ATTACHMENT 11

Consideration of Alternatives

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

A11 CONSIDERATION OF ALTERNATIVES

A11.1 OVERVIEW

Statutory Context and Assessment Requirements

This Attachment has been prepared in consideration of the following requirements of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation), *State Significant Infrastructure Guidelines* and the Secretary's Environmental Assessment Requirements (SEARs) (Attachment 1) as they relate to consideration of alternatives.

Clause 192(1)(c), Part 8 of the EP&A Regulation requires that an environmental impact statement must include:

> *(c) an analysis of feasible alternatives to the carrying out of the development, activity or infrastructure, considering its objectives, including the consequences of not carrying out the development, activity or infrastructure …*

The EP&A Regulation also requires that an environmental impact statement for State Significant Infrastructure must have regard to the *State Significant Infrastructure Guidelines* (see clause 179(4) of Part 8]), which relevantly state in regard to consideration of alternatives:

> *This section* [Strategic Context] *should also include an analysis of feasible alternatives considered having regard to the objectives of the project, including the consequences of not carrying out the project.*
>
> *The analysis of alternatives should explain how the project has ended up in its current form, summarising the key alternatives that have been considered and rejected (e.g. alternative ways of achieving the objectives of the project; and alternative sites, designs, mitigation measures) and the reasons why they were rejected.*

The SEARs for the Dendrobium Mine Extension Project (the Project) (Attachment 1) require:

> *1. **Justification and Alternatives** – including:*
>
> *…*
>
> *- a comprehensive assessment of alternatives, including alternative mine design (including panel dimensions and layout), mining methods (including minimal subsidence options such as bord and pillar/partial extraction) and coal supply (including supply from other coal operations in the Southern coalfields);*
>
> *- The consideration of alternatives must be supported by an assessment comparing the social, economic and environmental impacts of each feasible alternative, a risk evaluation of options and justification for why each alternative has not been adopted; and*

Accordingly, this Attachment analyses the proponents view on the key, feasible alternative mine designs, as well as key potential alternative coal supply options to the BlueScope Port Kembla Steelworks and the consequences of not carrying out the Project. It should be noted the analysis of alternatives is in relation to the Project as proposed in the EIS, hence comparative analysis against the objectives of the Project (described below) and potential social, economic and environmental impacts is provided.

Objectives of the Project

The EP&A Regulation requires for State Significant Infrastructure that an environmental impact statement must include a statement of the objectives of the infrastructure (see clause 192(1)(b) of Part 8 of the EP&A Regulation).

The objectives of the Project (Section 8.1.1) can be summarised as follows:

- To facilitate continuity of mining at the Dendrobium Mine, directly through the addition of Area 5 for the Project, and also indirectly as the Project supports the financial sustainability of Illawarra Metallurgical Coal (IMC) (Dendrobium Mine and Appin Mine) as well as the broader Southern Coalfield economic ecosystem.
- To address the IPC's concerns for the previous application.
- To avoid and minimise impacts on the Metropolitan Special Area.

Approach to Consideration of Alternatives

This Attachment considers the following key feasible alternatives to the Project:

- **Consequences of not proceeding with the Project**:
  - The direct and indirect socio-economic implications of the Project not proceeding to the financial sustainability of IMC and to the broader Southern Coalfield economic ecosystem.
  - The implications for continued supply of metallurgical coal to the BlueScope Port Kembla Steelworks if it was reliant on supply from other (non-IMC) operations.
- **Alternative longwall mining locations** within IMC's existing coal tenements:
  - Areas 4, 5 and 6.
  - Areas 5 and 6 (i.e. the previous application).
  - Area 5 (as per the previous application).
- **Alternative underground mining methods** within the Project underground mining area (Area 5) (noting open cut mining is not considered a feasible alternative):
  - Bord and pillar.
- **Alternative longwall layouts** within the Project underground mining area to further avoid mining directly beneath surface features:
  - WaterNSW 'significant' streams.
  - Upland swamps.
  - Aboriginal heritage sites.
- **Alternative mine parameters** within the Project underground mining area to consider the implications to sub-surface fracturing and potential surface water losses:
  - Panel width.
  - Panel height.

Summary of Consideration of Alternatives

A summary of the consideration of the key alternatives is below.

Consequences of not Proceeding with the Project

- If the Project were not to proceed, while there would be reduced environmental impacts, there would be likely significant adverse socio-economic implications given that:
  - In the absence of the Project, operations at the Dendrobium Mine would cease following the completion of approved mining, with associated:
    - Discontinuation of employment opportunities for the existing Dendrobium Mine and the Project, royalty payments, taxes and expenditure with regional businesses.
    - Increased risks to the financial sustainability of the Appin Mine, as continued operation of the Dendrobium Mine via the Project offsets the higher costs of IMC's Appin mine operations, and as such supports the financial sustainability of IMC and the broader Southern Coalfield economic ecosystem.
    - Increased risks of impacts on downstream industries in the Southern Coalfield economic ecosystem that currently transport or directly use coal from the Dendrobium Mine, including Port Kembla Coal Terminal (PKCT) and Port Kembla Steelworks.

- There would also be increased risks to the availability of local supplies of metallurgical coal to the Port Kembla Steelworks, given that:
    - Non-IMC coal supplies are not currently approved past 2033, compared to anticipated demand up to 2046 based on BlueScope's recent decision to seek Infrastructure Approval for the Blast Furnace No. 6 Reline Project.
    - As such, while BlueScope may be able to source alternate supplies of metallurgical coal locally, the quantity and longevity of this option is uncertain.
    - It should be noted that, ultimately, decisions around coal supplies and blends as important ingredients for steelmaking lie with the end user and any coal supply arrangement is contingent upon future decisions by and agreements between the end user and supplier as to coal supply. As such, while BlueScope has stated that over 80% of its coal supplies are currently sourced from mines in the Illawarra Region[1], with IMC currently supplying approximately 60% of its total hard coking coal requirements, the make-up of specific future coal supplies to the Port Kembla Steelworks is outside of IMC's control. Similarly, decisions by non-IMC operations regarding their product sales is outside of IMC's control.

Alternative Longwall Locations to the Project

- Alternative longwall locations, including scenarios involving underground mining larger portions of IMC's existing tenements compared to the Project, which could result in increased resource recovery, may also result in associated increased economic, environmental and social impacts.
- While these alternative locations could potentially meet the Project objective of continuity of mining, it is considered they would not meet the Project objective of addressing the concerns raised by the IPC.
- Accordingly, these alternatives were not adopted for the Project.

Alternative Underground Mining Methods within the Project Underground Mining Area

- Bord and pillar mining would not be economic for the Project, and would not meet the Project objective of continuity of mining.
- The consequences of not carrying out the Project are described above.
- Accordingly, alternative mining methods were not adopted for the Project.

Alternative Longwall Layouts within the Project Underground Mining Area

- The Project has already significantly reduced potential impacts compared to the previous application, including an approximately 60% reduction in mining area, no mining beneath 3rd order and above streams, and no mining beneath previously identified high archaeological (scientific) significance Aboriginal heritage sites, and is therefore considered to address the concerns raised by the IPC.
- Reductions in longwall layout to further reduce potential impacts to surface features are not considered reasonable and feasible as:
    - Avoidance of streams defined as 'significant' by WaterNSW and upland swamps would result in a mine plan that is not economically sustainable.
        - These alternatives would not meet the Project objective of continuity of mining.
        - The consequences of not carrying out the Project are described above.
        - Accordingly, these alternatives were not adopted for the Project.

1 BlueScope Steel Limited (2020) Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission.

  - Any mine design seeking to achieve no risk of impact to Aboriginal cultural heritage may not be economically sustainable.
    - Avoidance of directly mining beneath previously identified Aboriginal heritage sites (which are identified as having low or medium archaeological [scientific] significance) would result in a decrease in resource recovery and a mine plan that may be less economically sustainable, and would not achieve no risk of potential impact.
    - There are other factors that affect potential impacts to cultural values, for example potential impacts to streams, and for some stakeholders, any mining development may be considered to impact intangible cultural values.
    - This alternative would not meet the Project objective of continuity of mining and/or would not materially change the Project objective relating to addressing the IPC concerns or minimising potential impacts.
    - Accordingly, this alternative was not adopted for the Project.

Alternative mine parameters within the Project

- The Project has already significantly reduced potential surface water impacts compared to the previous application, and is therefore considered to address the concerns raised by the IPC.
  - As the Project targets areas of relatively higher depth of cover and lower cutting height (in the Bulli Seam) there is no predicted seam-to-surface fracturing (or free drainage) when calculated using the Tammetta Equation.
  - There is an estimated reduction of approximately 78% in peak annual surface water losses for the Project compared to the previous application.
  - It is proposed that surface water offsets would be provided for the Project, consistent with the terms agreed with the NSW Government for the previous application.
- Reductions in longwall width and/or cutting height to limit the predicted height of connective fracturing would adversely affect the financial sustainability of the Project and are not considered reasonable and feasible given that:
  - Significant reductions in longwall widths/cutting heights to limit the predicted height of fracturing using the Tammetta Equation to below the Bald Hill Claystone (as suggested by the IAPUM) would not be financially sustainable given the significantly increased operating costs and reduced resource recovery.
  - Marginal reductions in longwall width/cutting heights are not expected to materially change potential surface water losses (i.e. surface water losses would occur and surface water offsets would be required).
  - Accordingly, these alternatives do not satisfy the Project objectives of maintaining longwall continuity and/or would not materially change the Project objective relating to addressing the IPC concerns or minimising potential impacts. The consequences of not carrying out the Project are described above.
  - It is noted that subsidence-related effects for reduced longwall width and cutting height would still be sufficient to result in impacts and consequences to surface features, and as such, these alternatives would not satisfy the Project objective of minimising impacts in the Metropolitan Special Area. Consideration of alternative mine layouts is provided above.
- Accordingly, these alternatives were not adopted for the Project.

A11.2 CONSEQUENCES OF NOT PROCEEDING WITH THE PROJECT

A11.2.1 Direct and Indirect Consequences

The Project is required to facilitate the continuation of the Dendrobium Mine, with uncertainty regarding the ability to extract the remaining resource in the approved Area 3C and the timing, which is contingent on IMC's ability to effectively drain gas from the seam to achieve levels that facilitate safe extraction of the resource. In the absence of the Project there will be longwall discontinuity and, therefore, no production from the Dendrobium Mine, which will potentially make the Dendrobium Mine (as well as Area 3C) and IMC less financially sustainable.

Were the Project not to proceed, the following consequences are inferred:

- 31 million tonnes (Mt) of additional ROM coal extracted over the life of the Project would not be mined;
- approximately 650 existing employment opportunities would be discontinued following completion of currently approved mining activities at the Dendrobium Mine;
- an additional 100 direct construction employment opportunities and a peak of up to 700 on-site direct operational employment opportunities and associated flow-on effects would not be created;
- additional tax revenue from the Project would not be generated (Appendix L);
- additional royalties to the State of NSW would not be generated (Appendix L);
- a net benefit of $649 million (in Net Present Value [NPV] terms) to the State of NSW and $264 million (NPV) to the greater Wollongong Region would be forgone (Appendix L);
- the potential incremental environmental impacts described in this EIS would not occur;
- economic and social benefits to the region (including to the Wollongong, and Wollondilly and Wingecarribee LGAs) associated with the Project would not be realised; and
- the Project biodiversity offsets and water offsets would not be established.

The independent economic study (BAEconomics, 2020) stated that the future of IMC and the broader Southern Coalfield economic ecosystem is also related:

> *… the historical linkages and dependencies between Illawarra Metallurgical Coal and the primary steelmaking operations at BlueScope mean that the failure of one will compromise the other.*

The continued operation of the Dendrobium Mine via the Project (which offsets the higher costs of IMC's Appin mine operations) supports the financial sustainability of IMC and the broader Southern Coalfield economic ecosystem.

As such, the cessation of the Dendrobium Mine would also have impacts on downstream industries in the Southern Coalfield economic ecosystem that currently transport or directly utilise Project coal, including PKCT and Port Kembla Steelworks.

A11.2.2 Consequences to Coal Supply to the Port Kembla Steelworks

Consideration has been given to the following potential supply options for the BlueScope Port Kembla Steelworks based on publicly available information at the time of writing:

- **Supply from Appin Mine**: consideration of supplies from IMC's Appin Mine (in isolation).
- **Non-IMC coal supplies**: consideration of supplies from local coal mines not operated by IMC.
- **Non-local coal supplies**: consideration of supplies from outside the Illawarra Region.

It should be noted that, ultimately, decisions around coal supplies and blends as important ingredients for steelmaking lie with the end user and any coal supply arrangement is contingent upon future decisions by and agreements between the end user and supplier as to coal supply. As such, while BlueScope has stated that over 80% of its coal supplies are currently sourced from mines in the Illawarra Region[2], with IMC currently supplying approximately 60% of its total hard coking coal requirements, the make-up of specific future coal supplies to the Port Kembla Steelworks is ultimately outside of IMC's control. Similarly, decisions by other coal operations regarding their product sales is outside of IMC's control.

For the scenarios described above it is assumed the Port Kembla Steelworks will require supply of approximately 2.4 million tonnes per annum (Mtpa) of local metallurgical coal (and up to 3 Mtpa of metallurgical coal in total) until at least approximately 2046, given:

- In their submission to the IPC on the previous application, BlueScope stated that the Port Kembla Steelworks consumes approximately 3 Mtpa of metallurgical coal, of which over 80% is sourced from mines in the Illawarra Region[3].
- BlueScope is seeking Infrastructure Approval for the Port Kembla Steelworks Blast Furnace No. 6 Reline Upgrade Project (Blast Furnace No. 6 Reline Project), which would involve:
  - a capital investment value of $700 - $800 million for the Blast Furnace No. 6 Reline Project[4]; and
  - an operational lifespan of approximately 20 years, with expected commissioning between 2026 and 2030[5].
- The declaration by the Minister for Planning and Public Spaces of the Blast Furnace No. 6 Reline Project as Critical State Significant Infrastructure (CSSI)[6], acknowledging the Port Kembla Steelworks, is essential to NSW for economic and employment reasons (e.g. significant benefits to NSW).
- BlueScope have reiterated the need for continued supply of metallurgical coal for steelmaking as emerging "green steel" technologies are not yet ready for large-scale implementation, and would not be ready in the timeframes required for BlueScope to continue operations[7].
- BlueScope has outlined the increased capital and operational costs associated with sourcing metallurgical coal from mines outside the Illawarra Region (BlueScope Steel Limited, 2020).

In summary:

- Based on current approvals, or currently proposed modifications, non-IMC metallurgical coal supplies from the Illawarra Region will cease by 2033, whereas it is anticipated the relined Blast Furnace No. 6 at the Port Kembla Steelworks will operate for 20 years from approximately 2026-2030 following the $700 - $800 million capital investment for the reline by BlueScope in the early 2020s.
- Accordingly, BlueScope would be reliant on local metallurgical coal supplies from IMC (which includes Appin Mine and the Dendrobium Mine [including the Project]) beyond 2033, unless approvals for new resources are granted (for which there is no certainty of approval). It should be noted that by 2033, is it anticipated the relined Blast Furnace No. 6 would only be three to seven years into its expected 20-year life. It is noted IMC currently supplies approximately 60% of its total hard coking coal requirements, and it is expected that supply from IMC to BlueScope will continue up to 2033.

2 BlueScope Steel Limited (2021) BlueScope submission for the Independent Planning Commission's consideration of the Tahmoor South Coal Project
3 BlueScope Steel Limited (2020) *Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission*.
4 BlueScope (2021) *Port Kembla Steelworks Blast Furnace Reline Announcement*.
5 BlueScope Steel (AIS) Pty Ltd (2021) *No. 6 Blast Furnace Reline and Operations Scoping Report*.
6 Department of Planning, Industry and Environment (2021) *Statement of Reasons Declaration of Critical State Significance Infrastructure – Blast Furnace No. 6 Reline*.
7 BlueScope (2021) *Port Kembla Steelworks Blast Furnace Reline Announcement*.

- Approval of the Project could facilitate coal supplies being available from the Dendrobium Mine from Area 5 and potentially Area 3C beyond 2033. The Dendrobium Mine (including the Project) also offsets the higher cost operations of IMC's Appin Mine, which is approved to operate until 2041. In the absence of the Project, the Dendrobium Mine and Appin Mine may become less financially sustainable, which increases the risk that IMC mines are not available to supply metallurgical coal to the Port Kembla Steelworks, including for the period after 2033 when there are no other approved local coal supplies. Any potential supply (including beyond 2033) is subject to future decisions by and agreement of IMC and BlueScope.
- Even if the Appin Mine continues to operate (if the Project is not approved), reliance on a single local metallurgical coal supply beyond 2033 may result in increased risk of supply discontinuity to the Port Kembla Steelworks, which operates on a "just-in-time" supply basis (e.g. if there were unforeseen extended production shutdowns at the Appin Mine due to gas management, geological structure, water management or other operations issues). BlueScope has outlined the adverse impact of discontinuity of its just-in-time local coal supply (BlueScope Steel Limited, 2020).
- In addition, if the Project was not approved, and the Appin Mine were to close, it could affect the financial sustainability of other local producers' customers in the Southern Coalfield economic ecosystem, such as the PKCT, as outlined in BAEconomics (2020)[8].
- Noting that there are no other hard coking coal reserves in NSW, there would be lost royalties, employment and other economic benefits to NSW if metallurgical coal supply from the Illawarra Region to the Port Kembla Steelworks was discontinued.

Supply from the Appin Mine

The Appin Mine (Project Approval 08_0150) is owned by IMC and was approved in December 2011. The Appin Mine is approved to produce up to 9.3 Mtpa of product coal until 31 December 2041. The Appin Mine is a higher-cost operation than the Dendrobium Mine (including the Project), as it is deeper, faces significant technical challenges (e.g. geology, gas management and water management) and transport costs to Port Kembla are greater (i.e. greater distance, rail transport is not available so coal is transported via on-road haul trucks).

The continued operation of the Dendrobium Mine via the Project offsets the higher costs of the Appin Mine operations. The Project also allows for possible access to the remaining reserves in Dendrobium Area 3C while gas drainage occurs. These factors mean the Project supports the financial sustainability of all IMC operations.

Therefore, the Project provides greater certainty for the continued operations of the Appin Mine, allows potential access to Dendrobium Area 3C and the possible continuation of coal production facilities beyond 2033. The Project is, therefore, an important potential source of coal supply to the Port Kembla Steelworks as other local supply is not approved beyond 2033 (as described above).

Further, solely relying on IMC's Appin Mine (if the Project were not to be approved) for supply of local metallurgical coal may give rise to a greater risk of supply interruptions at the Port Kembla Steelworks (e.g. disruptions to the supply from Appin Mine due to unforeseen issues).

In their submission to the IPC on the previous application, BlueScope emphasised the importance of continual supply of locally sourced metallurgical coal to the Port Kembla Steelworks, stating:

> *There are no facilities at Port Kembla Steelworks to allow BlueScope to stockpile coal sufficient to feed the coal beds, and therefore the operation of the Steelworks is reliant on uninterrupted just-in-time supplies of coal from the Southern Coalfields.* [9]

The continued operation of the Dendrobium Mine via the Project, in conjunction with the Appin Mine, could provide an alternative local source of coal supply which could limit the reliance of the Port Kembla Steelworks on a sole supply of local coal from the Appin Mine, particularly beyond 2033 when other local supply is not approved.

[8] BAEconomics (2020) *Review of the Key Economic Interactions between the Dendrobium Mine and Related Entities in the Wollongong Region*.

[9] BlueScope Steel Limited (2020) *Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission*.

Non-IMC Local Coal Supplies

Currently approved or proposed non-IMC, local metallurgical coal sources that could potentially supply the Port Kembla Steelworks are the Metropolitan Mine, Tahmoor Colliery, approved Russell Vale Underground Project and the proposed Wongawilli Colliery (Modification 2) (Figure A11-1).

Graph A11-1 shows the cumulative production profile of the available local supplies of metallurgical coal in the Illawarra Region to the Port Kembla Steelworks, as well as the assumed metallurgical coal demand and lifespan of the Port Kembla Steelworks (as described above). It is acknowledged that further approvals may be obtained to either extend the life of existing operations or access additional reserves beyond those shown on Graph A11-1.

Local supplies of metallurgical coal from non-IMC coal supplies are not currently approved past 2033, compared to anticipated demand up to 2046. While BlueScope may be able to source alternate supplies of metallurgical coal locally, the quantity and longevity of this option is uncertain.

Given this, IMC may be able to continue to supply metallurgical coal to BlueScope beyond 2033 from the Dendrobium Mine and the Appin Mine if the Project was approved, in line with the planned continuation of the blast furnace operations via the Blast Furnace No. 6 Reline Project. As previously indicated, any potential supply is subject to future decisions by, and agreements of, users and suppliers including as to specification blends and terms of supply. IMC has the potential to blend products to achieve customer specifications.

Non-local Supply from Outside the Illawarra Region

Local supply of metallurgical coal creates a competitive advantage for steelmaking facilities, as coal can be supplied on a just-in-time basis, and there are no costs or delays associated with importing coal by ship.

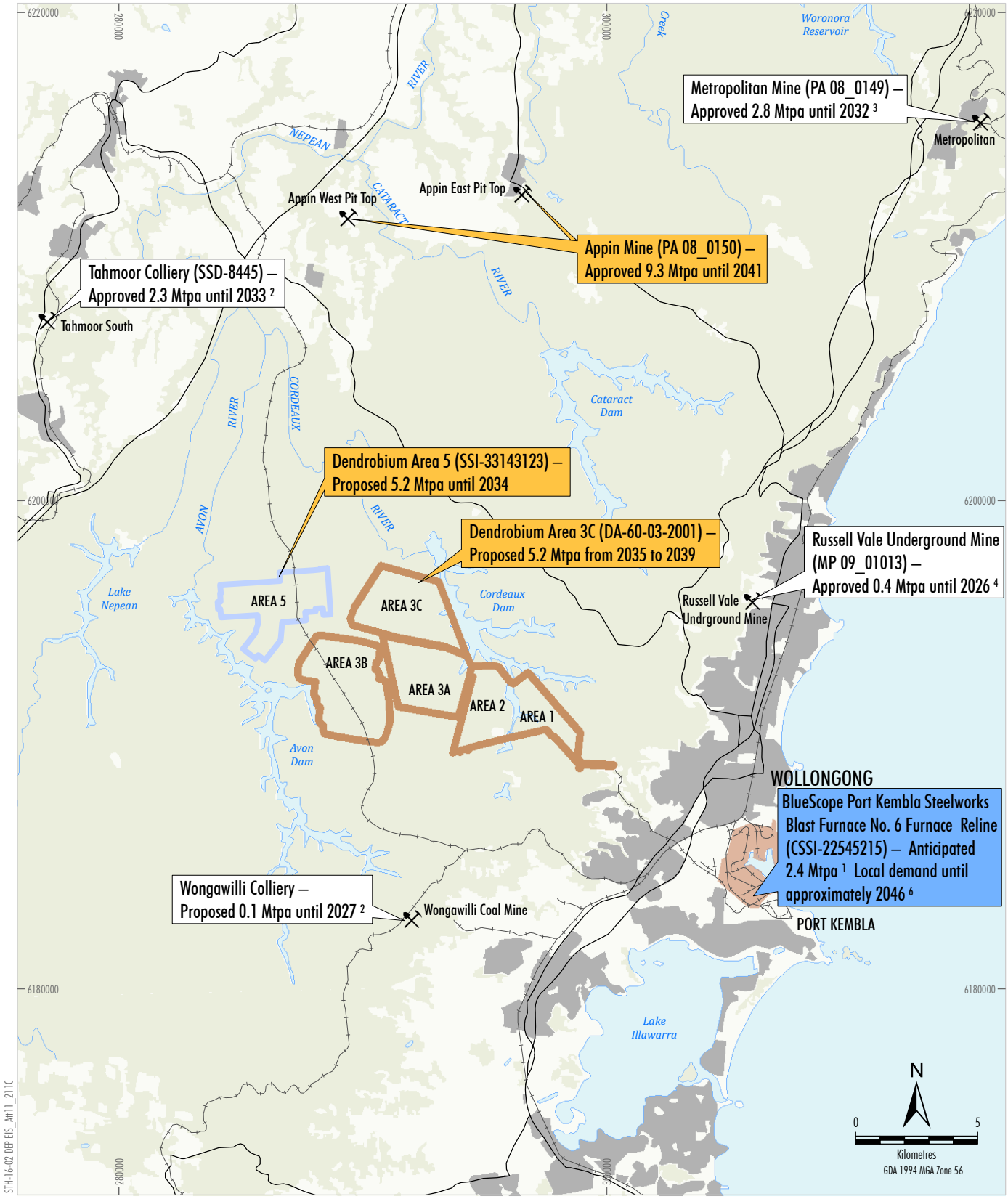
Any increase in seaborne coal supply delivered to the Port Kembla Steelworks is likely to be at an overall higher delivered cost per tonne than equivalent local coal supply.

The importance of multiple local metallurgical coal supplies to the Port Kembla Steelworks is also outlined by the ACCC (2017), which noted the disadvantages the Port Kembla Steelworks may face if it were required to source metallurgical coal from the Bowen Basin in Queensland (rather than the Illawarra Region):

> *… there is significant additional cost associated with transporting substitutable coking coal from alternative sources to the Australia steelmakers as well as potential capacity constraints limiting the ability of one steelmaker to import large volumes of coal by ship.*
>
> *… In relation to transportation costs, BlueScope would incur significantly higher freight logistics costs to ship coal from the Bowen Basin via the Queensland coal exporting ports to its steel mill at Port Kembla compared to the costs associated with the supply of coal from South32 and Metropolitan's mines in the Illawarra to its steelworks at Port Kembla. Market inquiries indicate that the cost of transporting coal from the Bowen Basin to Port Kembla is likely to be between $US10-15 per tonne.*[10]

Furthermore, supplying the Port Kembla Steelworks with metallurgical coal produced from interstate (or overseas) would not allow for additional royalties to the State of NSW to be generated from metallurgical coal produced in the Southern Coalfield, and potential economic and social benefits to NSW and the Illawarra Region associated with producing local metallurgical coal would not be realised.

[10] Australian Competition and Consumer Commission (2017) *Statement of Issues – South32 Proposed Acquisition of Metropolitan*.



STH-16-02 DEP EIS_Art11_211C

LEGEND

- Road
- Railway
- Urban Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Extension Project

Note:

1. *80% of 3 Mtpa of coal used (i.e. 2.4 Mtpa) is locally sourced based on BlueScope Steel Limited (2020) Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission.*
2. *23 Mt of product coking coal over 10 years (i.e. 2.3 Mtpa) based on SIMEC (2020) Second Project Amendment Report - Appendix A - Updated Project Description and approval until December 2033 based on Development Consent SSD-8445.*
3. *2.8 Mtpa of product coal and approval until June 2032 based on Project Approval MP 08-0149 for the Metropolitan Mine.*
4. *3.7 Mtpa of ROM coal over five years at 57% coking coal product based on NSW Independent Planning Commission (2020) Russell Vale Underground Expansion Statement of Reasons for Decision assuming commencement in 2022.*
5. *0.486 Mt of ROM coal over five years (i.e. ~0.1 Mtpa) based on Wollongong Coal Pty Ltd (2021) Wongawilli Colliery Modification 2 - North West Mains Development Submissions Report.*
6. *Approximate commissioning timeframe (2026 to 2030) and lifespan of the Re-lined Blast Furnace No. 6 (i.e. 20 years) based on BlueScope Steel (AIS) Pty Ltd (2021) No. 6 Blast Furnace Reline and Operations Scoping Report.*

Source: Geoscience Australia, 2006; Department of Industry (2018); Department of Finance, Services & Innovation (2018);

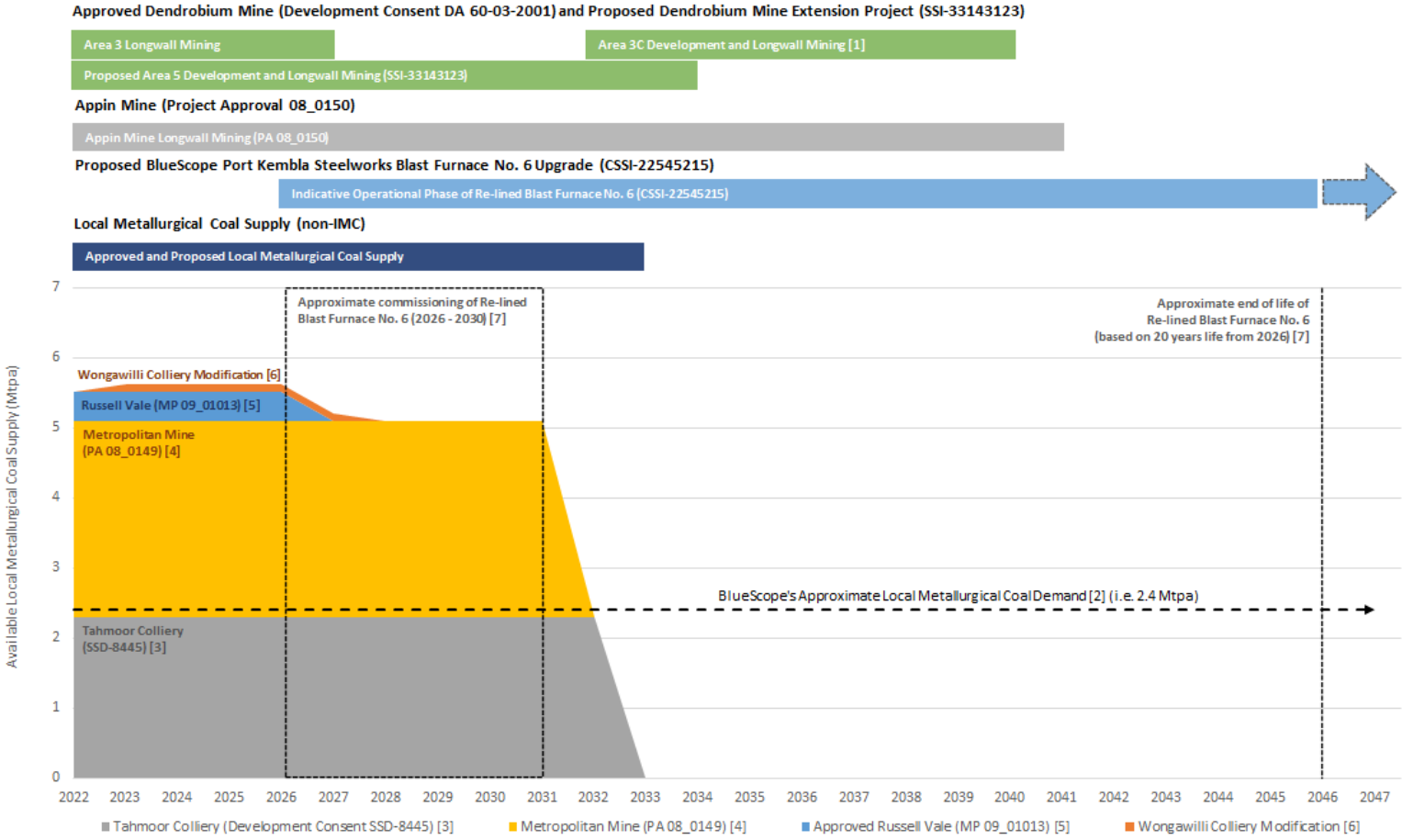
SOUTH32
Illawarra Coal

DENDROBIUM MINE

Surrounding Mining Operations Producing Local Metallurgical Coal

Figure A11-1

Graph A11-1
Available Local Metallurgical Coal Supply from Non-IMC Operations and BlueScope's Local Metallurgical Coal Demand



Notes:
[1] Mining in the majority of Area 3C (i.e. areas where there is currently high gas content) after 31 December 2030, under Development Consent DA 60-03-2001, would be subject to a separate application for approval.
[2] 80% of 3 Mtpa of coal used (i.e. 2.4 Mtpa) is locally sourced based on BlueScope Steel Limited (2020) Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission.
[3] 23 Mt of product coking coal over 10 years (i.e. 2.3 Mtpa) based on SIMEC (2020) Second Project Amendment Report - Appendix A - Updated Project Description and approval until December 2033 based on Development Consent SSD-8445.
[4] 2.8 Mtpa of product coal and approval until June 2032 based on Project Approval MP 08-0149 for the Metropolitan Mine.
[5] 3.7 Mtpa of ROM coal over five years at 57% coking coal product based on NSW Independent Planning Commission (2020) Russell Vale Underground Expansion Statement of Reasons for Decision assuming commencement in 2022.
[6] 0.486 Mt of ROM coal over five years (i.e. ~0.1 Mtpa) based on Wollongong Coal Pty Ltd (2021) Wongawilli Colliery Modification 2 - North West Mains Development Submissions Report.
[7] Approximate commissioning timeframe (2026 to 2030) and lifespan of the Re-lined Blast Furnace No. 6 (i.e. 20 years) based on BlueScope Steel (AIS) Pty Ltd (2021) No. 6 Blast Furnace Reline and Operations Scoping Report.

A11.3 ALTERNATIVE LONGWALL MINING LOCATIONS

This section describes the consideration of alternative longwall mining locations within IMC's existing coal tenements:

- Areas 4, 5 and 6 ("maximum case").
- Areas 5 and 6 (the previous application).
- Area 5 (as per the previous application).

A11.3.1 Maximum Case

This alternative considers longwall mining in Area 4 as well as Areas 5 and 6 (as per the previous application). The indicative mining area is shown in Figure A11-2.

An assessment of this alternative is provided in Tables A11-1 and A11-2.

Based on the key mine design metrics, this alternative mine plan is considered to be economically sustainable. However, while the inclusion of Area 4, Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure), this alternative mine design is not proposed in consideration of potential environmental impacts (including the significant number of swamps in Area 4) and the potential increase in potential impacts for the key issues identified by the IPC for the previous application.

Table A11-1
Mine Design and Assessment of Economic Sustainability – Maximum Case

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Increase in mine plan extent (additional Areas 4 and 6 and increased extent of Area 5).	↑
Target coal seams	• Bulli Seam (Area 5) and Wongawilli Seam (Areas 4 and 6).	↑
Coal product types	• No change – majority metallurgical coal with small portion of thermal or PCI coal (e.g. heat-affected portions of the Bulli Seam in the northern part of Area 5).	–
Indicative resource	• Relative increase compared to Project.	↑
Indicative resource value	• Relative increase compared to Project.	↑
Indicative royalty value	• Relative increase compared to Project.	↑
Mine life	• Increased mine life due to increased resource recovery.	↑
Employment	• Increased peak employment due to increased development and surface infrastructure, as well as increased mine life.	↑
Panel width	• No change – 305 m (as per the Project and previous application).	–
Surface development	• Increased surface disturbance relative to the Project to facilitate additional ventilation, gas management, etc.	↑
Capital costs	• Increased capital costs associated with additional underground development, surface infrastructure and potential additional/replacement longwall machine.	↑

Table A11-1 (Continued)
Mine Design and Assessment of Economic Sustainability – Maximum Case

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics (continued)		
Operational costs	• Increased operational costs proportional to increased resource recovery (e.g. increased mining rate and/or mine life duration) and employment.	↑
Assessment of Economic Sustainability		
Expected to be economically sustainable given significantly increased resource recovery.		

Table A11-2
Consideration of Environmental, Social and Economic Aspects – Maximum Case

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[11]
Key Environmental Considerations[12]			
Surface water losses (including post-mining)	• Mechanism 1[13] losses – increase of diversion of surface water flows due to subsidence-related impacts to stream beds (e.g. cracking) as a result of mining beneath increased length of streams. • Mechanism 2 losses – increased risk of losses due to connective fracturing due to increased mining footprint, including in areas of lower depth of cover relative to the Project. • Mechanism 3 losses – increase in spatial extent of surface water losses due to groundwater depressurisation as a result of increased mining footprint.	↑	x
Surface water quality (including post-mining)	• Increase in risk of water quality impacts due to mining beneath increased length of streams (e.g. with associated risk of iron staining). • Increased risk of post-mining water quality impacts as greater extent of post-mining re-pressurisation including via surface and sub-surface fracture networks.	↑	x

11 Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
12 Generally as per key residual environmental issues identified by the IPC for the previous application.
13 Mechanism 1, 2 and 3 defined as per the Submissions Report for the previous application, as follows:

Mechanism 1 *– Surface Water Diversion (within the mine footprint). Localised surface water losses due to subsidence-related impacts such as cracking of stream beds. Where localised surface water losses re-emerge downstream (i.e. the surface fracture network does not interact with sub-surface fracturing connected to the goaf) there is no net loss to catchment surface water supplies.*

Mechanism 2 *– Permanent Surface Water Diversion (within the mine footprint). As per Mechanism 1, however, this mechanism relates to situations where the surface fracture network interacts with sub-surface fracturing, and surface water does not re-emerge downstream (i.e. it is transmitted to the groundwater system and possibly to mine workings) and therefore is no longer available as surface water supply within the catchment.*

Mechanism 3 *– Groundwater Depressurisation (beyond the mine footprint). Beyond the extent of the area potentially affected by subsidence, groundwater drawdown can increase leakage from (or reduce baseflow to) surface water. That is, this mechanism is not necessarily directly associated with subsidence (or other physical) impacts to the beds of the surface water bodies, rather, losses are a result of changes in the hydraulic gradient of surface water and groundwater interactions.*

Table A11-2 (Continued)
Consideration of Environmental, Social and Economic Aspects – Maximum Case

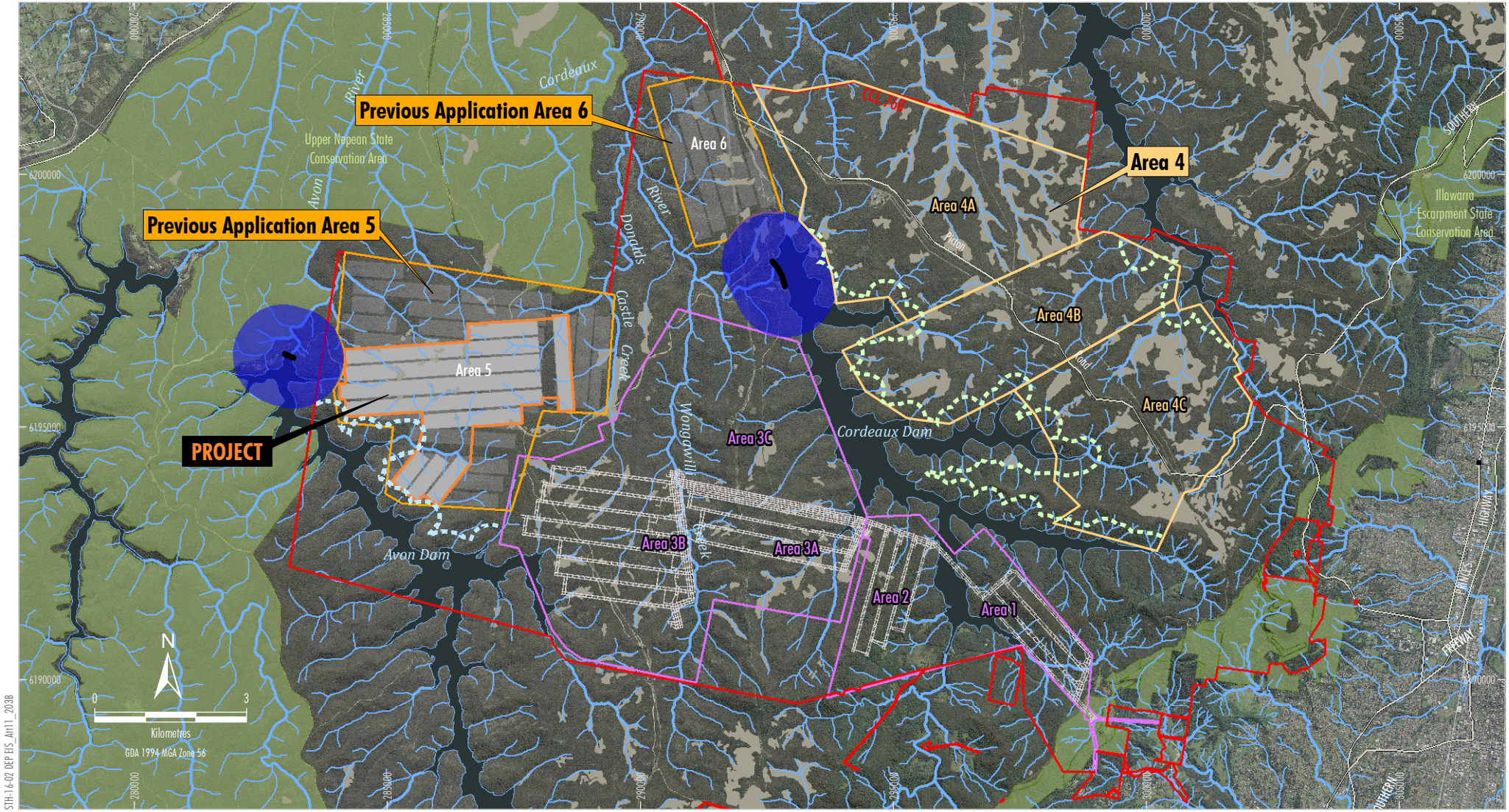
CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[14]
Key Environmental Considerations (continued)[15]			
Biodiversity impacts (including upland swamps)	• Upland swamps – risk of hydrological changes to increased number of upland swamps, including OEH (2012) "key swamp clusters" in Area 4. • Subsidence-related consequences to threatened species – increased risk of impacts due to increased area of potential habitat susceptible to subsidence-related impacts (e.g. streams, pools, upland swamps, cliffs) mined beneath. • Surface disturbance – increased surface disturbance and associated impacts to biodiversity.	↑	x
Aboriginal heritage and cultural values	• Increased risk of impacts to Aboriginal heritage sites and other matters affecting cultural values due to increased mining footprint.	↑	x
Compatibility with the Special Catchment Area	• Mining beneath greater area of Special Catchment Area.	↑	x
Offsets	• Surface water quantity and quality – increased surface water offset payment proportional with increased impacts, noting this would result in increased payments to the NSW Government to achieve a net gain to Sydney's drinking water supplies. • Biodiversity – increased biodiversity impacts proportional with increased area mined beneath, noting offsets would be calculated in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) and NSW *Biodiversity Assessment Method* (BAM), and therefore security of the required offsets would achieve "no net loss" of biodiversity.	↑	x
Fugitive greenhouse gas emissions	• Increased fugitive greenhouse gas emissions as a result of increased mining area.	↑	x
Key Social Considerations			
Positive social	• Increased positive social impacts associated with increased employees and duration of employment.	↑	✓
Negative social	• Increased negative social impacts associated with community concerns relating to increased extent and duration of potential environmental impacts.	↑	x
Key Economic Considerations			
Direct net economic benefits	• Increased direct economic benefits to NSW due to increased coal extraction and mine life duration, with associated increase in royalty payments to NSW, employment benefits and payments of taxes. • While there would likely be increased externalities, including increased cost of greenhouse gas emissions, it is expected net benefits would increase.	↑	✓

[14] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
[15] Generally as per key residual environmental issues identified by the IPC for the previous application.

Table A11-2 (Continued)
Consideration of Environmental, Social and Economic Aspects – Maximum Case

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[16]
Key Economic Considerations (continued)			
Indirect and flow-on economic benefits	• Increased flow-on economic benefits, due to increased financial sustainability of other operations in the Southern Coalfield economic ecosystem, as well as increased duration of operational wage payments and expenditure with local suppliers.	↑	✓
Risk Evaluation and Justification			
• While the inclusion of Area 4, Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure), this alternative mine design is not proposed in consideration of potential environmental impacts (including the significant number of swamps in Area 4) and the potential increase in potential impacts for the key issues identified by the IPC for the previous application.			

[16] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.



LEGEND

- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Indicative Area 4 Extent
- Dendrobium Underground Mining Area - Previous Application
- Dendrobium Underground Mining Area - Extension Project
- Coastal Upland Swamp
- Streams -3rd and Higher Order
- Streams -1st and 2nd Order
- Dam Wall Setback (1 km)
- Cordeaux and Contaract Dams FSL 300 m Setback in Area 4
- Avon Dam FSL 300 m Setback in Lease

Note: Areas 4A, 4B and 4C represent indicative potential future mining domains only, within CCL 768.

Source: Geoscience Australia, (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018)

SOUTH32
Illawarra Coal

DENDROBIUM MINE

Maximum Case - Areas 4, 5 and 6

Figure A11-2

A11.3.2 Previous Application

This alternative considers longwall mining in Areas 5 and 6 (as per the previous application). The indicative mining area is shown in Figure A11-3.

An assessment of this alternative is provided in Tables A11-3 and A11-4.

This alternative mine plan is considered to be economically sustainable, as described in the EIS for the previous application. The inclusion of Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure). In addition, the NSW Government concluded the previous application was in the public interest in its "whole-of-government" Assessment Report. However, this alternative mine design is not proposed as it was refused by the IPC for the previous application.

Table A11-3
Mine Design and Assessment of Economic Sustainability – Previous Application

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Increase in mine plan extent (additional Area 6 and increased extent of Area 5).	↑
Target coal seams	• Bulli Seam (Area 5) and additional Wongawilli Seam (Area 6).	↑
Coal product types	• No change – majority metallurgical coal with portion of thermal or PCI coal (e.g. heat-affected portions of the Bulli Seam in the northern part of Area 5).	–
Indicative resource	• Relative increase compared to Project.	↑
Indicative resource value	• Relative increase compared to Project.	↑
Indicative royalty value	• Relative increase compared to Project.	↑
Mine life	• Increased mine life due to increased resource recovery.	↑
Employment	• Increased duration of employment due to increased development and surface infrastructure, as well as increased mine life.	↑
Panel width	• No change – 305 m (as per the Project and previous application).	–
Surface development	• Increased surface disturbance relative to the Project to facilitate additional ventilation, gas management, etc.	↑
Capital costs	• Increased capital costs associated with additional underground development, surface infrastructure and potential additional/replacement longwall machine.	↑
Operational costs	• Increased operational costs proportional to increased resource recovery (e.g. increased mining rate and/or mine life duration) and employment.	↑
Assessment of Economic Sustainability		
Financially sustainable given significantly increased resource recovery as per previous application.		

Table A11-4
Consideration of Environmental, Social and Economic Aspects – Previous Application

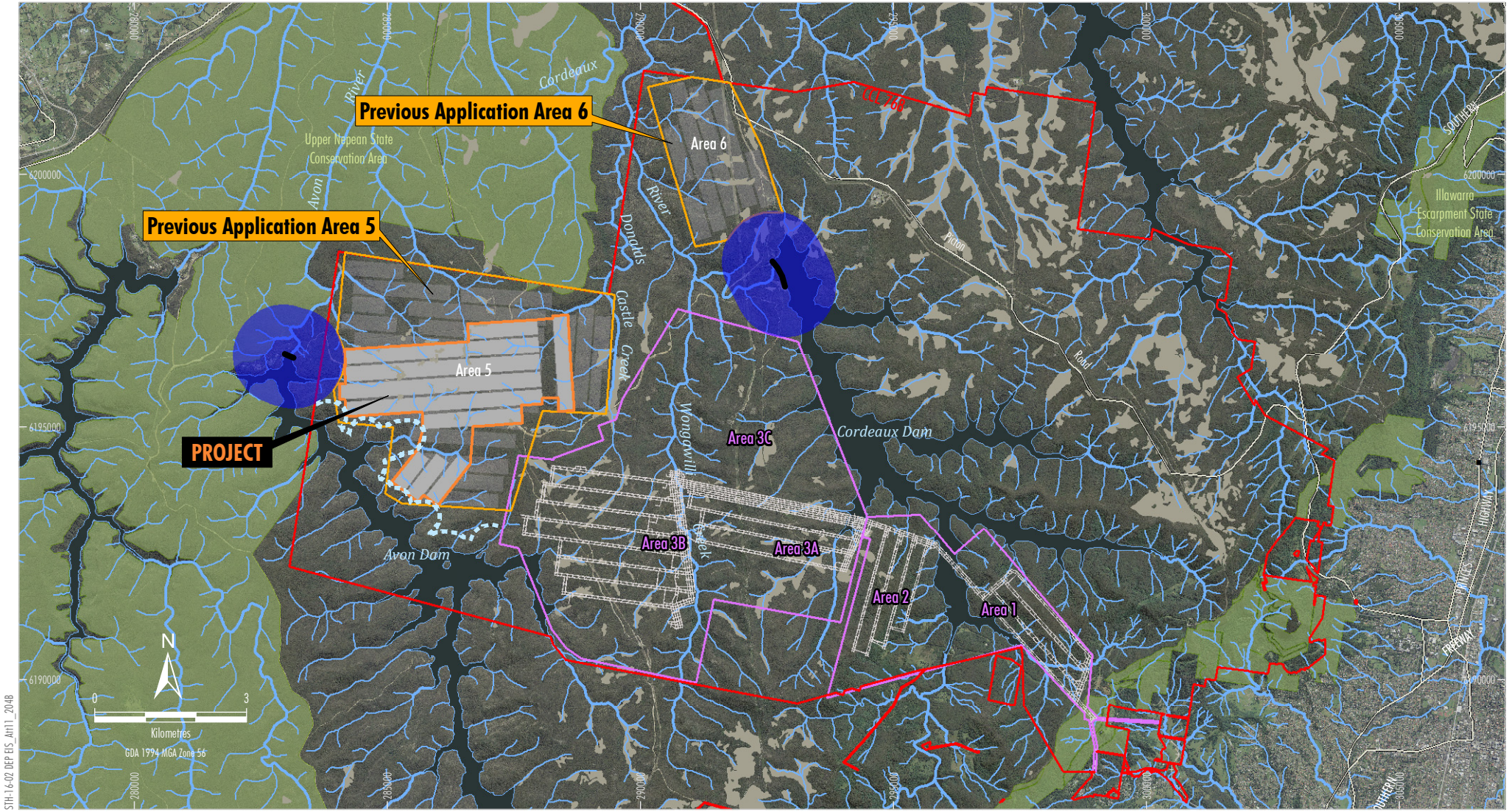
CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[17]
Key Environmental Considerations[18]			
Surface water losses (including post-mining)	• Mechanism 1 losses – increase of diversion of surface water flows due to subsidence-related impacts to stream beds (e.g. cracking) as a result of mining beneath increased length of streams. • Mechanism 2 losses – increased risk of losses due to connective fracturing due to increased mining footprint, including in areas of lower depth of cover relative to the Project. • Mechanism 3 losses – increase in spatial extent of surface water losses due to groundwater depressurisation as a result of increased mining footprint.	↑	x
Surface water quality (including post-mining)	• Increase in risk of water quality impacts due to mining beneath increased length of streams (e.g. with associated risk of iron staining). • Increased risk of post-mining water quality impacts as greater extent of post-mining re-pressurisation including via surface and sub-surface fracture networks.	↑	x
Biodiversity impacts (including upland swamps)	• Upland swamps – risk of hydrological changes to increased number of upland swamps. • Subsidence-related consequences to threatened species – increased risk of impacts due to increased area of potential habitat susceptible to subsidence-related impacts (e.g. streams, pools, upland swamps, cliffs) mined beneath. • Surface disturbance – increased surface disturbance and associated impacts to biodiversity.	↑	x
Aboriginal heritage and cultural values	• Increased risk of impacts to Aboriginal heritage sites and other matters affecting cultural values due to increased mining footprint.	↑	x
Compatibility with the Special Catchment Area	• Mining beneath greater area of Special Catchment Area.	↑	x
Offsets	• Surface water quantity and quality – increased surface water offset payment proportional with increased area mined beneath, noting this would result in increased payments to the NSW Government to achieve a net gain to Sydney's drinking water supplies. • Biodiversity – increased biodiversity impacts proportional with increased impacts, noting offsets would be calculated in accordance with the NSW BC Act and NSW BAM, and therefore security of the required offsets would achieve "no net loss" of biodiversity.	↑	x
Fugitive greenhouse gas emissions	• Increased fugitive greenhouse gas emissions as a result of increased mining area.	↑	x

[17] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
[18] Generally as per key residual environmental issues identified by the IPC for the previous application.

Table A11-4 (Continued)
Consideration of Environmental, Social and Economic Aspects – Previous Application

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[19]
Key Social Considerations			
Positive social	• Increased positive social impacts associated with increased employment and duration of employment.	↑	✓
Negative social	• Increased negative social impacts associated with community concerns relating to increased extent and duration of potential environmental impacts.	↑	x
Key Economic Considerations			
Direct net economic benefits	• Increased direct economic benefits to NSW due to increased coal extraction and mine life duration, with associated increase in royalty payments to NSW, employment benefits and payments of taxes. • While there would likely be increased externalities, including increased cost of greenhouse gas emissions, it is expected that net benefits would increase.	↑	✓
Indirect and flow-on economic benefits	• Increased flow-on economic benefits, due to increased financial sustainability of other operations in the Southern Coalfield economic ecosystem, as well as increased duration of operational wage payments and expenditure with local suppliers.	↑	✓
Risk Evaluation and Justification			
• The inclusion of Area 6 and the larger Area 5 (as per the previous application) would significantly increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure). In addition, the NSW Government concluded the previous application was in the public interest in its "whole-of-government" Assessment Report. However, this alternative mine design is not proposed as it was refused by the IPC for the previous application.			

[19] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.



LEGEND

- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Previous Application
- EIS Base Plan Longwalls
- Dendrobium Underground Mining Area - Previous Application
- Dendrobium Underground Mining Area - Extension Project
- Coastal Upland Swamp
- Streams -3rd and Higher Order
- Streams -1st and 2nd Order
- Dam Wall Setback (1 km)
- Avon Dam FSL 300 m Setback in Lease

Source: Geoscience Australia, (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018)

SOUTH32
Illawarra Coal

DENDROBIUM MINE

Previous Application (Area 5 and Area 6)

Figure A11-3

A11.3.3 Previous Application (Area 5 Only)

This alternative considers longwall mining in Area 5 (as per the previous application). The indicative mining area is shown in Figure A11-4.

An assessment of this alternative is provided in Tables A11-5 and A11-6.

Based on the key mine design metrics, this alternative mine plan is considered to be economically sustainable. However, while the inclusion of the larger Area 5 (as per the previous application) would increase resource recovery, with associated increases in economic benefits (including royalties, mine life, employment and direct expenditure), this alternative mine design is not proposed as IMC has re-designed the Area 5 mine plan to target the high-quality metallurgical coal resource with associated reductions in potential impacts on key features.

Table A11-5
Mine Design and Assessment of Economic Sustainability – Previous Application (Area 5 Only)

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Increase in mine plan extent of Area 5 compared to Project.	↑
Target coal seams	• No change – Bulli Seam (Area 5).	–
Coal product types	• Majority metallurgical coal with portion of thermal or PCI coal (e.g. heat-affected portions of the Bulli Seam in the northern part of Area 5). • Increased production of thermal coal products.	↑
Indicative resource	• Relative increase in total resource compared to Project.	↑
Indicative resource value	• Relative increase compared to Project.	↑
Indicative royalty value	• Relative increase compared to Project.	↑
Mine life	• Increased mine life due to increased resource recovery.	↑
Employment	• Increased duration of employment.	↑
Panel width	• No change – 305 m (as per the Project and previous application).	–
Surface development	• No significant change.	–
Capital costs	• Increased capital costs associated with additional underground development and potential additional/replacement longwall machine.	↑
Operational costs	• Increased operational costs proportional to increased resource recovery (e.g. increased mining rate and/or mine life duration) and employment.	↑
Assessment of Economic Sustainability		
Financially sustainable given increased resource recovery as per the previous application.		

Table A11-6
Consideration of Environmental, Social and Economic Aspects – Previous Application (Area 5 Only)

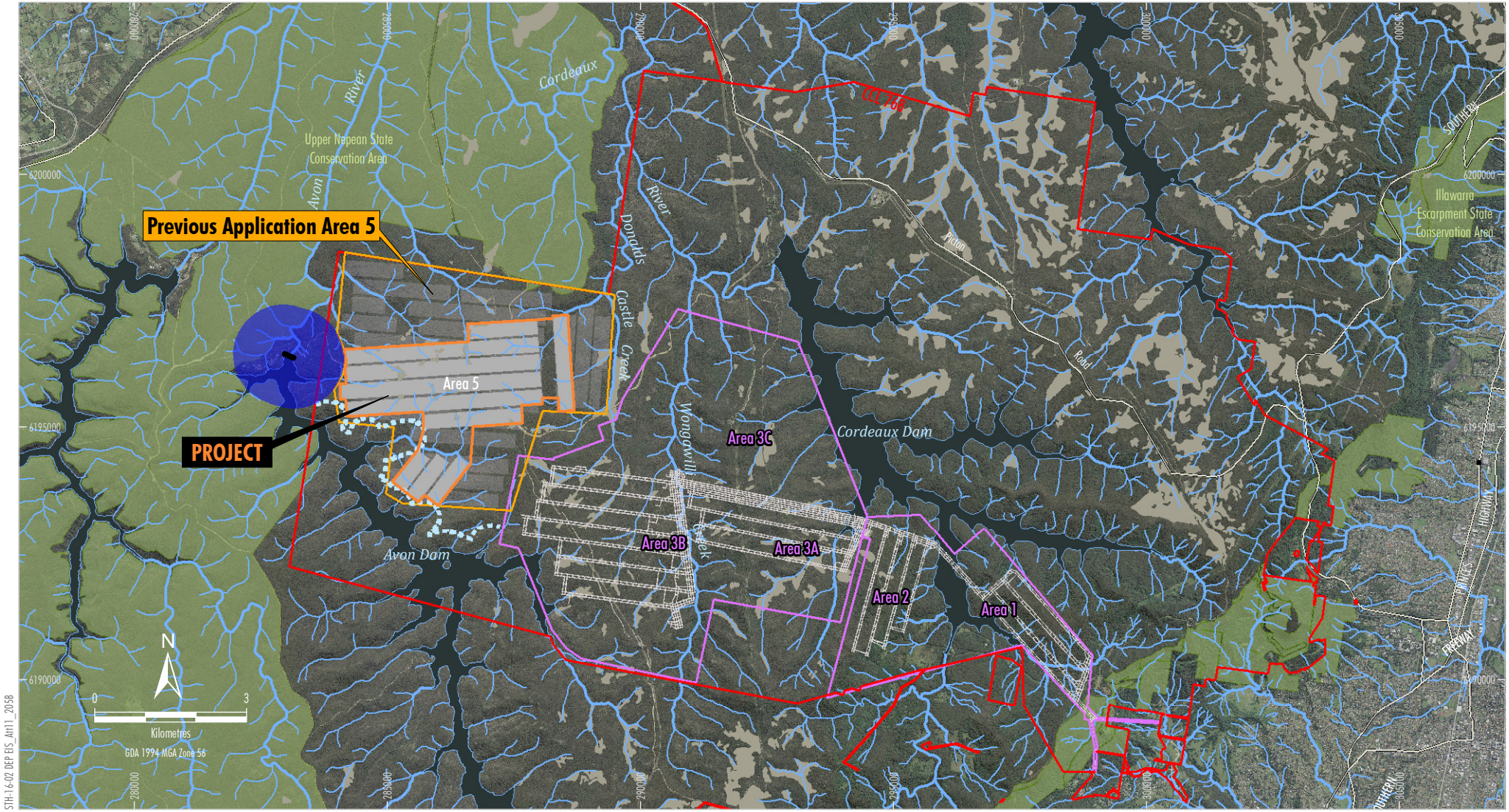
CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[20]
Key Environmental Considerations[21]			
Surface water losses (including post-mining)	• Mechanism 1 losses – increase of diversion of surface water flows due to subsidence-related impacts to stream beds (e.g. cracking) as a result of mining beneath increased length of streams. • Mechanism 2 losses – increased risk of losses due to connective fracturing due to increased mining footprint, including in areas of lower depth of cover relative to the Project. • Mechanism 3 losses – increase in spatial extent of surface water losses due to groundwater depressurisation as a result of increased mining footprint.	↑	x
Surface water quality (including post-mining)	• Increase in risk of water quality impacts due to mining beneath increased length of streams (e.g. with associated risk of iron staining). • Increased risk of post-mining water quality impacts as greater extent of post-mining re-pressurisation including via surface and sub-surface fracture networks.	↑	x
Biodiversity impacts (including upland swamps)	• Upland swamps – risk of hydrological changes to increased number of upland swamps. • Subsidence-related consequences to threatened species – increased risk of impacts due to increased area of potential habitat susceptible to subsidence-related impacts (e.g. streams, pools, upland swamps, cliffs) mined beneath.	↑	x
Aboriginal heritage and cultural values	• Increased risk of impacts to Aboriginal heritage sites and other matters affecting cultural values due to increased mining footprint.	↑	x
Compatibility with the Special Catchment Area	• Mining beneath greater area of Special Catchment Area.	↑	x
Offsets	• Surface water quantity and quality – increased surface water offset payment proportional with increased area mined beneath, noting this would result in increased payments to the NSW Government to achieve a net gain to Sydney's drinking water supplies. • Biodiversity – increased biodiversity impacts proportional with increased impacts, noting offsets would be calculated in accordance with the NSW BC Act and NSW BAM, and therefore security of the required offsets would achieve "no net loss" of biodiversity.	↑	x
Fugitive greenhouse gas emissions	• Increased fugitive greenhouse gas emissions as a result of increased mining area.	↑	x
Key Social Considerations			
Positive social	• Increased positive social impacts associated with increased duration of employment.	↑	✓
Negative social	• Increased negative social impacts associated with community concerns relating to increased extent and duration of potential environmental impacts.	↑	x

[20] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
[21] Generally as per key residual environmental issues identified by the IPC for the previous application.

Table A11-6 (Continued)
Consideration of Environmental, Social and Economic Aspects – Previous Application (Area 5 Only)

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[22]
Key Economic Considerations			
Direct net economic benefits	• Increased direct economic benefits to NSW due to increased coal extraction and mine life duration, with associated increase in royalty payments to NSW, employment benefits and payments of taxes. • While there would likely be increased externalities, including increased cost of greenhouse gas emissions, it is expected net benefits would increase.	↑	✓
Indirect and flow-on economic benefits	• Increased flow-on economic benefits, due to increased financial sustainability of other operations in the Southern Coalfield economic ecosystem, as well as increased duration of operational wage payments and expenditure with local suppliers.	↑	✓
Risk Evaluation and Justification			
• While the inclusion of the larger Area 5 (as per the previous application) would increase resource recovery, with associated increases in economic benefits (including royalties, mine life, duration of employment and direct expenditure), this alternative mine design is not proposed as IMC has re-designed the Area 5 mine plan to target the high-quality metallurgical coal resource with subsequent reductions in potential impacts on key features.			

[22] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.



STH-16-02 DEP EIS_Art11_2058

LEGEND

- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Previous Application
- EIS Base Plan Longwalls
- Dendrobium Underground Mining Area - Extension Project
- Coastal Upland Swamp
- Streams -3rd and Higher Order
- Streams -1st and 2nd Order
- Dam Wall Setback (1 km)
- Avon Dam FSL 300 m Setback in Lease

Source: Geoscience Australia, (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018)

SOUTH32
Illawarra Coal

DENDROBIUM MINE

Previous Application
(Area 5 Only)

Figure A11-4

A11.4 ALTERNATIVE UNDERGROUND MINING METHODS

The Dendrobium Mine currently uses conventional longwall underground mining methods.

Bord and pillar mining is undertaken at an isolated number of mines in Australia where conditions make it economically viable. The key conditions where bord and pillar mining is economic include:

- low depths of cover (<250 m) which typically results in low stress conditions;
- high seam heights of approximately 3-5 m (i.e. to achieve a higher volume of ROM coal per metre of mining);
- utilisation of established mining areas, for example either directly off an open-cut high wall or remnant areas around existing longwall workings, resulting in low-capital set-up costs which allows for the higher operating cost margin (i.e. due to lower productivity) as minimal capital repayment is required on the investment;
- high-quality coal resource to maximise revenues; and
- a typically higher market coal price (e.g. mid to upper portion of the pricing cycle) and bord and pillar mining cannot typically be sustained throughout the entire pricing cycle.

IMC has investigated bord and pillar mining as one of the mining methods for Area 5. However, the conditions in Area 5 are uneconomic for exclusively bord and pillar mining methods due to the following reasons:

- high depth of cover (majority of the underground mining area is 350-400 m) and associated higher stress regime, which would result in low productivity development due to the requirement for high density roof and rib support;
- low seam height (approximately 2 to 3 m) which would yield lower volumes of ROM coal per metre of mining;
- the high capital investment required to establish the Area 5 underground mining area (i.e. development of underground roadways to Area 5 from the existing Dendrobium Mine workings);
- unviability of operating a bord and pillar operation only when the market pricing cycle is in the mid to high range (i.e. due to costs and delays associated with stopping and starting the operation); and
- gas drainage requirements within Area 5 would add further complexity and productivity constraints.

In addition, labour costs for bord and pillar operations in Area 5 are forecast to require approximately three times the labour hours per tonne of coal mined compared to the proposed Area 5 longwall mining for the Project. In comparison to existing and recent bord and pillar operations in Australia, bord and pillar operations in Area 5 are forecast to require approximately two times the labour hours per tonne of coal mined. The approximate doubling of labour cost compared to other bord and pillar operations is due to lower productivity, primarily due to the higher depth of cover and associated stress, lower seam height and significant worker travel times to access Area 5 (i.e. approximately 15 km travel distance from the Dendrobium Pit Top) which would all affect production rates.

As described above, while bord and pillar mining is an underground mining technique that can be viable for some shallow coal seams, it is uneconomic in Australia to use bord and pillar mining as the primary production method at depths from the surface that are greater than about 200 m, as noted in the Southern Coalfield Panel Report (DoP, 2008).

Longwall mining is also recognised as a safer mining method compared with bord and pillar. The Southern Coalfield Panel Report (DoP, 2008) stated:

> *Safety, productivity and cost considerations dictate that longwall mining is now the only major, viable, high production mining method in the majority of Australian underground coal mines that operate at a depth of greater than about 300 m and in virtually all new coal mines (irrespective of depth).*

In addition, when considering safety, productivity and costs, longwall mining is considered to be the only viable mining method for the Project and, therefore, alternative extraction methods are not proposed.

A11.5 ALTERNATIVE LONGWALL LAYOUTS WITHIN THE PROJECT UNDERGROUND MINING AREA

This section considers alternative longwall layouts within the Project underground mining area to further avoid direct undermining surface features:

- WaterNSW 'significant' streams and upland swamps.
- Aboriginal heritage sites.

A11.5.1 Avoidance of WaterNSW 'Significant Streams' and Upland Swamps

In consideration of the advice provided by WaterNSW to the Department on the Project SEARs, this alternative considers a 100 m setback from "*all third order and above streams, all tributary streams flowing directly into reservoirs irrespective of their order, and streams and tributaries with upland swamps*" and a 60 m setback from upland swamps within the extent of longwall mining proposed for the Project. The indicative mining area is shown in Figure A11-5.

The 100 m setback is based in the adopted setback from 'key stream features', which is expected to reduce the likelihood of 'Type 3'[23] impacts (although the risk would not be nil). The setback would need to be increased to greater than 400 m to be beyond the setback distance where Type 3 impacts have been observed at the Dendrobium Mine. An assessment of this alternative is provided in Table A11-7.

Based on the key mine design metrics, this alternative mine plan is not considered to be economically sustainable. The avoidance of directly mining beneath 'significant streams' (as defined by WaterNSW) as well as upland swamps would result in a significant decrease in resource recovery and increase in operational costs (due to the number of longwall changeouts that would be required to avoid directly mining beneath these features).

This is consistent with the advice of the IAPUM[24] for the previous application, which acknowledged that complete avoidance of swamps/streams is not possible:

> *The Panel recognises that not all streams, swamps or other ecological assets can be protected while still having a viable mining plan.*

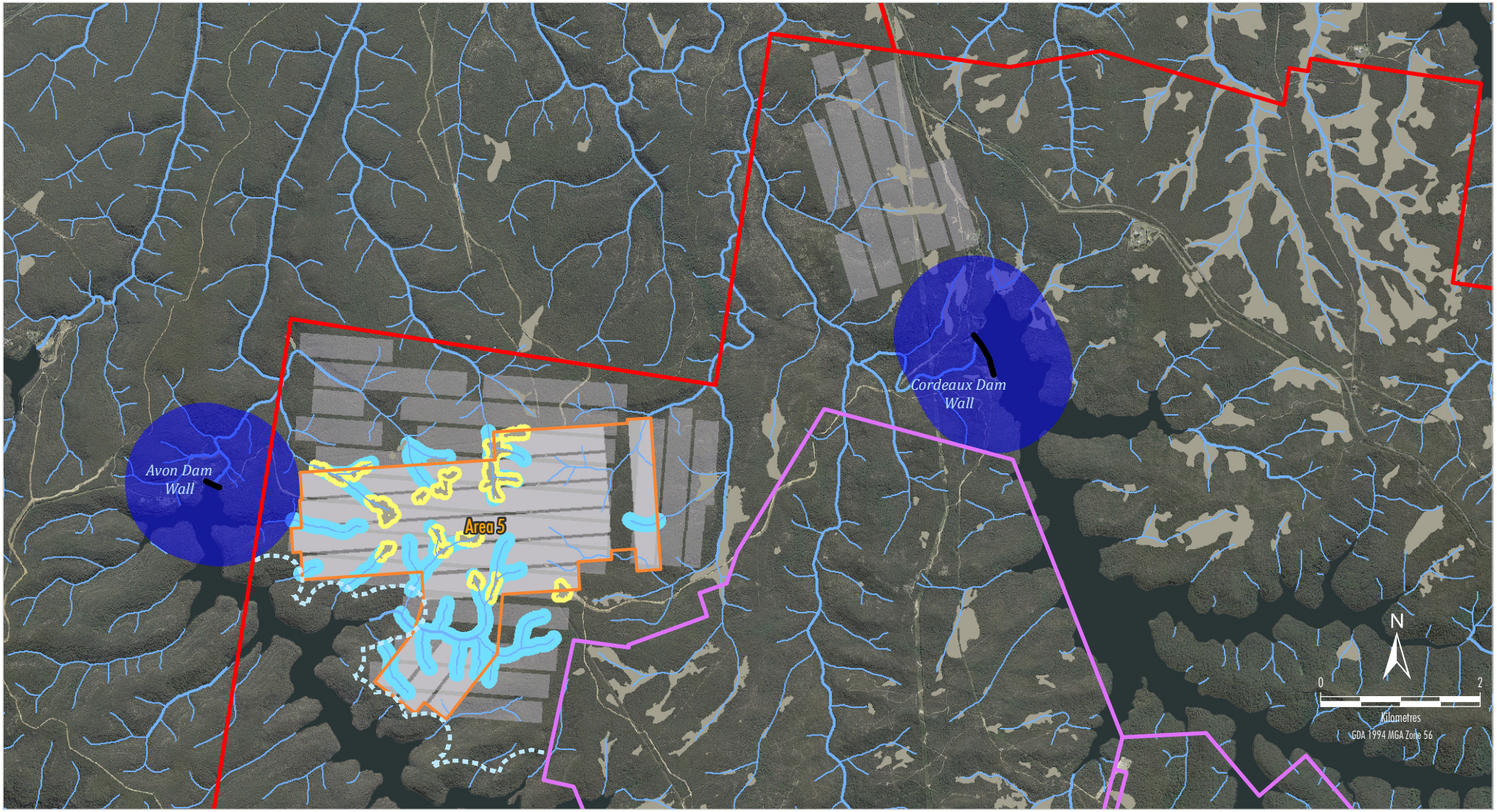
As such, this alternative mine design is not considered to be a "feasible" alternative and, in accordance with the SEARs, further consideration of the relative environmental, social and economic impacts compared to the Project has not been provided.

[23] Type 3 impact is defined by MSEC (2022) as fracturing in a rockbar or upstream pool resulting in reduction in standing water level based on current rainfall and surface water flow.

[24] Independent Advisory Panel for Underground Mining (2020) *Advice Regarding Dendrobium Extension Project SSD-8194*.

Table A11-7
Mine Design and Assessment of Economic Sustainability – Avoidance of WaterNSW 'Significant Streams'

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Reduction in mine plan extent compared to Project (and likely greater decrease as some remaining areas would become unviable).	↓
Target coal seams	• No change – Bulli Seam (Area 5).	–
Coal product types	• No change – majority metallurgical coal with portion of thermal or PCI coal.	–
Indicative resource	• Relative decrease compared to Project.	↓
Indicative resource value	• Relative decrease compared to Project.	↓
Indicative royalty value	• Relative decrease compared to Project.	↓
Mine life	• Similar or decreased mine life.	–
Employment	• Similar or decreased peak employment.	–
Panel width	• No change – 305 m (as per the Project and previous application).	–
Surface development	• No significant change.	–
Capital costs	• Similar capital costs.	–
Operational costs	• Increased operational costs due to increased longwall changeouts required to avoid features (i.e. to leave un-mined coal blocks beneath WaterNSW's streams and upland swamps).	↑
Assessment of Economic Sustainability		
Not expected to be financially sustainable given significantly reduced resource recovery and increased operational costs.		



STH-16-02 DEP EIS_Art11_207B

LEGEND

- Dendrobium Mining Lease
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Extension Project
- Avon Dam FSL 300 m Setback in Lease
- Streams -1st and 2nd Order
- Streams -3rd and Higher Order
- 100 m Buffer around Water NSW 'Significant Streams'
- Coastal Upland Swamp
- 60 m Buffer Around Coastal Upland Swamp within Area 5
- Dam Wall Setback (1 km)
- Previous Application Longwall Layout

Source: Geoscience Australia, (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018);

SOUTH32
Illawarra Coal

DENDROBIUM MINE

100 m Setback from Water NSW 'Significant Streams'

Figure A11-5

A11.5.2 Avoidance of Previously Identified Aboriginal Heritage Sites

This alternative considers setbacks of 100 m from all previously identified Aboriginal heritage sites within the extent of longwall mining proposed for the Project. The 100 m setback is based on key stream feature setbacks, expected to reduce but not eliminate the risk of potential impacts.

An assessment of this alternative is provided in Tables A11-8 and A11-9.

Based on the key mine design metrics, this alternative mine plan is likely to be less financially sustainable based on a 100 m setback distance due to the additional resource sterilisation. It is not considered reasonable to implement setbacks from all previously identified Aboriginal heritage sites given:

- The Project has already reduced the mine plan extent by approximately 60% compared to the previous application and results in significantly reduced resource recovery, and a reduction in the number of previously identified Aboriginal heritage sites directly mined under from 22 to six sites compared to the previous application.
- In their advice to the Department on the previous application the Biodiversity Conservation Directorate (BCD) recommended potential impacts to sites 52-2-1780, 52-2-1752 and 52-2-1456 in particular be minimised. These sites are of high archaeological significance and the Project mine plan already does not directly mine beneath these sites.
- The Aboriginal Cultural Heritage Assessment (Appendix F of the EIS) for the Project describes that, while all previously recorded Aboriginal cultural heritage sites identified within the Project area have some potential to be impacted by predicted subsidence movements (i.e. whether they are located directly above or proximal to the longwalls), based on monitoring to date the risk of damage to heritage values is considered low given only two of the 25 sites observed to have subsidence-related changes in the Southern Coalfield have had adverse consequences to the physical fabric which supports the heritage values.
- The 100 m setback from previously identified sites would not eliminate the risk of potential impacts to sites. If the setback distance was increased to 400 m (i.e. beyond the setback distance where Type 3 impacts have been observed at the Dendrobium Mine) then it is unlikely the mine design would be economically sustainable. In addition, there is potential for additional sites to be identified within the Project area when additional surveys are conducted.
- There are other factors that affect potential impacts to cultural values, for example potential impacts to streams, and for some stakeholders, any mining development may be considered to impact intangible cultural values. As described in Section A11.5.1, it is not economically sustainable to avoid all ‘significant streams’. As such, any mine design seeking to achieve no risk of impact to Aboriginal cultural heritage would not be economically sustainable.

Avoidance of directly mining beneath previously identified Aboriginal heritage sites (which are identified as having low or medium archaeological [scientific] significance) would result in a decrease in resource recovery and a mine plan that may be less financially sustainable, and would not achieve no risk of potential impact. Therefore, it is not considered that the potential minor decrease in the risk is reasonable given the certain decrease in economic benefits (including royalties), and accordingly this alternative mine design is not proposed.

Table A11-8
Mine Design and Assessment of Economic Sustainability – Avoidance of Previously Identified Aboriginal Heritage Sites

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Minor reduction in mine plan extent compared to Project.	↓
Target coal seams	• No change – Bulli Seam (Area 5).	–
Coal product types	• No change – majority metallurgical coal with portion of thermal or PCI coal.	–
Indicative resource	• Relative decrease compared to Project.	↓
Indicative resource value	• Relative decrease compared to Project.	↓
Indicative royalty value	• Relative decrease compared to Project.	↓
Mine life	• Similar or decreased mine life.	–
Employment	• No significant change.	–
Panel width	• No change – 305 m (as per the Project and previous application).	–
Surface development	• No significant change.	–
Capital costs	• No significant change.	–
Operational costs	• Increased operational costs relative to resource recovery.	↑
Assessment of Economic Sustainability		
Expected to be less financially sustainable for 100 m setback from previously identified Aboriginal cultural heritage sites, with significantly reduced Project value for 400 m setbacks which is unlikely to be economically sustainable.		

Table A11-9
Consideration of Environmental, Social and Economic Aspects – Avoidance of Previously Identified Aboriginal Heritage Sites (100 m Setbacks)

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[25]
Key Environmental Considerations[26]			
Surface water losses (including post-mining)	• Mechanism 1, 2 and 3 losses – no significant change.	–	–
Surface water quality (including post-mining)	• No significant change.	–	–
Biodiversity impacts (including upland swamps)	• No significant change.	–	–
Aboriginal heritage and cultural values	• Reduction in risk of impacts to individual Aboriginal heritage sites due to setbacks, noting the risk of impact for directly mining beneath is low based on monitoring in the Southern Coalfield (i.e. only two of the 25 sites observed to have subsidence-related changes in the Southern Coalfield have had adverse consequences to the physical fabric which supports the heritage values). Assessment would still require acknowledgement of potential risk of impact notwithstanding setbacks. • No significant change to other matters affecting cultural values (i.e. intangible values).	–	–
Compatibility with the Special Catchment Area	• No significant change.	–	–
Offsets	• No significant change.	–	–
Fugitive greenhouse gas emissions	• No significant change.	–	–
Key Social Considerations			
Positive social	• No significant change.	–	–
Negative social	• Potential decreased negative social impacts associated with reduced community concerns due to perceived reduction in potential impacts to Aboriginal heritage sites.	🡻	✓
Key Economic Considerations			
Direct net economic benefits	• Reduced royalties due to resource sterilisation.	🡻	x
Indirect and flow-on economic benefits	• No significant change.	–	–
Risk Evaluation and Justification			
• Avoidance of directly mining beneath (with 100 m setbacks) previously identified Aboriginal heritage sites (which are identified as having low or medium archaeological [scientific] significance) would result in a decrease in resource recovery and a mine plan that may be less financially sustainable, and would not achieve no risk of potential impact. Therefore, it is not considered that the potential minor decrease in the risk of impacts is reasonable given the certain decrease in economic benefits (including royalties) and this alternative mine design is not proposed.			

[25] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
[26] Generally as per key residual environmental issues identified by the IPC for the previous application.

A11.6 ALTERNATIVE MINE PARAMETERS WITHIN THE PROJECT UNDERGROUND MINING AREA

Dendrobium Mine currently operates with longwall panels up to 305 m wide and this would continue under the Project.

Subsidence-related Surface Impacts

With respect to surface impacts (e.g. to stream beds, swamps), experience at Dendrobium Mine and other mining operations shows that surface impacts related to subsidence can occur at panel widths significantly narrower than 305 m. Mine Subsidence Engineering Consultants (MSEC) (2019) conducted an analysis of variable longwall widths and concluded the following:

- although maximum predicted vertical subsidence decreases as longwall void width reduces, the predicted conventional strains are still sufficient to result in the fracturing of bedrock for reduced longwall widths down to approximately 150 m;
- valley-related effects are seen at narrow longwall widths and, therefore, so are related potential impacts; and
- strains due to the valley-related effects would still be sufficient to result in fracturing of rockbars, pools and bedrock above and adjacent to the longwalls and, therefore, resultant surface water losses for reduced longwall widths down to approximately 150 m.

Accordingly, adverse environmental impacts are still anticipated for reduced longwall widths down to approximately 150 m and the potential for losses in surface flow and diversion of water from the bases of pools and/or upland swamps would, therefore, be largely unchanged by the adoption of narrower longwall panels.

In their advice on the previous application, the IAPUM[27] concluded the following in regard to narrower panel widths:

> *At Dendrobium Mine, longwall panel width is not the key control when considering environmental impacts on natural surface features due to mining-induced non-conventional subsidence, in particular, valley closure. This is because environmental impacts due to non-conventional surface subsidence start to plateau at longwall panel widths that are reported to be too narrow to be economic at Dendrobium Mine.*

The adoption of narrower longwall panels for the Project would still require IMC to apply the same compensatory and offset measures to address potential impacts to surface features, including water quality, aquatic ecology and upland swamps, that have been adopted for the proposed 305 m wide Project longwall panels. It should be noted that impacts to surface features have already been significantly reduced when compared to the previous application, due to the reduction in layout of 60%. Consideration of further reductions in layout to further minimise impacts to surface features are described in the sections above.

Sub-surface Fracturing, Height of Depressurisation and Surface Water Loss

The key potential environmental impact of wider longwall panels is the height of sub-surface fracturing above the coal seam, as this affects the height of groundwater depressurisation and magnitude of predicted surface water losses from the Special Catchment Area. Panel width is one of several parameters that affects the height of fracturing, along with cutting height and depth of cover. Reductions in panel width could reduce the height of fracturing in Area 5.

[27] Independent Advisory Panel for Underground Mining (2020) *Advice Regarding Dendrobium Extension Project SSD-8194*.

Surface Water Offsets

It is noted that the NSW Government proposed a planning agreement that would require IMC to make payments to the NSW Government to offset water quantity and quality impacts during and post-mining, the terms of which were accepted by IMC for the previous application. IMC would seek to enter into a similar agreement with the NSW Government that would allow the Minister for Water, Property and Housing to spend these funds (as required) on priority water projects to result in a net benefit to Sydney's drinking water supply, consistent with the recommendations of the IEPMC. As such, the payment to the NSW Government would be proportional to surface water losses (noting that peak annual surface water losses for the Project are predicted to be approximately 78% less than the previous application).

Economic Consequence of Narrower Longwall Panels and Lower Cutting Height

Narrower panels and/or lower cutting height would result in significant adverse impacts to the financial sustainability of the Project, particularly when considering the significant reduction in resource recovery for the Project compared to the previous application. The independent mine plan review commissioned by the Department of Planning, Industry and Environment (DPIE) (now the Department of Planning and Environment [DPE]) from MineCraft for the previous application quantified the loss of project value at $100 million (in NPV terms) per 25 m reduction in panel width.

It is acknowledged this review was undertaken for the previous application mine plan; however, it provides an appropriate indication of reduced project value (primarily due to increased development costs) for narrower longwall widths.

Widths with Predicted Height of Depressurisation Remaining Below the Bald Hill Claystone

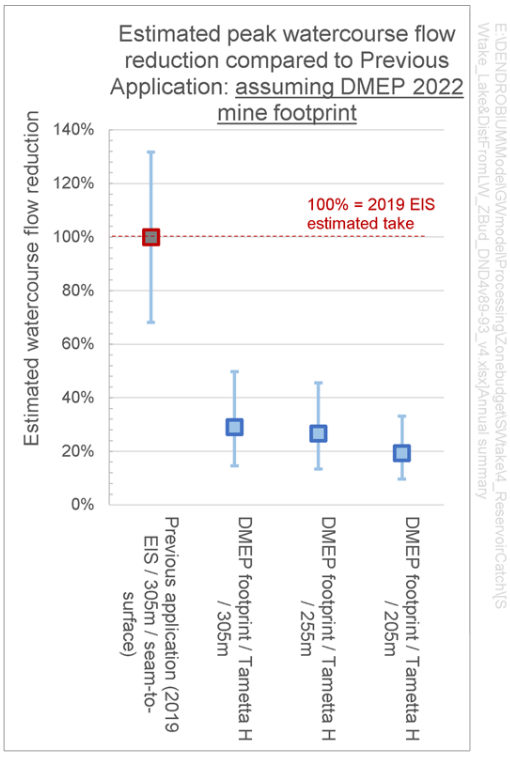
The IAPUM in their advice on the previous application to DPE considered a mine plan scenario whereby the height of fracturing was reduced to be below the Bald Hill Claystone:

> *The IAPUM considered one of the options which could have been tested was the possibility of leaving a barrier in place by using the Bald Hill Claystone, which has low water permeability. If fracturing was confined to below the claystone there could be very little surface water loss.*
>
> *…*
>
> *The data provided suggest that the predicted zones of complete drainage above the long walls will intersect the Hawkesbury Sandstone over much of Area 5 and all of Area 6. This implies that even with no enhancement of connected fracturing the inflows to the mines could be significant and, with only a modest increase in background vertical conductivity, the inflows could be of the same order as the recharge over the mining area. It is possible that for areas where the zone of complete drainage lies within or below the Bald Hill Claystone that there might be lower inflow magnitudes. However, the uncertainty in the model results precludes any definitive statements being made about the risks of mine inflows. Overall, the magnitudes of predicted mine inflows appear acceptable as a first estimate based on the model calibration. The approach to model parameterisation provides little ability to explore the impacts of alternative mine designs or to be confident that surface impacts could be significantly reduced using narrower longwalls or smaller longwall extraction heights.*

Based on analysis of alternative panel widths, Watershed HydroGeo has predicted that the panel width would need to be reduced to approximately 205 m to remain directly below the Bald Hill Claystone for the entirety of Area 5.

Analysis undertaken by Watershed HydroGeo indicates that significant reductions in panel width may marginally reduce, but not eliminate potential surface water losses for panel widths down to 205 m (Graph A11-2). However, based on the outcomes of the independent mine plan review commissioned by the DPE from MineCraft for the previous application, the adoption of a 205 m panel width would result in a loss of project value such that it would make the Project uneconomic.

Graph A11-2
Estimated Peak Watercourse Losses



DMEP 2022 longwall footprint = 8 sq.km

In addition, the predicted reduction in surface water losses as a result of limiting the height of fracturing to be below the Bald Hill Claystone is not expected to be significant in comparison to the approximate 78% reduction in peak annual surface water losses as a result of the revised Project mine plan, when compared to the previous application, due to the Project resulting in:

- approximately 60% reduction in longwall mining area;
- no predicted connective fracturing from the seam-to-surface when using the Tammetta Equation;
- no longwall mining beneath 3rd, 4th and 5th order (or above) streams;
- approximately 50% reduction in the length of 1st and 2nd order streams longwall mined beneath;
- approximately 40% reduction in the number of swamps (listed as threatened) longwall mined beneath;
- commitment to avoid longwall mining beneath identified key stream features; and
- longwall mining distance of at least 400 m from named watercourses (i.e. the Avon River, Cordeaux River and Donalds Castle Creek).

Overall, when considering the Project has already reduced the mine plan extent by approximately 60% from the previous application, the additional reduction in Project value due to reducing panel width to 205 m to achieve height of fracturing that remains below the Bald Hill Claystone would not be economically sustainable (Table A11-10).

Table A11-10
Mine Design and Assessment of Economic Sustainability – Widths with Predicted Height of Depressurisation Remaining Below the Bald Hill Claystone

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Reduction in mine plan extent compared to Project.	↓
Target coal seams	• No change – Bulli Seam (Area 5).	–
Coal product types	• No change – majority metallurgical coal with portion of thermal or PCI coal.	–
Indicative resource	• Relative decrease compared to Project.	↓
Indicative resource value	• Relative decrease compared to Project.	↓
Indicative royalty value	• Relative decrease compared to Project.	↓
Mine life	• No significant change.	–
Employment	• No significant change in peak employment.	–
Panel width	• Less than 205 m.	↓
Surface development	• No significant change.	–
Capital costs	• No significant change.	–
Operational costs	• Increased operational costs due to increased underground roadway development required for narrower panels, relative to resource recovery.	↑
Assessment of Economic Sustainability		
Overall, when considering the Project has already reduced the mine plan extent by approximately 60% from the previous application, the additional reduction in Project value due to reducing panel width to less than 205 m to achieve a predicted height of fracturing that remains below the Bald Hill Claystone would not be financially sustainable.		

Widths with Predicted Height of Depressurisation Within the Hawkesbury Sandstone

The Project mine plan (e.g. 305 m longwall panel width) would not result in seam-to-surface fracturing when calculated using the Tammetta Equation.

Based on analysis of alternative panel widths undertaken for the previous application, Watershed HydroGeo predicted that panel widths between 205 m and 305 m would result in the height of fracturing intersecting the Hawkesbury Sandstone when using the Tammetta Equation.

The reduction in surface water losses as a result of limiting the height of fracturing to be less than 305 m, but remaining within the Hawkesbury Sandstone, is not expected to be material in comparison to longwall panel widths of 305 m (Graph A11-1) and insignificant compared to the predicted reduction in surface water losses as a result of the revised Project mine plan relative to the previous application (i.e. mine plan and resulting reduction in peak annual surface water losses of approximately 78%).

In addition, there would be a loss of Project value due to any reduction in the longwall panel width, consistent with the findings of the independent mine plan review commissioned by the DPE from MineCraft for the previous application[28].

[28] Department of Planning, Industry and Environment (2020) *Dendrobium Mine Extension Project State Significant Development SSD-8194*.

Any reduction in panel width below 305 m would significantly adversely affect the financial sustainability of the Project (Tables A11-11 and A11-12). A reduction in panel width is not considered reasonable, as it is not significantly advantageous in reducing potential subsidence-related impacts to surface features or surface and groundwater and is, therefore, not proposed as:

- the Project has already reduced the mine plan extent and resulting peak annual surface water losses by approximately 78% from the previous application;
- the net effect of any reduction in longwall panel width would be a material reduction in the value of the Project to IMC; and
- in comparison, the reduction in the magnitude of surface water losses and cost of environmental externalities would not be significant, particularly when considering that IMC would implement surface water offsets, which would allow the NSW Government to fund projects that would have a net gain in drinking water supplies.

Table A11-11
Mine Design and Assessment of Economic Sustainability – Widths with Predicted Height of Depressurisation Within the Hawkesbury Sandstone

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)
Mine Design – Key Metrics		
Mine plan area	• Reduction in mine plan extent compared to Project.	↓
Target coal seams	• No change – Bulli Seam (Area 5).	–
Coal product types	• No change – majority metallurgical coal with portion of thermal or PCI coal.	–
Indicative resource	• Relative decrease compared to Project.	↓
Indicative resource value	• Relative decrease compared to Project.	↓
Indicative royalty value	• Relative decrease compared to Project.	↓
Mine life	• No significant change.	–
Employment	• No significant change.	–
Panel width	• 205 m to 305 m.	↓
Surface development	• No significant change.	–
Capital costs	• No significant change.	–
Operational costs	• Increased operational costs due to increased underground roadway development required for narrower panels, relative to resource recovery.	↑
Assessment of Economic Sustainability		
Any reduction in longwall panel width would significantly affect the financial sustainability.		

Table A11-12
Consideration of Environmental, Social and Economic Aspects – Widths with Predicted Height of Depressurisation Within the Hawkesbury Sandstone

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[30]
Key Environmental Considerations[31]			
Surface water losses (including post-mining)	• Mechanism 1 losses – no significant change as subsidence-related surface cracking impacts would be similar for narrower longwall panel widths. • Mechanism 2 losses – no significant change as height of fracturing would remain within the Hawkesbury Sandstone (noting the Project is not predicted to result in fracturing to the surface at 305 m longwall panels when calculated using the Tammetta Equation). • Mechanism 3 losses – no significant change as depressurisation beyond the mine footprint is expected to be similar.	–	–
Surface water quality (including post-mining)	• No significant change as subsidence-related impacts to surface features still expected for narrower panel widths.	–	–
Biodiversity impacts (including upland swamps)	• No significant change as subsidence-related impacts to surface features still expected for narrower panel widths.	–	–
Aboriginal heritage and cultural values	• No significant change as subsidence-related impacts to surface features still expected for narrower panel widths.	–	–
Compatibility with the Special Catchment Area	• No significant change as subsidence-related impacts to surface features still expected for narrower panel widths. • The predicted height of fracturing remains within the Hawkesbury Sandstone (when calculated with the Tammetta Equation) consistent with the Project (e.g. at longwall panel widths of 305 m).	–	–
Offsets	• No significant change, noting any marginal change in surface water losses accounted for via surface water offsets.	–	–
Fugitive greenhouse gas emissions	• No significant change.	–	–

[30] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.
[31] Generally as per key residual environmental issues identified by the IPC for the previous application.

Table A11-12 (Continued)
Consideration of Environmental, Social and Economic Aspects – Widths with Predicted Height of Depressurisation Within the Hawkesbury Sandstone

CONSIDERATION	DESCRIPTION (RELATIVE TO THE PROJECT)	EXPECTED CHANGE (RELATIVE TO THE PROJECT)	
		INCREASE/ DECREASE	BENEFIT TO NSW[32]
Key Social Considerations			
Positive social	• No significant change.	–	–
Negative social	• No significant change given limited change to environmental impacts.	–	–
Key Economic Considerations			
Direct net economic benefits	• Decreased net benefits to NSW due to decreased producer surplus accruing to NSW stakeholders.	🡻	x
Indirect and flow-on economic benefits	• No significant change.	–	–
Risk Evaluation and Justification			
• This alternative is less financially sustainable and is not considered reasonable on the basis it is not significantly advantageous in reducing potential impacts as subsidence-related impacts to surface features, surface and groundwater would still be expected. The Project has already reduced the mine plan extent (by approximately 60% compared to the previous application) and resulting peak annual surface water losses (by approximately 78% from the previous application). The net effect of any reduction in longwall panel width where the predicted height of fracturing remains in the Hawkesbury Sandstone (when calculated with the Tammetta Equation) would be a material reduction in the value of the Project to IMC with no significant change in surface water losses (which would be offset) and other environmental impacts.			

[32] Green shading indicates potential positive change to NSW relative to the Project, pink shading indicates potential negative change.

A11.7 REFERENCES

Australian Competition and Consumer Commission (2017). *Statement of Issues – South32 Proposed Acquisition of Metropolitan.*

BAEconomics (2020). *Review of the Key Economic Interactions between the Dendrobium Mine and Related Entities in the Wollongong Region.*

BlueScope Steel Limited (2020). *Dendrobium Mine Extension Project Submission - Submission to Independent Planning Commission*.

BlueScope Steel Limited (2021a). *BlueScope submission for the Independent Planning Commission's consideration of the Tahmoor South Coal Project*.

BlueScope Steel Limited (2021b). *Port Kembla Steelworks Blast Furnace Reline Announcement*.

BlueScope Steel (AIS) Pty Ltd (2021c). *No. 6 Blast Furnace Reline and Operations Scoping Report*.

Department of Planning (2008). *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield: Strategic Review.*

Department of Planning, Industry and Environment (2020). *Dendrobium Mine Extension Project State Significant Development SSD-8194*.

Department of Planning, Industry and Environment (2021). *Statement of Reasons Declaration of Critical State Significance Infrastructure – Blast Furnace No. 6 Reline*.

Independent Advisory Panel for Underground Mining (2020). *Advice Regarding Dendrobium Extension Project SSD-8194*.

Mine Subsidence Engineering Consultants (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Influence of longwall void width on the predicted subsidence effects*.

Mine Subsidence Engineering Consultants (2022). *Dendrobium Mine Extension Project – Subsidence Assessment.*

Office of Environment and Heritage (2012). *Upland Swamp Environmental Assessment Guidelines: Guidance for the underground mining industry operating in the southern coalfield.*