative of each drill core.

Golder later released a report “Coal Rejects Evaluation for Underground Disposal Report, April 2015” providing the results of further test work.

RGS Environmental Pty Ltd (RGS) also completed a literature review for Hume Coal of discoverable information on the use of underground storage areas for backfilling coal reject materials and mixing these materials with cement. RGS submitted a report titled "Literature Review – Underground backfill Using Coal Reject and Cementing November 2015".

RGS concluded that backfill was a well-established technique that has been used at an increasing number of underground mining operations in NSW, Australia and overseas over the past three decades.

All of these above-mentioned reports and studies informed the final reject emplacement methodology and design, as described in the Hume Coal Project EIS (EMM 2017), for which approval is sought.

In addition to the above works, and as described in the response above Hume Coal commissioned Palaris Australia to produce two reports that provide further detailed descriptions of the proposed reject emplacement process and schedule, and another QPS:

- Hume Coal Reject Emplacement Schedule (Palaris 2019);
- Hume Coal Reject Emplacement Methodology (Palaris 2019);
- Hume Coal CHPP Backfill Concept Design Report (QPS 2019).

## 2.3 Economics

*Mr White stated that the proposed Hume Coal reject management process is likely to be large and complex. He raised concerns that the size and complexity of the process would impact upon the project economics.*

As a coal reject disposal method, backfill is typically more expensive (per tonne of coal reject) than normal surface emplacement methods and is generally not the lowest cost option, and so is not normally used in Australia unless there is a specific reason. However, to meet the highest possible environmental standards, Hume Coal have selected 100% underground backfill for rejects disposal.

BA Economics was commissioned by Hume Coal to prepare an economic impact assessment of the proposed Hume Coal Project. This assessment, which found that the project's benefits will far outweigh its costs, included the costs associated with the proposed reject emplacement system.

## 2.4 Water Impacts

Mr White raises a number of concerns in both his presentation to the IPC Public Hearing and in his supplementary submission relating to the potential for the Hume Coal project to impact upon both surface and groundwater. These issues are summarised below along with a response from Hume Coal's technical experts.

*Mr White raises a concern that there will need to be a large stockpile of waste given that early production will be from high-waste content areas. Surface water management will be greatly complicated by the scale of the large reject stockpiles and processing facilities.*

The project includes a temporary reject emplacement area for the stockpiling of waste material extracted before underground emplacement areas are available. The surface water management system has been designed to accommodate this stockpile. As described above, this stockpile will only be used for the first 12-18 months of the mine life to store rejects extracted from the first western panel, until a completed panel is available to store rejects underground. Once no longer needed, the emplacement of the rejects from this stockpile will be scheduled into the reject emplacement schedule over the life of mine.

The impact of the Hume Coal Project on the surrounding surface and groundwater systems and the proposed management actions are described in detail in both the EIS (EMM 2017) and in the revised Water Impact Assessment within the RTS (EMM 2018).

Additionally, before the commencement of operations, a detailed Water Management Plan will be developed by Hume Coal in conjunction with the NSW Department of Planning and Environment (DPE) and the NSW Department of Industry-Water. This plan must be approved by DPE before operations can commence.

*Mr White raised concerns that there is a high risk of groundwater contamination from "additives introduced during processing and/or the rejects material itself".*

The groundwater quality assessment in both the EIS (EMM 2017) and RTS report (EMM 2018) conclude that there will be negligible impacts to groundwater quality from the Hume Coal Project.

The risk of any potential impact to groundwater from the quality of coal reject slurry transferred into underground workings has been assessed as part of the RGS Hydrogeochemical Modelling Program and has been demonstrated to be negligible (RGS 2018). Further, to ensure excess alkalinity in backfilled coal reject materials, Hume Coal will add up to 1% limestone to the backfill to ensure that any residual risk of impacting groundwater at the site is negligible (QPS 2019).

The underground emplacement of tailings was a direct request of the NSW government to efficiently and safely deal with this waste stream. There are long term environmental benefits to permanently store tailings in underground workings behind bulkheads as mining progresses.

Also, currently (ie under a non-mining scenario) the hydraulic head (pressure) in the coal seam is lower than the immediately overlying Hawkesbury Sandstone. Thus, there is a downward hydraulic gradient (and potential downward flow path), from the overlying sandstone into the coal seam. It is expected that during mining this downward hydraulic gradient (ie from the sandstone into the coal seam) will remain, and following full recovery back to current natural condition, this same downwards hydraulic gradient will persist. This effectively means that there is no mechanism for upward flow of water to flow from the coal seam into the overlying Hawkesbury Sandstone currently, during mining, during recovery or post final recovery.

The Geosyntec (2016) report considers the conclusions of the groundwater modelling undertaken for the EIS, and the NSW Government independent expert reviews on subsidence and groundwater modelling. The Geosyntec (2016) work therefore robustly and adequately considers the likely risks to groundwater quality.

The results of the limestone-amended KLC tests indicated that the expected water quality resulting from rainfall infiltration into the reject stockpile presents a negligible risk to the baseline beneficial uses of Hawkesbury Sandstone groundwater resource.

If the coal rejects are managed appropriately the potential for adverse impacts to receiving groundwater is considered low as the water quality resulting from the reject emplacement is similar to the natural groundwater quality of the Wongawilli Coal seam.

*Mr White raised a concern that Hume Coal has not undertaken adequate studies to investigate the amount of water required to transport rejects material or the pumping systems required.*

Groundwater and surface water modelling has been undertaken by Hume Coal as a requirement of the environmental assessment and approval process and in accordance with regulatory guidelines to assist in impact predictions.

Numerical models, by definition, are mathematical simulations that attempt to replicate the complex real world situation using appropriate assumptions and field data. Sensitivity and uncertainty analysis are performed to reduce the uncertainty in the assumptions and increase the accuracy and precision of the models' predictions. The numerical modelling that has been undertaken for the Hume Coal Project as presented in the EIS and the RTS is above industry standards for consideration of uncertainty with model results. This modelling incorporates the water supply requirements of the rejects management system.

Extensive work has been undertaken to determine the pumping systems required for the proposed emplacement method. Initial assessments by Hume Coal's design team identified that centrifugal pumps were adequate for a medium density slurry with a short pipeline length, whereas positive displacement pumps are required for a high-density slurry with long pipelines. For intermediate systems, both centrifugal and positive displacement pump options were investigated to determine the most cost-effective solution over the design life of the system.

The centrifugal pump option was rejected due to the high number of booster pumps required. Hose pumps were similarly rejected. Consequently, a high-density slurry disposal using piston pumps was selected. A design utilising backfill solids concentration of between 60-70%, was selected to give an acceptable compromise between the risk of blockage at a higher percentage of solids, and the high wear at a lower percentage of solids.

### 2.5 Net Make-Up water

*Mr White states that nearly a quarter of the net make-up water needs are to be provided by decant recovery of entrained water in the co-disposed rejects. He says this raises the significance of his concerns about the ability to drain water from paste fill, and that this is exacerbated by the majority of filled voids being in down-dip plunges. It is claimed that the ability to recover water from this source has been grossly over-estimated.*

Hume can extract water from the active mining panels, sealed and unsealed downdip panels that do not have reject emplaced. Hume are not proposing and have never proposed to extract water from sealed panels with reject emplacement.

In the mid to later years of the project, the net demand is lower than the groundwater inflows to the mine sump and void so the demand is met by groundwater inflows. During the early years of the project, the net demand is higher than the groundwater inflows to the mine. There will be some water stored in panels (without reject emplaced) and groundwater extraction from bores can occur within the existing Hume Coal licence, of which the full volume is not required to account for inflows until year 17 of the project.

## 3 Conclusion

In summary, Hume Coal considers that the issues raised by Mr White in his submissions to the IPC have been adequately addressed in the Hume Coal EIS, RTS and subsequent documents. As further demonstrated in this submission, Hume Coal has engaged numerous suitably qualified experts to design a robust underground reject emplacement system, thus avoiding the environmental impacts associated with a permanent surface emplacement of all rejects. If additional information or clarification is required, Hume Coal would be pleased to make its experts available to discuss the matter further with the commissioners.

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OUT19/5211

Professor Chris Fell
Independent Planning Commission NSW
Level 3, 201 Elizabeth Street
SYDNEY NSW 2000

Dear Professor Fell

**Hume Coal Project**

Thank you for your request dated 1st April 2019 seeking additional information about groundwater modelling and make good provisions in relation to the Hume Coal Project. I attach our advice in detail on these matters.

I note that the proponent is predicting significant impacts on a number of existing water users, and the value of this groundwater source is relatively high. As such, it is important that the assessment and the supporting modelling is robust.

While the model has improved from earlier models, the additional modelling and hydrogeology work to date has not improved upon a number of key indicators which are required to:

- predict water level and volume impacts to the water supply aquifer due to mine dewatering (to a sub metre scale resolution for drawdowns)
- allow assessment of volume losses at the resolution of individual agricultural users
- confirm licensed allocation volumes.

Yours sincerely

Mitchell Isaacs
Director Strategic Relations
24 April 2019

GPO Box 5477, Sydney NSW 2001, Australia
Level 49 MLC Centre, 19 Martin Place, Sydney NSW 2000, Australia,
Tel: +612 9338 6600 Fax: +612 9338 6860 www.industry.nsw.gov.au ABN: 72 189 919 072

## Department of Industry (Water) additional technical advice to the Independent Planning Commission (IPC) about the Hume Coal Project

## 17th April 2019

In summary, the Department of Industry - Water considers there are significant uncertainties in the predictive capabilities of the model, and as such the risk to an important groundwater source is relatively high. The predictions of the proponent are not adequately supported by robust evidence when compared to the existing value of the aquifer to water users.

### Question 1 - Has the class of the groundwater model been resolved in your opinion? We note there has been at least one meeting between modellers

While the model is significantly improved from earlier models, the confidence level classification has yet to be resolved.

DOI Water considers this latest model to be incomplete, with the model neither optimally using all the available field data nor incorporating prior recommendations. As such we do not consider it appropriate to be classified, however it resembles a Class 1 model with some higher class indicators. According to the checklist in the peer review the model incorporates some Level 2 and Level 3 elements. However that does not rationalise the overall classification to an acceptable degree. The Australian Groundwater Modelling Guidelines are clear on the distinction between levels based on reported error statistics falling within defined ranges. Failure to achieve error statistics within these ranges imply that, although parts of the model might be well developed, as a functional predictive tool the model is lacking in certain aspects. That position is supported by the range of error statistics that suggest the replication of existing conditions has not been reasonably achieved, and therefore the predictive capability is not certain.

The additional modelling and hydrogeology work by the proponent to date has not improved upon a number of key indicators. As such we do not consider the model to be fit for the purpose of a robust assessment of impacts to a highly developed aquifer used for agricultural and domestic groundwater supplies. The specific objectives required are:

- predicting water level and volume impacts to the water supply aquifer due to mine dewatering (to a sub-metre scale resolution for drawdowns)
- to allow assessment of volume losses at the resolution of individual agricultural users
- to confirm licensed allocation volumes.

DOI Water has the following concerns:

- The model is uncalibrated and calibration statistics require further explanation and improvement.
- The calibration methodology is unsound as it uses uncertain calibration targets.
- Some model parameters are outside the range of a reasonable hydrogeological analysis of field information and literature values.
- There remains conceptual geological uncertainty.
- The spatial refinement is too coarse in key parts of the model domain.
- There is inadequate uncertainty analysis of the parameters applied (narrow range).

GPO Box 5477, Sydney NSW 2001, Australia
Level 49 MLC Centre, 19 Martin Place, Sydney NSW 2000, Australia,
Tel: +612 9338 6600 Fax: +612 9338 6860 www.industry.nsw.gov.au ABN: 72 189 919 072

There is uncertainty about recharge and manner in which evapotranspiration has been applied.

## Question 2 - Do you have concerns on how the interburden layer was modelled in the upgraded Merrick (2018) model?

DoI Water has concerns on how the interburden has been represented. Questions remain as to the extent of the Narrabeen Formation directly above the coal seams and the adequate representation of this in the model (thickness of the interburden and hydraulic parameters chosen for the groundwater model).

With respect to the location and thickness of the interburden, there is continuing uncertainty with regards to the thickness of the interburden in the Modified EIS USG-T model. The thickness and therefore significance of the interburden is modelled differently to the conceptualization of it. (Figure 3 in HS2018/02 vs Figure 4.3 and 4.4 in GEOTLCOV25281AB-ACA). The numerical model interburden thickness attains 6 - 10 m while the conceptualization of it in the Coffey report barely attains 2 m thickness in the exploration licence area A349.

As previously requested by the department the geological cross-sectional and bore log data and analysis should be compared to the layering cross-sectional data applied in the model.

With respect to hydraulic parameters chosen by the report, there is evidence to support the Hawkesbury Sandstone hydraulic conductivity ($K_h$ and $K_v$) being highest immediately above the coal seam to be mined. There are concerns about the adequate representation of this in the model. Alternative realizations of the model with higher $K_v$ values applied were not presented as requested and agreed to during a meeting with the proponents modelling consultant.

## Question 3 - The transfer of water from the primary water dam to underground voids was not included in the modelling due to lack of mining details. Middlemis (2018) says this makes the model conservative. What is your opinion?

The transfer of water is intended to re-pressurise the voids created by mining behind constructed bulkheads. There is considerable uncertainty around the success of this approach, in terms of the safety issues for those working in the underground mine, and in terms of the behaviour of the groundwater system. For example, the individual flooded voids could leak pressure to the surrounding rocks at different rates (due to variabilities in fracturing, porosity, permeability, etc.) therefore it would be difficult to predict the outcomes for each panel in the model. The lack of this aspect in the model does not necessarily make it conservative but reflects the difficulty in attempting to reasonably incorporate what could be extremely variable behaviour under pressurisation.

While it is true that the water transfer may provide some mitigation to depressurisation impacts, in reality the performance of the aquifer in this regard will only be known post-mining. The assumption that drawdowns or extraction volume impacts from the mining will be minimised because of the re-pressurized voids cannot be definite until they are observed in practice. Speculation about the impact of this issue is best performed with an appropriate sensitivity and uncertainty analysis on a fit for purpose model. The combination of insufficient information and model not being fit for purpose, does not allow an effective judgement of the degree of how conservative the model is.

NSW GOVERNMENT | Department of Industry

## Question 4- The DI-W Nov 2018 submission indicated that there were inconsistencies between the geological and groundwater model. The DPE independent reviewer (Middlemis, 2018) has indicated that the 3D semi regional model of Merrick (2018) is fit for purpose. Does your recommendation to use 90th percentile predictions allay some of your concerns regarding lack of geological detail? Would the use of the 67th percentile predictions of impacts, also be acceptable?

Using the 90th percentile predictions does not sufficiently allay our concerns regarding the lack of geological detail and as a result DoI Water provided comprehensive recommendations to address this issue. Our recommendation with regards to the 90th percentile had as its intention only to highlight and recommend the resolution of water licensing and allocation shortages that required addressing.

Considering the current level of confidence in the model that DOI Water holds, it is our opinion that performing an uncertainty or sensitivity analysis on this current latest model would provide unreliable results. DOI Water considers that the model is not currently a suitable tool to predict and understand the likely impacts with a reasonable level of certainty for this project. DOI Water supports comprehensive uncertainty and sensitivity analyses being performed on a model that has been improved and fit for purpose. DOI Water provided recommendations about the methodology of the analyses which were not implemented.

## Question 5- What is your opinion on hydraulic conductivity decreasing with depth, as modelled? Some groundwater specialists believe this interpretation is wrong.

In summary, we do not believe that the data presented by the proponent demonstrates clear field evidence for the assertion that hydraulic conductivity decreases with depth. In addition, we believe that the behaviour of hydraulic conductivity in the vertical and horizontal directions can vary significantly in the aquifers present in the Hume Coal project area.

The Hawkesbury Sandstone aquifer in the Hume Coal project area is primarily a fractured rock aquifer as well as a secondary porous rock aquifer. DOI Water experience from groundwater exploration drilling into fractured rock aquifer environments confirms that in such aquifers hydraulic conductivity in the vertical ($K_v$) and horizontal ($K_h$) directions is highly variable. In some situations $K_v$ and $K_h$ can be similar and in others $K_v$ is higher than $K_h$ . Increasing hydraulic conductivity with depth in such aquifers can also be common nor is it particularly rare even in primary porous aquifers.

With regards to groundwater flow in fractures, surrounded by bulk porous matrix, hydraulic conductivity is greater parallel to the fracture than normal to it. In a primarily vertical fracture network connected to a dewatered void at depth, groundwater would predominantly flow vertically downward at a greater rate than horizontally. Therefore the direction of conductivity is a key parameter that requires careful evaluation and sensitivity testing. The situation in the field is far more heterogeneous as described above and therefore DOI Water recommended sensitivity and uncertainty analyses on the full range of hydraulic conductivity for both $K_v$ and $K_h$. These were not undertaken.

Middlemis (2018) concurs that the mine inflow predictions are sensitive to $K_v$ (Pg. 16, Middlemis_2018_Hume_Coal_review_v5.docx). However during the sensitivity analysis, $K_v$ was not varied over a sufficient range (towards higher, more reasonable vertical hydraulic conductivity values), resulting in the model results not being sensitive to the narrow and unsuitable $K_v$ range applied. DoI Water recommended that an uncertainty and sensitivity analysis on $K_v$ be performed on the entire range of values with a maximum $K_v$ of 10 m/d to be applied.

Attention is drawn to Figure 4.5 of GEOTLCOV25281AB-ACB plus Figures 5.1 and 5.2 of GEOTLCOV25281AB-ACA. It is clearly observed that predominantly in the Hawkesbury Sandstone (but also in the Basalts, Wianamatta Group and Wongawilli seam):

- K values in the range 0.01 – 5 m/day occur to depths of between 120 - 160 m and are numerous.

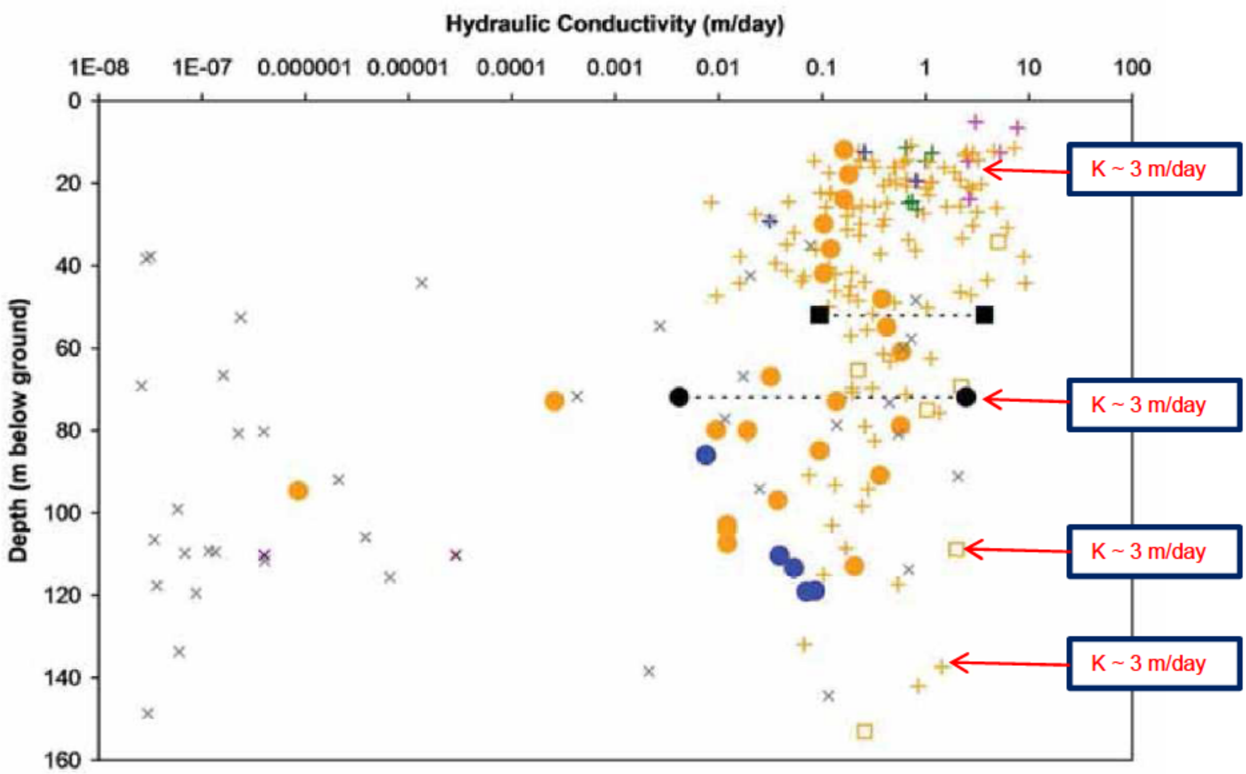


**Figure 1 - Figure 5.1 of GEOTLCOV25281AB-ACA, Hume Coal Project, Groundwater Assessment Volume 1: Data Analysis 17 November 2016.** ***Note red arrows and boxes added by DoI Water.***

- The data presented by the proponent does not demonstrate clear field evidence for the assertion that hydraulic conductivity decreases with depth. In contrast as demonstrated in the above figure, conductivity remains high at depth. The upper range values are of approximately 3 m/day occurring to depths of 140 m.

- The linear regression as applied by the proponents modelling consultant to prove a decrease of hydraulic conductivity with depth is in the opinion of DoI Water an unreasonable and inappropriate fit of the data.

DoI Water highlights that $K_v$ and $K_h$ values used in the model and also in the uncertainty analysis and sensitivity testing did not adequately range over the field values with depth. A model must reasonably represent field values, including with depth, and in this case the model clearly falls short of demonstrating this.

The geology also indicates the presence of geological intrusions such as dykes, sills, laccoliths, diatremes and plutons plus faulting in multiple orientations (Figures 4.5 – 4.8 of GEOTLCOV25281AB-ACA). It has been indicated that many of the dykes are vertical and weathered to significant depth indicating groundwater presence. It has also been indicated that haloes or zones around the intrusions are known to yield higher quantities of groundwater. Some of the fault orientations are likely to be open allowing groundwater flow. These features provide further justification for performing a complete sensitivity analysis on $K_v$ over the entire range of field obtained values.

There seems to be no clear justification to not test the model for the full range of $K_h$ and $K_v$ uncertainty and sensitivities for all layers (including the Wongawilli seam), as was recommended by DoI Water.

### Question 6 - What is your opinion on the approach taken to decide on the drain conductance values used in the modelling?

The drain sensitivity analysis has highlighted incomplete follow up modelling tasks that should have been performed to decrease the uncertainty about mine inflows and their impacts onto drawdowns affecting other water users.

The conductance equation is sensitive to its inputs derived from an equation that considers hydraulic conductivity, length and width of a cell boundary condition and the thickness. The conductance value is potentially sensitive to each of these. DoI Water was specifically concerned about the hydraulic conductivity and thickness applied in the equation used in order to assess the suitability of the drain conductance value used.

DoI Water requested further information about the drain conductance parameter and the derivation of its value. DoI Water also recommended that wells are alternatively used also, instead of drains to effect dewatering. This is so that it can be determined what is the real rate that the geological formation can provide water to the unrestricted wells in the model, as opposed to the modeller imposed rate assigned to the drains. Currently the restrictive drains act as the bottleneck control on the volumes of water allowed to exit the geological formation in the model, as opposed to the more physically naturally accurate formation rate, freely flowing into a well that can only pump water that is available to the pump, even if the pumping rate assigned to the well is excessively high. This was recommended in order to eliminate the confusion about the drain conductance value and its sensitivity to grid scale features.

- Drain conductance values were found by Merrick (2018) (Section 8.2) to be highly sensitive to an order of magnitude change nearly doubling the inflow intercepted by the drains.
- In contrast Middlemis (2018) (Section 4.2) stated in his review of Merrick's 2018 work, *"The revised groundwater modelling included a sensitivity analysis on drain conductance, with the results indicating low sensitivity"*.
- However Merrick (2018) presents Table 27, which DoI Water considers shows overall very large differences (which imply an area of uncertainty that should be diminished and addressed in detail) and yet claims, *"model is overall not particularly sensitive to changes in mine drain conductance".*

### Question 7 - The updated model is said by Middlemis (2018) to be a best practice model as it is simultaneously calibrated to four data sets and contains a detailed uncertainty analysis. What is your opinion?

DoI Water notes that Middlemis (2018) states the calibration to be acceptable in this case because of simultaneous calibration performance on four other key criteria:

a) matches to baseflow

b) matches to mine dewatering fluxes

c) aquifer parameters consistent with field measurements

d) a calibration history match.

DoI Water does not agree that the model is calibrated to four datasets simultaneously.

The calibration of the model against four data sets does not necessarily reflect the quality of the model in replicating the existing environment or predicting future impacts. It does serve to constrain the model to certain parametric fields that are of importance to groundwater behaviour. However, this means that other parameters in the model that are not constrained may have to be varied across unnaturally large ranges to achieve some form of calibration. It is also not clear how parameters might have been lumped together to enable the modelling to progress in the absence of specific data (e.g. specific storage values derived from site investigations), and whether these are a significant part of the four data sets being calibrated against.

DoI Water notes that a visual analysis of the calibration hydrographs concludes that the vast majority of bores are uncalibrated. A residual of far less than 2 m for the majority of the bores would be regarded as more acceptable to assess drawdown impact and impact on private bores (refer to response to Question 8 for more details).

Matches to baseflow

DoI Water considers that there has been insufficient detailed information provided about this criteria, showing the match. Apart from this, the model is not considered fit for purpose and therefore DoI Water regards the current results as unreliable.

Matches to mine dewatering fluxes at Berrima mine

DoI Water does not consider this a reliable calibration parameter. The use of drains to represent mine voids at Hume Coal voids is not adequately clarified to understand the details of the drain parameters selected for matching to a pre-selected flow at Berrima mine.

DOI Water highlights that the Berrima mine is in a very different hydrogeological situation:

1. Berrima mine occupies a much smaller footprint and therefore a smaller groundwater catchment; the implication with the Hume Coal mine project area, with a greater groundwater catchment area, is that relatively far greater volumes and perhaps rates of water are potentially available to the Hume Coal voids in a fractured rock environment. Without the specific mining plan details being applied to a fit for purpose Hume Coal model, using the Berrima mine inflows is tenuous and doesn't provide a high degree of confidence.
2. Berrima is a much older mine closer to steady state in terms of groundwater inflows, with decades of dewatering behind it and lowered water levels providing a lower gradient to flow. To use inflows from Berrima is inapplicable to a greenfield site like Hume Coal which will likely not reach the same degree of equilibrium for several decades. The Hume Coal mine has a larger volume of water immediately available to it than Berrima. In the initial years, inflows into Hume Coal mine would be far larger than the Berrima mine after decades of dewatering.
3. Geological heterogeneity almost ensures that hydrogeologically, the sites are incomparable in how water flows into a resulting mine void when comparing the two mine sites. There is uncertainty with regards to the presence, extent or differences between the thickness of the Narrabeen Group over the Hume and Berrima sites and the effect this has on potential recharge to the mine voids. DoI Water has recommended detailed clarification about the details of all aquifers, aquitards and

faults above both mines to allow full assessment of the hydrogeology and its eventual proper inclusion in the model.

Aquifer parameters consistent with field measurements

DOI Water does not consider the model parameters to be consistent with field measurements (refer also to earlier response to questions).

Calibration history match

DOI Water does not consider the model to be calibrated to monitoring well water levels (refer to response to questions below).

## Question 8 - What does the error statistic SRMS of 10.7% tell you about the model accuracy?

DOI Water continues to have concerns about the calculation of the SRMS error statistic at over 10%. It is good practice to also apply the error statistic to individual aquifers, as opposed to averaging it across all the model layers and assess the aquifers separately to gain a deeper insight. DOI Water recommended further clarification and without this information, is not in a position to comment further apart from providing the following points:

- The error statistic provides an aggregated measure of the calibration but does not indicate the spatial or temporal distribution of the error. The error statistic should be less than 5% for a model destined for the purpose stated earlier.
- DoI Water considers the model to be unacceptably calibrated as a direct consequence of the unsuitability of indicators/elements referred to in our reply to the first question from the IPC. DoI Water does not therefore consider the model (the improved Modified EIS USG-T model nor MEAN K model) to be fit for the purpose of assessing drawdown impacts resulting from mining, to an adequate level of certainty for decision taking purposes for this project.
- A visual analysis of the calibration hydrographs concludes that the vast majority of bores are uncalibrated. A residual of far less than 2 m for the majority of the bores would be regarded as more acceptable and should be achievable using PEST pilot points and spatially varying hydraulic parameters within reasonably possible ranges as has been recommended as a result of reviews of the modelling work to date.
- Only 21% of all the calibration bores have a residual that is less than 2 m between the observed field measurement and modelled results. This is important because the modelling is expected to provide information about drawdowns within that range at surface. This is an insufficient number of calibrated bores to provide confidence in the model predictions.
- 79% of all calibration bores exceed 2 m residual between the observed and modelled results. The vast majority of bores are therefore uncalibrated.
- 64.5% of the bores exceed 4 m residual between the observed and modelled results.
- 50 % of the bores exceed 10 m residual between the observed and modelled results.
- The calibration statistics provided require a deeper exploration and explanation to determine the consistency of the weighting applied to model parameters.

It is uncertain why the large dataset private bores were also not used within PEST to obtain a base case calibrated model.

The error statistic does not indicate adequate accuracy for a model with a requirement of being fit for predicting the impacts at this site. A visual analysis of the individual calibration hydrograph reveals also consistent issues with precision as observed in differences between both phase and amplitude between the measured and calculated water level observations.

## Question 9 -Do you have concerns with the make good strategy for affected bore owners?

While there is no clear policy on how make good should be achieved, DoI Water recommends that where impacts are known or likely, users should have pre-agreed make good measures in place before mining commences.

### a. Do you think the affected irrigation bore owners can obtain an equivalent water supply from the strata below the Hawkesbury sandstone?

Whilst it might be possible for affected landholders to obtain a similar supply from strata beneath the Hawkesbury Sandstone under undisturbed conditions, the availability of groundwater during and following mining is not known. There is also a question around the loss of opportunity for landholders as opposed to the loss of current supply. For example, a landholder that might currently only use part of the water from a well-constructed and efficient bore for stock and domestic purposes could be denied the future opportunity to develop a commercial business dependent on the full supply that the bore could provide. A deepened or replacement bore may need to be demonstrably equivalent in that regard, not just ‘equivalent’ to the current purpose for which it is being used.

There is currently little knowledge about the water supply quality of yields available from deeper formations to satisfy the demands of the current irrigation bore owners. Determining this would involve drilling, aquifer testing and monitoring of wells.

### b. What yields and water quality are likely from the deeper formations?

Typically bores that penetrate through the Hawkesbury Sandstone are lower yield and poorer quality. The Southern Highlands district in which the proposed mine is located is typically quite productive in terms of bore water supplies, due to a combination of influences including the structural setting, the recharge zone location and enhanced permeability of the Hawkesbury Sandstone.

The Illawarra Coal Measures unconformably underlying the Hawkesbury Sandstone tend to host groundwater that contains dissolved constituents derived from the coal seams and include other layers that are tighter, more massive, and with higher fines content. These conditions are common for undisturbed areas, however it is not clear how the proposed mining will impact the availability or quality of the deeper geological formations. In particular, the development of localised failure planes, the repressurisation of mined voids and the possible activation of major geological structures arising as a result of the proposed mining could all affect both yield and quality of the Hawkesbury Sandstone and the underlying coal measure formations in unforeseen ways.

### c. Do you consider the direct supply of water should be included in the make good options?

Due to the significance of impacts on groundwater resulting from this project there is the requirement for make good provisions to apply according to the NSW Aquifer Interference Policy. The intent of this is for the affected party to have a comparable water supply made available, or other suitable arrangements, however how this is to be achieved is not specified. Direct supply of water may be a valid option in some circumstances however DoI

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Water notes there are likely to be practical constraints or barriers to providing large volumes of water to a large number of impacted users.

In this case initial information indicates a third may require additional operating costs, a third may require deepening of bores and a third may require an alternate supply. Specific detail on these requirements is awaiting further individual bore assessments and development of viable make good measures.

Therefore DOI Water recommends viable measures need to be developed to address the make good provision requirement. The measures used are likely to vary and for example for some high yield irrigation bores, the ability to provide a viable make good option is yet to be confirmed.