DENDROBIUM MINE - PLAN FOR THE FUTURE: COAL FOR STEELMAKING

SUBMISSIONS REPORT
FEBRUARY 2020

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1 INTRODUCTION

The Dendrobium Mine is an underground coal mine situated in the Southern Coalfield of New South Wales (NSW) approximately 8 kilometres (km) west of Wollongong (Figure 1-1A). Illawarra Coal Holdings Pty Ltd (Illawarra Coal), a wholly owned subsidiary of South32 Limited (South32), is the owner and operator of the Dendrobium Mine.

In 2019, South32 submitted the *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Environmental Impact Statement* (the EIS) for assessment under the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act).

The EIS describes and assesses the potential impacts of the Dendrobium Mine – Plan for the Future: Coal for Steelmaking (the Project), which proposes the extraction of additional coal reserves within Consolidated Coal Lease (CCL) 768. The extraction of additional Project coal reserves would be supported by the development of supporting infrastructure and the use and augmentation of existing surface facilities at the Dendrobium Mine.

Public exhibition of the EIS concluded on 18 September 2019. During and following the public exhibition period, submissions on the Project were received by government agencies, organisations and members of the public. The majority of public submissions (81 percent [%]) expressed support for the Project. The most commonly raised aspects in all submissions related to:

- Positive socio-economic benefits of the Project, in particular the ongoing employment of the existing Dendrobium workforce of approximately 400 people, the additional employment opportunities that would be provided by the Project and the importance of the Project to the BlueScope Steelworks in Port Kembla.
- Potential surface water losses from the Metropolitan Special Area.
- Potential subsidence-related impacts to stream features, biodiversity and water storage infrastructure.
- The contribution of the Project to Australian and global greenhouse gas emissions.

On 3 October 2019, the Department of Planning, Industry and Environment (DPIE) requested that South32 prepare responses to the aspects raised in the submissions.

On 5 December 2019, DPIE requested (by letter) that South32 identifies within the Submissions Report which of the Independent Expert Panel for Mining in the Catchment (IEP) Report (2019a, 2019b) recommendations the company proposes to adopt or otherwise reflect in the current development application and/or during the actual undertaking of mining activity proposed in the application. This information is outlined in Attachment C.

This Submissions Report provides South32's responses to aspects raised in submissions. It has been prepared in consideration of the *Draft Guideline 4: Guidance for State Significant Projects - Preparing a Submissions Report June 2019* (DPIE, 2019).

The remainder of this Submissions Report is structured as follows:

Section 2 Provides an overview of the Project.

Section 3 Provides an analysis of the submissions received by DPIE during the public exhibition period.

Section 4 Summarises the actions taken since lodgement of the EIS.

Section 5 Outlines changes to proposed mitigation measures for the Project since lodgement of the EIS.

Section 6 Provides responses to aspects raised in submissions.

Section 7 Provides an updated evaluation of the Project merits.

Section 8 Lists the documents referenced in the Submissions Report.

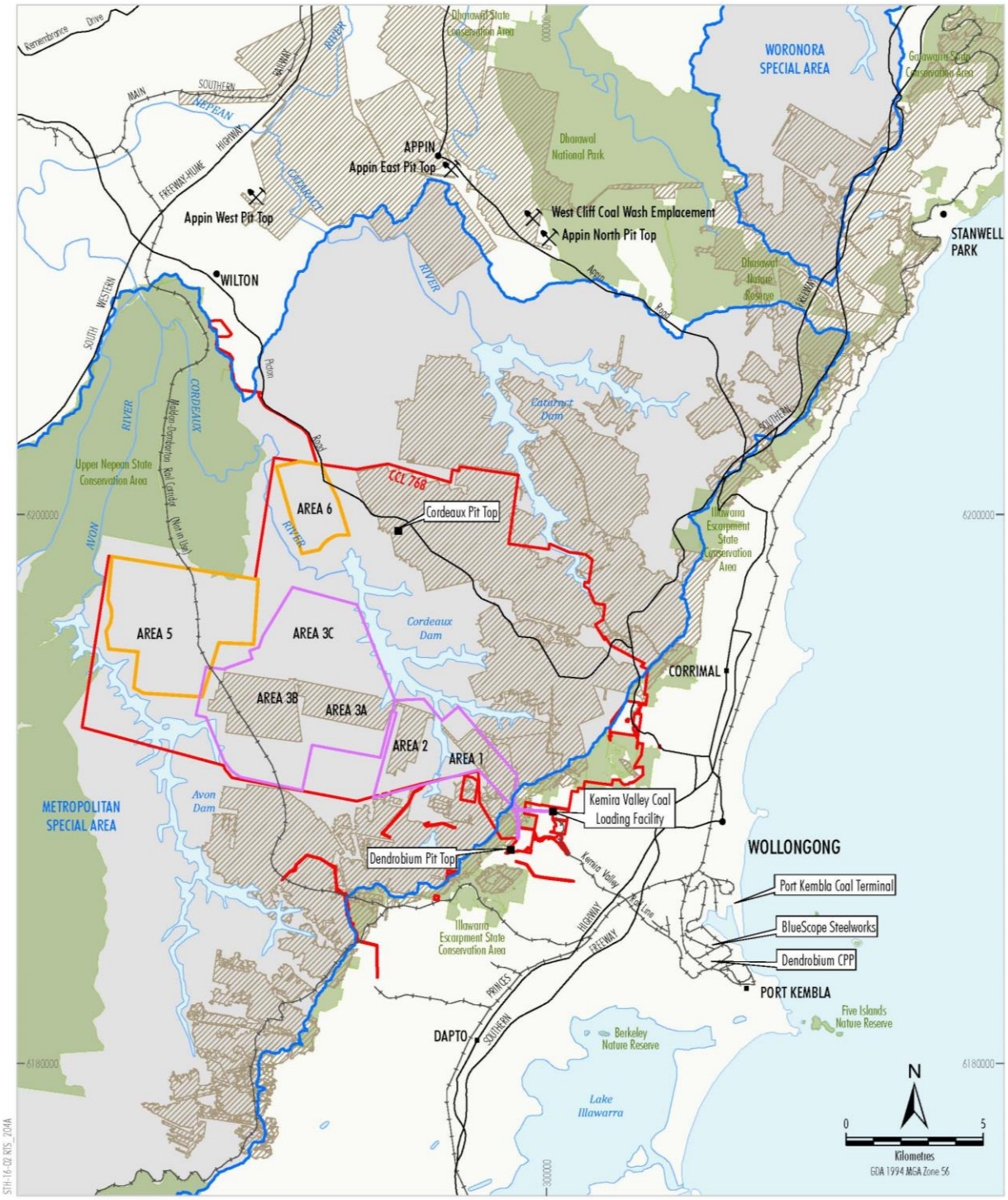

WORONORA SPECIAL AREA
APPIN
Appin East Pit Top
Appin West Pit Top
West Cliff Coal Wash Emplacement
Appin North Pit Top
WILTON
STANWELL PARK
Dharawal National Park
Dharawal State Conservation Area
Georgaway State Conservation Area
Dharawal Nature Reserve
Catarract Dam
Upper Nepean State Conservation Area
CCL 768
AREA 6
Cordeaux Pit Top
AREA 5
AREA 3C
AREA 3B
AREA 3A
AREA 2
AREA 1
Cordeaux Dam
Avon Dam
CORRIMAL
Illawarra Escarpment State Conservation Area
METROPOLITAN SPECIAL AREA
Kemira Valley Coal Loading Facility
Dendrobium Pit Top
WOLLONGONG
Port Kembla Coal Terminal
BlueScope Steelworks
Dendrobium CPP
PORT KEMBLA
Five Islands Nature Reserve
DAPTO
Berkeley Nature Reserve
Lake Illawarra
Illawarra Escarpment State Conservation Area
N
0
5
Kilometres
GDA 1994 MGA Zone 56
STH-16-02 RIS_204A
Project Area
NEWCASTLE
SYDNEY
WOLLONGONG
LEGEND
Dendrobium Mining Lease
Road
Railway
National Park, Nature Reserve and State Conservation Area
Historic Mine Workings
Declared Catchment Area
Dendrobium Underground Mining Area - Proposed Project
Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
Source: Geoscience Australia, (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018);
SOUTH32
Illawarra Coal
DENDROBIUM MINE
Regional Location

Figure 1-1A

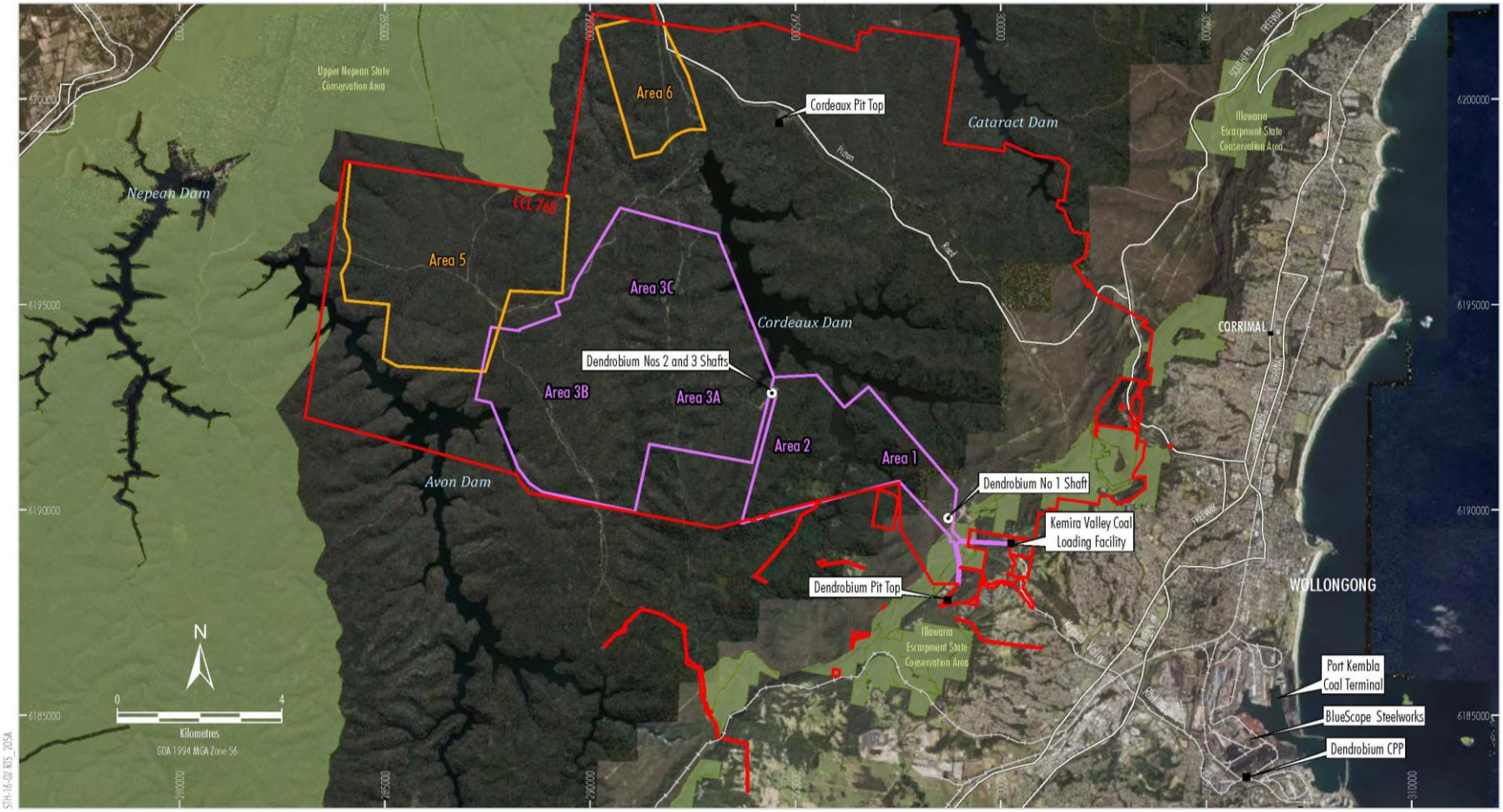
2 OVERVIEW OF THE PROJECT

The Project proposes the extraction of additional coal within CCL 768. This would be supported by the development of supporting infrastructure and the use and augmentation of existing Dendrobium Mine surface and sub-surface facilities (Figure 2-1A).

The Project would involve the extraction of approximately 78 million tonnes (Mt) of Run of Mine (ROM) coal from Area 5 and Area 6 (in addition to approximately 35 Mt of ROM coal from the approved Areas 3B and 3C). The anticipated life of the Project would be to 31 December 2048.

As described in the EIS, the Project would include the following activities:

- longwall mining of the Bulli Seam in a new underground mining area (Area 5);
- longwall mining of the Wongawilli Seam in a new underground mining area (Area 6);
- development of underground roadways within the Bulli Seam, Wongawilli Seam and adjacent strata to access mining areas;
- use of existing underground roadways and drifts for personnel and materials access, ventilation, dewatering and other ancillary activities related to Areas 5 and 6;
- development of surface infrastructure associated with mine ventilation and gas management and abatement, water management and other ancillary infrastructure;
- handling and processing of up to 5.2 million tonnes per annum (Mtpa) of ROM coal;
- use of the existing Dendrobium Pit Top, Kemira Valley Coal Loading Facility (KVCLF), Dendrobium Coal Preparation Plant (CPP) and Dendrobium Shafts with minor upgrades and extensions;
- transport of sized ROM coal from the KVCLF to the Dendrobium CPP via the Kemira Valley Rail Line;
- use of the Cordeaux Pit Top for mining support activities to reduce travel time for men and materials while development and mining operations occur in Area 6;
- augmentation of mine access arrangements, including upgrades to, and the use of, the Cordeaux Pit Top;
- handling and processing of coal from the Project, the approved Dendrobium Mine and the Bulli Seam Operations at the Dendrobium CPP;
- delivery of product coal from the Dendrobium CPP to the Port Kembla Steelworks for domestic use or to the Port Kembla Coal Terminal for transport to Liberty Primary Steel Whyalla Steelworks or export;
- transport of coal wash by road to customers for engineering purposes (e.g. civil construction fill), for other beneficial uses and/or for emplacement at the West Cliff Stage 3 and Stage 4 Coal Wash Emplacement;
- development and rehabilitation of the West Cliff Stage 3 Coal Wash Emplacement (noting that opportunities for beneficial reuse of coal wash would be maximised);
- progressive development of sumps, pumps, pipelines, water storages and other water management infrastructure;
- controlled release of excess water in accordance with the conditions of Environment Protection Licence (EPL) 3241 and/or beneficial industrial (or other) mine water use;
- monitoring, rehabilitation and remediation of subsidence and other mining effects; and
- other associated infrastructure, plant, equipment and activities.



LEGEND
- Dendrobium Mining Lease
- Road
- Railway
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Dendrobium Underground Mining Area - Proposed Project

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

DENDROBIUM MINE

General Arrangement of the Approved Dendrobium Mine and Proposed Underground Mining Areas 5 and 6

Figure 2-1A

Table 2-1A provides a summary comparison of the Dendrobium Mine and the Project components.

Table 2-1A
Comparison between the Dendrobium Mine and Project

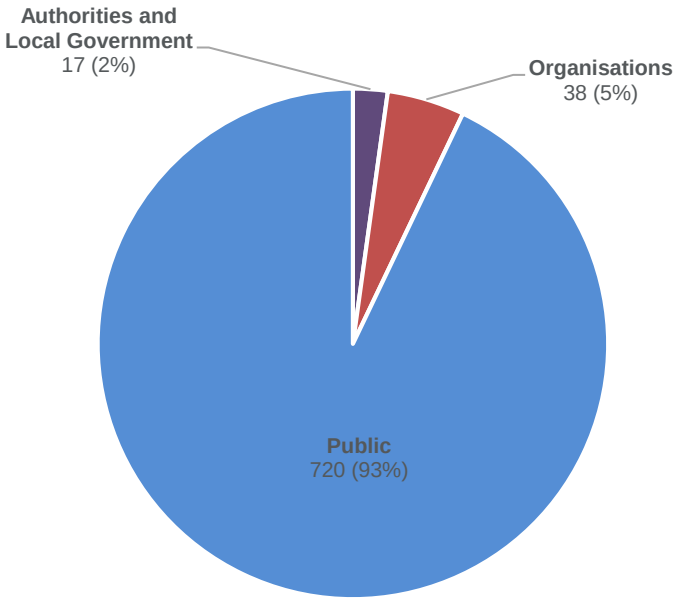
Project Component	Approved Dendrobium Mine (DA 60-03-2001)	Project
Mine Life	Until 31 December 2030.	Until 31 December 2048.
Mining Method	Underground extraction using longwall mining methods.	No change.
Resource	Mining of the Wongawilli Seam in Areas 1, 2, 3A, 3B and 3C within CCL 768.	Additional mining of the Bulli Seam in Area 5 and the Wongawilli Seam in Area 6 within CCL 768.
Annual Production	Handling and processing of up to 5.2 Mtpa of ROM coal.	No change.
Resource to be Recovered	At 1 July 2019, it is estimated that approximately 35 Mt of ROM coal will remain.	Approximately 78 Mt of additional ROM coal.
Coal Handling and Processing	Transport of coal from underground workings to the KVCLF via an underground conveyor network. Sizing and stockpiling of coal at the KVCLF prior to transport to the Dendrobium CPP via the Kemira Valley Rail Line, in accordance with the approved hours of operation. Processing of up to 5.2 Mtpa of sized ROM coal at the Dendrobium CPP.	No change.
Management of Mining Waste	Transportation of up to approximately 1.1 Mtpa of coal wash by road from the Dendrobium CPP to the West Cliff Stage 3 and Stage 4 Coal Wash Emplacement. Development and rehabilitation of the West Cliff Stage 3 Coal Wash Emplacement. Supply of coal wash to customers for engineering purposes (e.g. civil construction fill) or for other beneficial uses.	Transportation of up to approximately 1.6 Mtpa of coal wash by road from the Dendrobium CPP to the West Cliff Stage 3 and Stage 4 Coal Wash Emplacement. No change. No change.
General Infrastructure	• Dendrobium Pit Top. • KVCLF. • Kemira Valley Rail Line. • Dendrobium CPP. • Dendrobium Shafts Nos 1, 2 and 3.	Continued use of existing infrastructure with minor upgrades and extensions. Use of the Cordeaux Pit Top for mining support activities. Augmentation of mine access arrangements, including upgrades to, and the use of, the Cordeaux Pit Top. Development of surface infrastructure associated with mine ventilation and gas management and abatement, and other ancillary infrastructure.
Product Transport	Delivery of product coal from the Dendrobium CPP to the BlueScope Port Kembla Steelworks (BlueScope Steelworks) or to Port Kembla Coal Terminal for transport to Liberty Primary Steel Whyalla Steelworks or for export.	No change.
Water Management	Water management infrastructure to separate clean, oily and dirty water. Use of a combination of recycled treated mine water and potable water purchased from Sydney Water in underground and surface operations. Release of water in accordance with the conditions of EPL 3241.	Augmentations and extensions to existing water management infrastructure (including use of existing infrastructure). No change – continued use of a combination of recycled treated mine water and potable water purchased from Sydney Water in underground and surface operations. No change – continued release of water in accordance with the conditions of EPL 3241. Release volumes and release infrastructure to be modified as required based on Project mine inflow rates. Beneficial use of excess Project mine water by industrial (or other) users, where practicable.

3 ANALYSIS OF SUBMISSIONS

3.1 NUMBER OF SUBMISSIONS

A total of 775 submissions on the Project were received from Government agencies, organisations and members of the public. Chart 3-1A presents a summary of the total number of submissions by submitter category. The key aspects raised in submissions are summarised in Section 3.5.

Chart 3-1A
Summary of All Submissions



A summary of the submissions received during the public exhibition period and a register of submitters are provided in Attachments A and B, respectively.

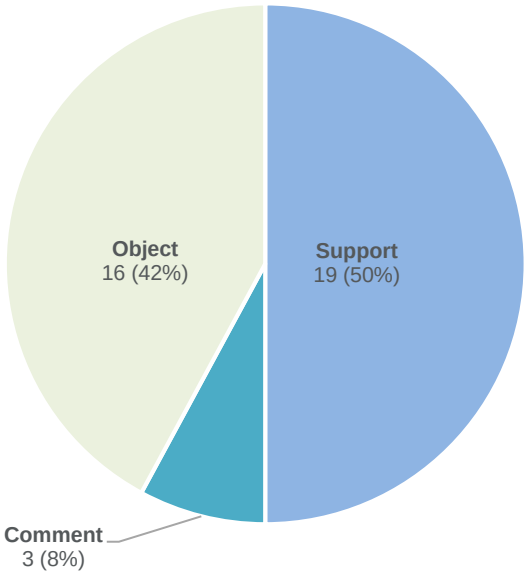
3.2 AGENCY AND COUNCIL SUBMISSIONS

A total of 17 submissions were received from NSW agencies and local councils, the majority of which were in the form of comments or suggested conditions. The Project is located in three local government areas (LGAs) (the Wollongong, Wollondilly and Wingecarribee LGAs). One local council (the Wollondilly Shire Council, where the West Cliff Coal Wash Emplacement is located) objected to the Project.

3.3 ORGANISATION SUBMISSIONS

A total of 38 submissions were received from organisations. Of these, 19 supported the Project, three provided comments and 16 objected to the Project (Chart 3-3A).

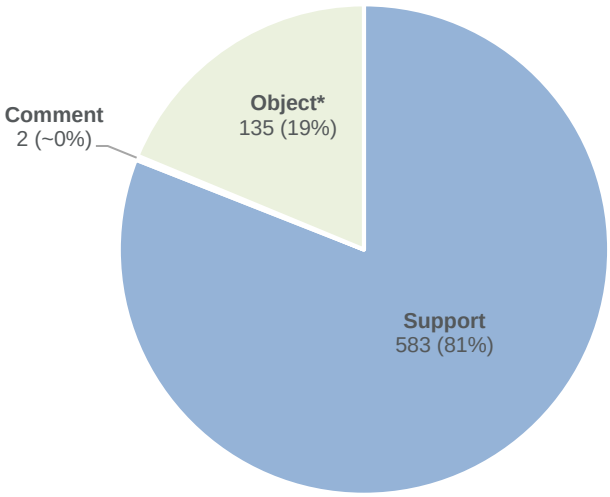
Chart 3-3A
Summary of Organisation Submissions



3.4 PUBLIC SUBMISSIONS

A total of 720 submissions were received from members of the public. Of these 583 supported the Project, two provided comments and 135 objected to the Project (Chart 3-4A).

Chart 3-4A
Summary of Public Submissions



*Note 60 of the objections (i.e. 44%) are based on the Protect Our Water Alliance pro-forma submission template.

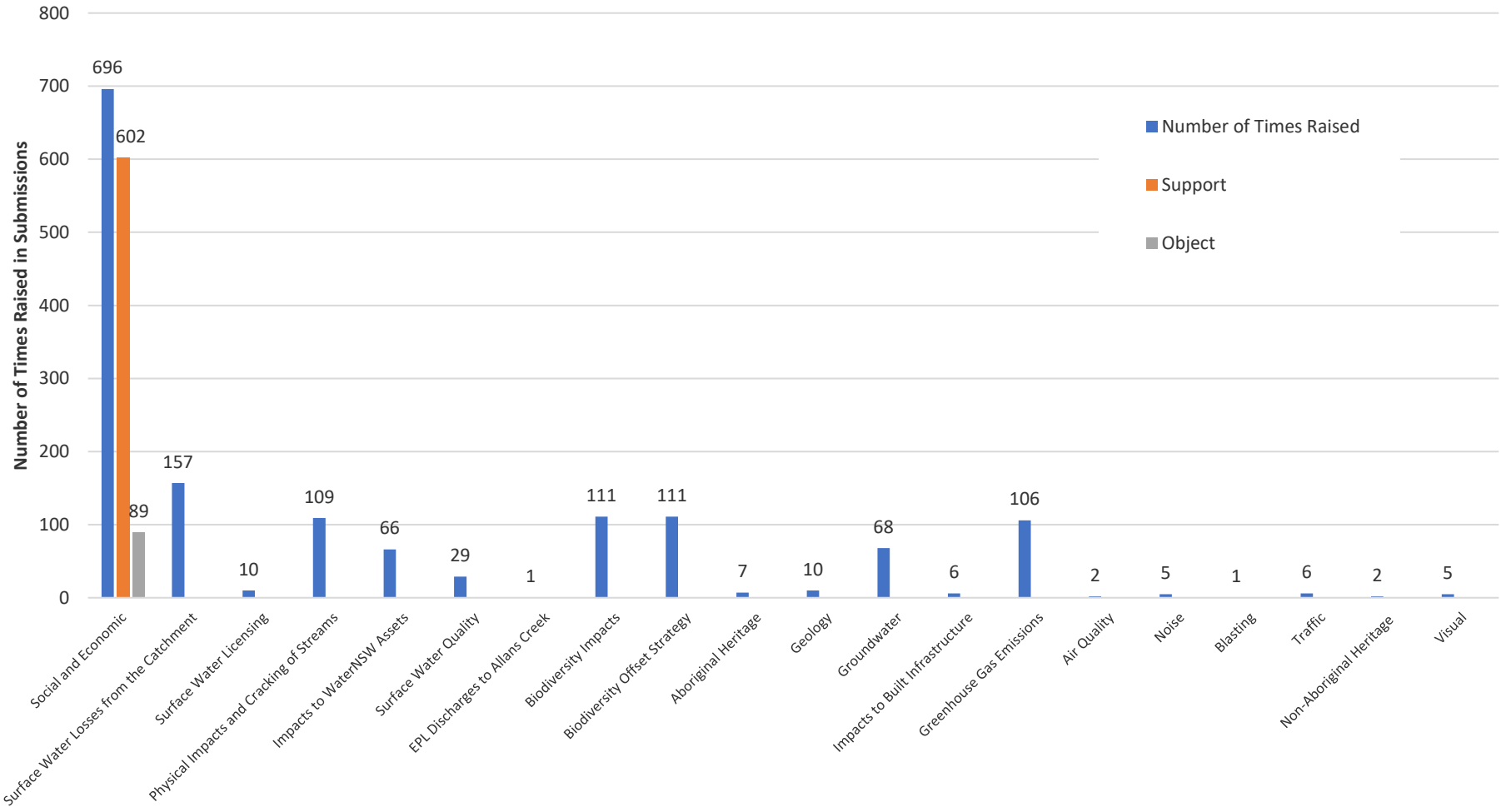
3.5 KEY ASPECTS RAISED IN SUBMISSIONS

The most commonly raised aspects in the submissions related to the following:

- Positive socio-economic benefits, in particular the:
  - continuation of employment of the existing Dendrobium Mine workforce of approximately 400 personnel;
  - additional employment opportunities that the Project would provide; and
  - importance of the Project to the BlueScope Steelworks in Port Kembla.
- Adverse socio-economic effects of the Project.
- Surface water losses from the catchment.
- Surface water licencing.
- Physical impacts and cracking of streams.
- Impacts to WaterNSW assets.
- Surface water quality.
- EPL discharges to Allans Creek.
- Biodiversity impacts.
- Biodiversity Offset Strategy.
- Aboriginal heritage.
- Geology.
- Groundwater.
- Impacts to built infrastructure.
- Greenhouse gas emissions.
- Air quality.
- Noise.
- Blasting.
- Traffic.
- Non-Aboriginal Heritage.
- Visual.

Chart 3-5A provides a breakdown of aspects raised in submissions.

Chart 3-5A
Key Aspects Raised in Submissions



4 ACTIONS TAKEN SINCE LODGEMENT OF THE PROJECT EIS

4.1 ENGAGEMENT ACTIVITIES

Since the lodgement of the EIS, South32 has continued to consult with Government, Councils, industry and community members regarding the Project, this includes:

- a number of community information sessions held regarding the Project (particularly for those residents located proximal to the existing Dendrobium Mine surface facilities);
- ongoing consultation with landowners and the community;
- consultation with NSW Government agencies, including;
  - WaterNSW;
  - Sydney Water; and
  - Commonwealth Department of Environment and Energy (DoEE);
- consultation with industry stakeholders and businesses (including BlueScope Steelworks and Pacific National);
- consultation with the Wollondilly Shire Council and Wollongong City Council;
- consultation with non-government organisations and environmental groups; and
- DPIE.

4.2 FURTHER ENVIRONMENTAL ASSESSMENT

Since lodgement of the EIS, and in consideration of submissions received, environmental analysis and assessment has been ongoing, as outlined in this Submissions Report. In particular, since the EIS, South32 has:

- Consulted with key stakeholders and progressed options analysis for the beneficial use of mine water captured in the mine workings, with the objective that this water would be treated and used (e.g. by industrial or other users) to offset existing demands on drinking water supplies.
- South32 has finalised purchase of freehold land (herein referred to as the Offset Property), and biodiversity surveys have been undertaken to confirm the Offset Property's contribution to meeting the Project's Offset Liability.

4.3 INDEPENDENT EXPERT PANEL FOR MINING IN THE CATCHMENT

On 14 October 2019, after the public exhibition period for the EIS closed, the IEP published Part 2 of its report on coal mining impacts in the Special Areas of the Greater Sydney Water Catchment (the IEP Report) (IEP, 2019b).

As the Dendrobium Mine and the Project are located within the Metropolitan Special Area (i.e. one of the Special Areas of the Greater Sydney Water Catchment) many of the conclusions and recommendations of the IEP Report are of relevance to the Project.

As per the Department's letter dated 5 December 2019, a reconciliation of how the IEP's recommendations have been addressed in this Submissions Report, or would be addressed as part of the Project is provided in Attachment C of this Submissions Report.

Part 1 of the IEP's Report was initially published in November 2018. A reconciliation of how the IEP's recommendations from Part 1 of its Report was provided in Section 8 of the EIS. The Part 1 Report was updated (in consideration with stakeholder feedback) and the final version published in October 2019 (IEP, 2019b). Attachment C also provides a reconciliation against the final Part 1 IEP Report recommendations.

5 CHANGES TO THE PROJECT AND ADDITIONAL COMMITMENTS

Additional clarification and justification of EIS commitments is presented in this Submissions Report.

In consideration of the key aspects raised in submissions objecting to the Project, South32 makes the following additional commitment to clarify the intent of beneficial use of mine water collected in the mine workings to offset predicted surface water losses from the Metropolitan Special Area:

South32 commits to implement or fund works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area.

This would include beneficial use of mine water to reduce existing demands on the drinking water system, and/or funding or implementing works that reduce existing losses (e.g. pipe losses or evaporation).

This commitment is consistent with the existing condition of the Subsidence Management Plan (SMP) approval for Longwall 17 for the Dendrobium Mine, which requires South32 to suitably offset predicted surface water losses from the catchment.

6 RESPONSES TO SUBMISSIONS

6.1 POSITIVE SOCIO-ECONOMIC BENEFITS

6.1.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions, including in submissions from BlueScope Steel, South32 employees and local suppliers relevant to positive socio-economic benefits included:

- Importance of the Project to the BlueScope Steelworks and Port Kembla Coal Terminal.
- Importance of the mining industry to ongoing employment in the region.
- Clarification of the use of coal provided to BlueScope Steelworks and other customers.

Agency, Local Council and Service Provider Submissions

The Division of Resources and Geoscience, Wollongong City Council, Resources Regulator, NSW Ports and NSW Health provided comments on the Project relevant to socio-economic benefits, including the economic benefits of the Project to the region and importance of the Project to BlueScope Steelworks and Port Kembla Coal Terminal.

6.1.2 Key Aspects

In consideration of the submissions described above, responses to the following key matters are provided below:

1. Justification of the importance of the Project and associated socio-economic benefits.
    a. Socio-economic benefits of the Project.
    b. Benefits to BlueScope Steelworks and Port Kembla Coal Terminal.
    c. Impacts of not carrying out the Project.
2. Clarification of the use of coal at the BlueScope Steelworks.

6.1.3 Responses

1. Justification of the importance of the Project and associated socio-economic benefits.

a. Socio-economic benefits of the Project.

The Project would involve the production of up to approximately 5.2 Mtpa of ROM coal, with approximately 78 Mt of additional ROM coal extracted over the life of the Project in comparison to the approved Dendrobium Mine. The Project would increase the availability and longevity of employment at the Dendrobium Mine for an additional 18 years from the currently approved mine life (which is to 2030).

The Project would provide continuation and extension of employment for the existing Dendrobium Mine workforce of approximately 400 personnel and provide an estimated 100 additional jobs during operations and up to approximately 200 jobs during construction and development.

The Economic Assessment indicates the Project would result in a total net benefit to the NSW economy of $1,073.2 million in net present value (NPV) terms, inclusive of estimated costs for environmental externalities and internalisation of environmental management costs by South32 (Appendix L of the EIS).

This net benefit includes some $497.8 million in total direct benefits to NSW in NPV terms, comprising (Appendix L of the EIS):

- $74.9 million of net producer surplus attributable to NSW;
- $150.8 million in company tax attributable to NSW; and
- $272.1 million paid to the NSW and local governments, in the way of coal royalties, payroll tax, land taxes and council rates.

In addition to the direct economic impacts, it is estimated the Project would generate $583.4 million in indirect economic impacts in NPV terms, comprising (Appendix L of the EIS):

- a Project increase in worker benefit for the NSW economy of $365.8 million; and
- a Project net supplier benefit for the NSW economy of $217.6 million.

Further, Project coal production would continue to contribute to the continuation of manufacturing operations at the BlueScope Steelworks and Liberty Primary Steel Whyalla Steelworks, the operation of the Port Kembla Coal Terminal, NSW export income and industry in other countries that purchase Project product coal.

Unlike some greenfield mining proposals that are developed to address general projected global commodity demand, the Dendrobium Mine is an existing metallurgical coal mine that has a high level of integration with its primary metallurgical coal customer, BlueScope Steelworks.

In the absence of the Project, there would be a discontinuity of mining at the Dendrobium Mine following the completion of mining in Area 3B and Longwalls 20 and 21. This would adversely affect the economic viability of the remainder of Area 3C, resulting in reduced employment numbers during any such discontinuity and have flow-on implications for BlueScope Steelworks, the Port Kembla Coal Terminal, Bulli Seam Operations and local suppliers to the Dendrobium Mine.

Strategic considerations that may be relevant in determining the Project include:

- The Project represents a continuation of mining in the Illawarra providing metallurgical coal to the BlueScope Steelworks at Port Kembla, supporting NSW regional manufacturing industries and significantly supporting the Illawarra and NSW economies.
- The Project maximises the continued use of existing South32 surface infrastructure to support the continuation of underground mining operations.
- The Project seeks to avoid a discontinuity in mining at the Dendrobium Mine caused by high gas coal in approved Area 3C, and avoid job losses/unemployment that would result from discontinuation of mining.
- The Dendrobium Mine ships metallurgical coal to the Liberty Primary Steel Whyalla Steelworks, thereby continuation of the Project will also support other steel manufacturing in Australia.

b. Benefits to BlueScope Steelworks and Port Kembla Coal Terminal.

The Project would support the extraction of ROM coal that would be processed at the Dendrobium CPP to primarily produce coking coal products for use in steelmaking. This would provide an ongoing, local supply of metallurgical coal to the BlueScope Steelworks at Port Kembla.

The steelworks at Port Kembla (referred to as the BlueScope Steelworks) was originally developed due to its proximity to the coal mines of the Southern Coalfield. South32 currently supplies the BlueScope Steelworks with the majority of its metallurgical coal requirements.

Under the Project, Dendrobium Mine product coal would continue to be transported from the Port Kembla Coal Terminal to Australian and international customers.

The Project would continue to make use of the existing Kemira Valley Rail Line, which connects the KVCLF directly to Port Kembla. The Dendrobium CPP is located in the Port Kembla industrial precinct (regulated under the BlueScope Steelworks EPL 6092) and South32 pays a fee to BlueScope Steelworks for the use of the facility.

The continued use of this existing infrastructure for the Project would allow the existing arrangement between the Dendrobium Mine and the BlueScope Steelworks to continue.

Steel remains a fundamental material for a variety of construction and manufacturing industries, and domestic steelmaking is a strategically valuable asset for Australia's economic security and prosperity.

The importance of local (i.e. Australian) steelmaking is described in the Parliamentary Report *Australia's Steel Industry: Forging Ahead* (Commonwealth of Australia, 2017), which outlines the safety benefits and economic significance of the steel industry to the Australian economy and regional economies where steelmaking facilities are located. In the Illawarra region, the BlueScope Steelworks (Commonwealth of Australia, 2017):

- directly employs 3,000 people;
- indirectly supports about 10,000 jobs in the region (with the Illawarra Business Chamber noting in its submission to the Parliamentary Report that the multiplier effect of the steel industry is three to five indirect jobs for every direct job generated by the industry); and
- contribute approximately $1.9 billion per annum to the economy, based on analysis conducted by Wollongong City Council (without considering any multiplier effect).

The BlueScope Steelworks at Port Kembla is the largest steel production facility in Australia, and one of only two primary iron and steelmaking facilities in Australia.

The importance of a local coking (also known as metallurgical coal) coal supply to the BlueScope Steelworks is outlined by the Australian Competition and Consumer Commission (ACCC) (2017), who noted the disadvantages the BlueScope 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.*

In addition, the importance of the Project to the BlueScope Steelworks is outlined in BlueScope's submission on the Project, which states:

> *The purpose of BlueScope's submission is to emphasise to the NSW Minister for Planning and the Independent Planning Commission for the Project the critical importance of a continuation of mining at the Dendrobium Mine situated in the Southern Coalfield of NSW. This continuation is vital for the continuing protection of the economic health of the Illawarra region and NSW at large, including the 3,500 direct jobs and 5,400 indirect jobs that rely on Port Kembla Steelworks, the largest steel production facility in Australia…*
>
> *…*
>
> *… The Dendrobium Mine Project produces metallurgical coal for steelmaking. Currently, there is no economically viable, commercial-scale alternative to the use of metallurgical coal in the blast furnace method of steelmaking, which is employed at Port Kembla Steelworks. The Project would provide a local and continued supply of metallurgical coal to the Steelworks, allowing BlueScope to continue to generate at least $6.5 billion in regional economic output for the Illawarra region.*

c. Impacts of not carrying out the Project.

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

- 78 Mt of additional ROM coal extracted over the life of the Project would not be mined;
- approximately 400 existing employment opportunities would be discontinued following completion of currently approved mining activities at the Dendrobium Mine and an additional 100 operational employment opportunities (created by the Project) would be forgone;
- up to approximately 200 direct construction employment opportunities and associated flow-on effects would not be realised;
- additional tax revenue from the Project would not be generated (Appendix L of the EIS);
- additional royalties to the State of NSW would not be generated (Appendix L of the EIS);
- a net benefit of $1,073.2 million to the State of NSW and $431 million to the greater Wollongong Region in NPV terms would be forgone (Appendix L of the EIS);
- the potential incremental environmental impacts would not occur;
- economic and social benefits to the region (including to the city of Wollongong and Wollondilly and Wingecarribee Local Government Areas [LGAs]) associated with the Project would not be realised; and
- the additional biodiversity offsets and water quality offsets for the Project would not be established.

In addition, the cessation of the Dendrobium Mine would also have significant impacts on downstream industries that currently transport or directly utilise Project coal, including BlueScope Steelworks, Port Kembla Coal Terminal and Liberty Primary Steel Whyalla Steelworks.

2. Clarification of the use of coal at the BlueScope Steelworks.

Metallurgical coal (also known as coking coal) is a raw material that is essential for the manufacture of ‘virgin iron’ and steel (also known as ‘primary steelmaking’ or ‘integrated steelmaking’). The other key raw material for steelmaking is iron ore.

While the BlueScope Steelworks produces a portion of its steel using recycled scrap steel as a feed stock, there is not sufficient supply of scrap steel to meet demands and, therefore, the steelmaking process continues to require the use of metallurgical coal and iron ore. South32 currently supplies the BlueScope Steelworks with the majority of its metallurgical coal requirements.

Specifically, metallurgical coal is used as a reducing agent in the steelmaking process. The carbon in the metallurgical coal is used to convert iron ore to molten iron in a blast furnace.

Research into the use of alternative reducing agents in the blast furnace method, such as hydrogen, is being undertaken. However, there is currently no economically viable alternative to the use of metallurgical coal as a reducing agent in the blast furnace method (i.e. a method employed at the BlueScope Steelworks) at a commercial scale (BlueScope Steel, 2019).

The steelmaking industry is highly trade exposed, with Australian steelmakers competing against suppliers across the globe. Accordingly, maintaining low production costs are critical to the competitiveness and viability of the Australian steelmaking industry.

The proximity of the existing Southern Coalfield mines, including Dendrobium Mine, to BlueScope Steelworks facilities at Port Kembla is a factor in BlueScope Steel’s ability to make economically competitive steel.

BlueScope has previously noted that without local metallurgical coal suppliers, it may struggle to remain economically viable at Port Kembla (BlueScope Steel, 2019).

The metallurgical coal produced by the Project cannot be replaced by renewable or alternative energy, because currently South32 supplied coal is, and future Project coal will be, used as a reducing agent in the steelmaking process, not for power generation.

The continued supply of coal from the Dendrobium Mine to the BlueScope Steelworks, which would be facilitated by approval of the Project, would contribute to its ongoing economic viability and associated socio-economic benefits.

6.2 ADVERSE SOCIO-ECONOMIC EFFECTS

6.2.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to potential adverse socio-economic effects included:

- Amenity impacts and associated physical and mental health impacts on the community.
- Consideration of the occupational risks of the underground coal industry.
- Adequacy of the Economic Assessment, including:
  - assessment of impacts to cultural values;
  - underestimates of greenhouse gas emissions cost;
  - assessment of the cost of reduced economic reliance on coal;
  - cost of rehabilitation and mine closure; and
  - impacts on property values.
- Clarification of public consultation undertaken to date.
- Risk of potential impacts to WaterNSW and Sydney Water revenue-generation and employment as a result of Project-related impacts to the Sydney Drinking Water Catchment.
- Employment benefits associated with the Project workforce are outweighed by potential impacts to employment provided by Sydney Water and WaterNSW, as well as in the wider Illawarra region.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to adverse socio-economic effects included the NSW Government Division of Resources and Geoscience (DRG), Wollongong City Council, Resources Regulator, NSW Ports and NSW Health. These comments included:

- Reduction of resource recovery in mine design.
- Worker health and safety.

6.2.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Amenity impacts and associated health impacts.
2. Consideration of occupational risks of underground coal industry.
3. Adequacy of the Economic Assessment undertaken for the EIS.
   a. Clarification of economic benefits of the Project.
   b. Calculation of indirect costs (including greenhouse gas emissions costs).
   c. Consideration of mine closure and rehabilitation costs.
   d. Potential impacts to property value.

4. Risk of potential impacts to WaterNSW and Sydney Water revenue-generation and employment as a result of Project-related impacts to the Sydney Drinking Water Catchment.
5. Clarification of community consultation undertaken.

Comments regarding reduction in resource recovery for the Project are addressed in Section 6.5.

6.2.3 Responses

1. Amenity impacts and associated health impacts.

Potential impacts to physical and mental health as a result of the Project have been assessed in Section 4.7.1 of the Social Impact Assessment prepared for the Project (Appendix K of the EIS).

Some community members expressed concern about the potential effects of coal dust and rail noise on their health. The risk of adverse impacts as a result of air quality impacts was considered in the Air Quality and Greenhouse Gas Assessment (Appendix I of the EIS) and the risk of rail noise impacts was considered in the Noise and Blasting Assessment (Appendix J of the EIS).

Based on feedback from community members received as part of consultation conducted for the Social Impact Assessment to mitigate potential health impacts associated with anxiety related to potential impacts from the Project, it was recommended by Elliot Whiteing (2019) that South32 should provide clear information in regard to the extent and nature of potential impacts, provide access to monitoring data and engage in regular communication to mitigate potential health impacts. This provision of information and regular communication occurs for the Dendrobium Mine and would continue for the Project.

The Air Quality and Greenhouse Gas Assessment presents a quantitative assessment of potential air quality impacts from the Project as assessed against criteria levels set to protect human health and amenity in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (Environmental Protection Authority [EPA], 2016).

South32 would operate the Project within the compliance limits for air quality, including both health and amenity criteria and it is not expected that the Project would result in adverse health impacts to the community.

South32 understands that community concerns about dust are likely to persist regardless of the compliance with relevant criteria, and would provide information about existing air quality, the Project's air quality targets and the results of air quality monitoring which may assist to reduce concern about coal dust and community health. The results of air quality compliance monitoring would continue to be made available on South32's website for the Project and when requested by members of the community.

The Noise and Blasting Assessment (Appendix J of the EIS) predicted a small number of 'negligible' (i.e. 0-2 dBA) exceedances of the Project Specific Trigger Levels (PSTLs).

One receiver was predicted to experience more than a negligible exceedance of the PSTLs as a result of the Project (i.e. a 'marginal' [3-5 dBA] exceedance which would occur during the evening and night periods during adverse weather conditions).

South32 has offered to implement reasonable and feasible noise mitigation measures at this receiver.

The Social Impact Assessment (Appendix K of the EIS) identified those residents in the Mount Kembla area affected by rail noise from the Kemira Valley Rail Line described feeling stress and frustration, as well as occasional sleep disturbance due to rail noise.

The recent rail noise mitigation measures implemented by South32 have resulted in a significant decrease in brake squeal noise. The successful implementation of noise mitigation measures on the Kemira Valley Rail Line are acknowledged by the EPA in their submission on the Project EIS:

> *The noise report shows that the most recent program (Environmental Improvement Program 1) has been successful in reducing noise levels and certain features of the noise emission such as wheel/brake squeal.*

As such, affected residents are likely to experience some relief from the stress and frustration experienced previously.

South32 would seek to mitigate other potential concerns from members of the community through the ongoing provision of accessible information about the Project. However, it is noted that some concerns may persist for some community members regardless of these strategies.

2. Consideration of the occupational risks of the underground coal industry.

South32 implements a safety management system at the Dendrobium Mine to manage risks to health and safety in accordance with the requirements of the NSW *Work Health and Safety (Mines and Petroleum Sites) Act, 2013* and the NSW *Work Health and Safety (Mines and Petroleum Sites) Regulation, 2014*. South32 would continue to meet these commitments for the Project.

A number of hazard control and mitigative measures are currently in place at the Dendrobium Mine, which are described in the existing Dendrobium Mine management plans (available on South32's website) which would be reviewed and revised accordingly for the Project.

3. Adequacy of the Economic Assessment undertaken for the EIS.

a. Clarification of economic benefits of the Project.

The Economic Assessment prepared for the Project (Appendix L of the EIS) (Cadence Economics, 2019) was undertaken in accordance with *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government, 2015) and the *Technical Notes Supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (Department of Planning and Environment, 2018).

The cost-benefit analysis and local effects analysis conducted as part of the Economic Assessment by Cadence Economics was undertaken in consideration of *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government, 2015).

The Economic Assessment indicated a net benefit of $1,073.2 million (in NPV terms) to the State of NSW and $431 million (in NPV terms) to the greater Wollongong Region. This includes an estimated $272.1 million in royalties, payroll tax and council values (in NPV terms).

In their submission on the Project EIS, the DRG presented the results of their own independent assessment of economic benefits from the Project.

Based on the parameters used and time that the assessment was undertaken by the DRG (i.e. after the Economic Assessment for Project [Appendix L of the EIS]), the DRG calculated that royalties generated by the Project would be $254 million (in NPV terms), which is comparable to the estimate by Cadence Economics (2019) in the EIS ($272.1 million in NPV terms).

b. Calculation of indirect costs (including greenhouse gas emissions costs).

The Economic Assessment included consideration of indirect costs of the Project on the NSW community through the generation of externalities, as well as the costs incurred by South32 (i.e. internalised costs) associated with the mitigation and management of the potential environmental impacts, including subsidence mitigation, the purchasing of water rights and mitigation and management costs associated with cultural heritage.

The externality costs included costs associated with the greenhouse gas emissions of the Project. Scope 1 and Scope 2 greenhouse gas emissions were priced in accordance with the latest carbon pricing undertaken by the Clean Energy Regulator under the Emissions Reduction Fund (ERF).

The average carbon price adopted in the Economic Assessment was $13.52 per tonne carbon dioxide equivalent (t CO_2-e) abated. While this is an average figure, it represents an estimate of the marginal cost of greenhouse gas abatement under Australia's current emission abatement policy represented by the ERF, and therefore is both contemporary and representative for the Project (Appendix L of the EIS).

Consistent with the *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government, 2015), the greenhouse gas costs associated with the Project were apportioned based on the NSW population (i.e. as greenhouse gas emissions are global in nature, the total global cost of Scope 1 and Scope 2 emissions were not allocated to NSW, rather were allocated based on the proportion of the NSW population to the global population) resulting in an attributed cost of $0.122 million to NSW in NPV terms. These indirect costs are significantly less than the economic benefits of the Project.

The net benefits of the Project to NSW estimated in the Economic Assessment do not include flow-on, or indirect benefits associated with the end use of Project coal at the BlueScope Steelworks. However, it is noted that the Parliamentary Report *Australia's Steel Industry: Forging Ahead* (Commonwealth of Australia, 2017), states that the BlueScope Steelworks (Commonwealth of Australia, 2017):

- directly employ 3,000 people;
- indirectly support about 10,000 jobs in the region (with the Illawarra Business Chamber noting in its submission to the Parliamentary Report that the multiplier effect of the steel industry is 3 to 5 indirect jobs for every direct job generated by the industry); and
- contribute approximately $1.9 billion per annum to the economy, based on analysis conducted by Wollongong City Council (without considering any multiplier effect).

As the Economic Assessment also does not include indirect economic benefits associated with the end use of coal, it does not include the indirect (i.e. Scope 3) externality costs associated with greenhouse gas emissions generated by the end use of Project coal by third parties.

c. Consideration of mine closure and rehabilitation costs.

The Economic Assessment for the Project considered the economic impacts of mine closure (in a regional economic sense), as well as direct closure costs associated with decommissioning the existing Dendrobium Mine surface infrastructure and undertaking rehabilitation activities for the Project that would be incurred by South32 (Section 2.1 of Appendix L of the EIS).

Broadly, the implications of the cessation of the mining operations of the Project would result in a contraction in regional economic activity, including impacts on downstream industries that currently transport or directly utilise Project coal, particularly the BlueScope Steelworks, as well as Port Kembla Coal Terminal and Liberty Primary Steel Whyalla Steelworks.

The magnitude of the regional economic impacts due to cessation of the Project would depend on a number of interrelated factors, including the movements of workers and their families, alternative development opportunities and economic structure and trends in the broader regional economy at the time.

d. Potential impacts to property value.

The Dendrobium Mine has historically co-existed with suburban areas and this would continue for the Project, therefore, the Project would not be inconsistent with adjoining land uses (i.e. residential areas particularly in Kembla Heights and Mount Kembla).

As such, it is not anticipated that the Project would have an adverse impact on property values for those residential areas located proximal to the Project surface facilities.

4. Risk of potential impacts to WaterNSW and Sydney Water revenue-generation and employment as a result of Project-related impacts to the Sydney Drinking Water Catchment.

The maximum predicted surface water losses for the Project represent a negligible impact to the yields of the Metropolitan Special Area (less than 1% reduction).

As noted by the Independent Expert Scientific Committee (IESC) in their submission on the Project, the reduction to Sydney's drinking water supply is "unlikely to be of material concern".

The predicted maximum losses are also insignificant when compared to other losses from the drinking water network (e.g. the maximum predicted Project losses of 1,935 megalitres per annum (ML/annum) is small compared to the increase in estimated water losses from the Sydney drinking water pipe network between financial years 2016-17 and 2017-18 [i.e. 5,500 ML in a single year]).

South32 would pay WaterNSW for the volume of surface water diverted from the Sydney Drinking Water Catchment during the Project mine life. The purpose of the commitment to pay WaterNSW for predicted surface water loss is to compensate WaterNSW for lost revenue for water it may otherwise be able to sell.

As such, it is not expected that the Project would pose a risk to revenue-generation or employment opportunity as a result of the operations of WaterNSW or Sydney Water.

5. Clarification of community consultation undertaken.

Stakeholder consultation has been undertaken prior to (i.e. during the operation of the Dendrobium Mine) and during the preparation of the EIS for the Project. Consultation conducted during the preparation of this EIS provided the opportunity to identify aspects of concern or interest to stakeholders and these were considered in the EIS.

South32 liaise with the community via the established Dendrobium Community Consultation Committee (DCCC) and the Dendrobium Community Consultation Committee – Plan for the Future Working Group.

The Dendrobium Community Consultative Committee – Plan for the Future Working Group is a sub-committee of the DCCC and provides a forum to discuss Project-related matters and represent community interests, which would continue for the Project.

6.3 SURFACE WATER LOSSES FROM THE CATCHMENT

6.3.1 Overview of Response

South32 recognises the importance of the Metropolitan Special Area to the water supply system and the potential impact the Project may have on the availability of water resources within the catchment.

To minimise potential surface water losses, the Project mine layout has been designed to incorporate setbacks from the Metropolitan Special Area water storages (Avon and Cordeaux Dams), named watercourses and key stream features. The consequence of this decision is the sterilisation of approximately 25 Mt of ROM coal within South32's existing mining tenement (CCL 768) (adjacent to Area 5), worth some $3.58 billion and $222 million in associated royalties (this mine layout, which is consistent with the mine plan assessed in the Project EIS, is shown on Figure 6-3A).

Potential Loss Mechanisms

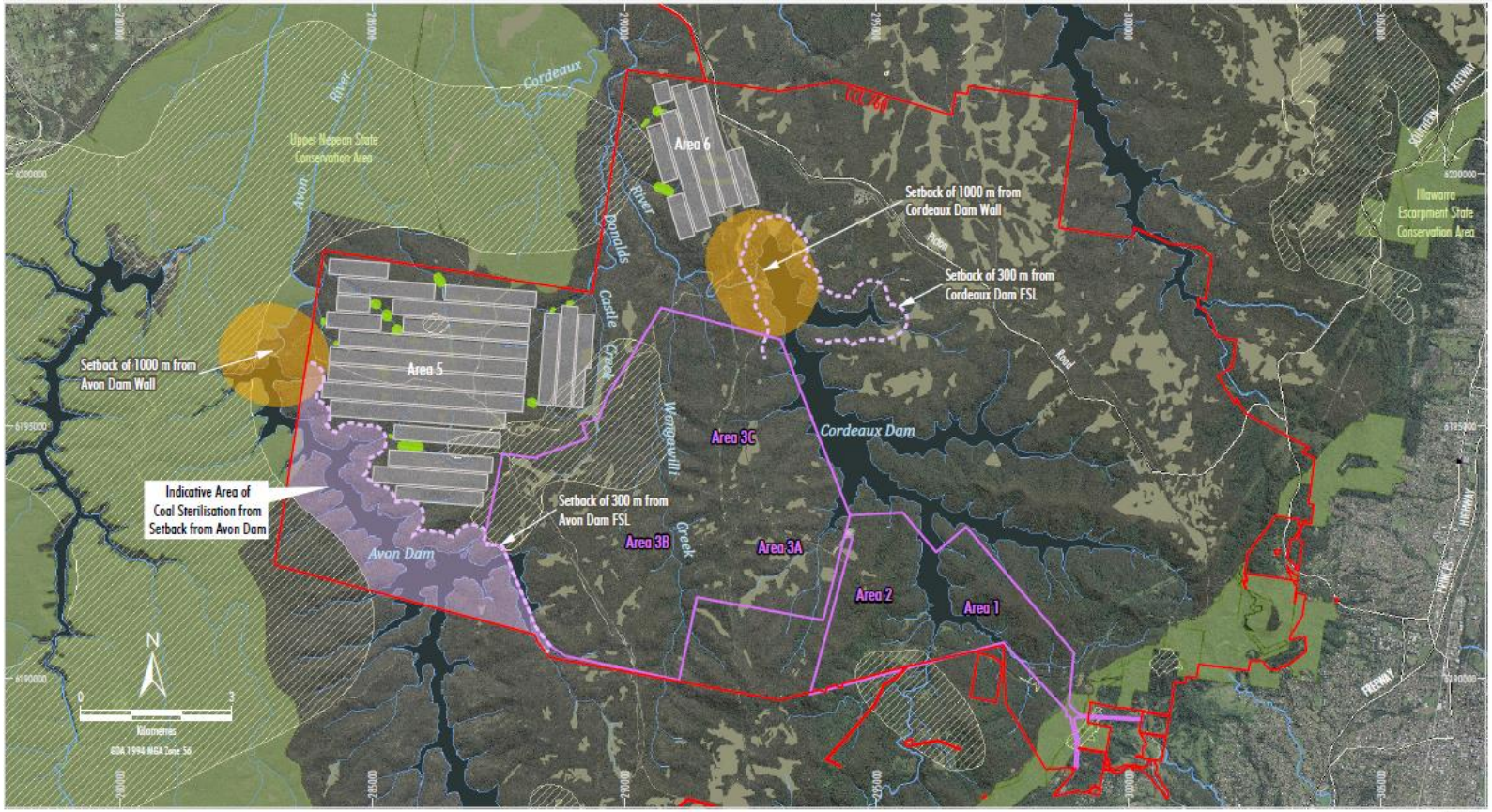
Part 2 of the IEP Report (2019b) describes various mechanisms of potential surface water loss resulting from longwall mining. Three mechanisms relevant to the Project are characterised as follows:

- **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.

Predicted surface water losses from the catchment due to the Project are related to Mechanisms 2 and 3 and are estimated to increase over the life of the Project up to a maximum of approximately 1,935 ML/annum (or 5.2 megalitres per day [ML/day]) at the end of mining (2048) (based on predictions of surface water losses, assuming wet climatic conditions in the Groundwater Assessment [Appendix B of the EIS]). The groundwater model results have been interrogated to estimate the losses due to Mechanisms 2 and 3, which are reported in the following sections of this Submissions Report. Note that the effect of Mechanisms 2 and 3 are difficult to isolate in the model due to interaction between drawdown and enhanced permeability, so the estimates have been presented as ranges.

For the Project, Mechanism 2 losses are associated with the ephemeral streams overlying the longwall area. The modelled Mechanism 2 losses comprise approximately 55-78% of the total maximum predicted loss of up to 1,935 ML/annum.

Due to the Project setbacks, the Metropolitan Special Area water storages (e.g. Avon and Cordeaux Dams) and named watercourses would not experience Mechanism 2 losses. Predicted losses from these water bodies are associated with depressurisation only (i.e. Mechanism 3 losses), which accounts for a total of 22-45% of the total maximum predicted loss of up to 1,935 ML/annum.



LEGEND
- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- EIS Base Plan Longwalls
- Indicative Area of Coal Sterilisation
- Coastal Upland Swamp
- Stream Feature Setback
- Bulli Sill Geology
- Setback from Full Supply Levels
- Setback from Dam Walls

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

DENDROBIUM MINE

Setbacks Adopted in the EIS Mine Plan

Figure 6-3A

*The figure shows the area of coal resource within South32's existing mining tenement (Dendrobium Mining Lease [CCL 768]) that is sterilised as a result of **South32's decision to not undermine storages** in the Metropolitan Special Area.*

The value of this sterilised resource is some $3.58 billion (equivalent to $222 million in royalties).

To maximise value in the remaining mining areas within CCL 768, continuation of mining with panels at the width consistent with the existing Dendrobium Mine is proposed for the Project (subject to dam wall, named watercourse and key stream feature setbacks).

Conservatism of the Groundwater Modelling

In practice, neither Mechanism 2 or 3 losses are directly measurable. Therefore, groundwater modelling is the primary tool used to estimate maximum potential losses from the Project. The groundwater model developed for the Project uses leading-practice modelling software, is constrained by hydrogeological data, is calibrated to historical mining effects (e.g. groundwater drawdown and mine inflows) and peer-reviewed by an independent and experienced hydrogeologist and groundwater modeller as per the Australian Groundwater Modelling Guidelines (Barnett *et al.,* 2012*)*.

Conservative assumptions have been adopted in the groundwater model, such that the surface water loss estimates in the EIS provide a likely upper maximum of impacts. In particular:

- The height of connective fracturing is assumed to extend from the seam to the surface fracture network for the Project longwall panels with void width of 305 m. If other recognised methodologies were used to estimate the height of connective fracturing, such as the 'Tammetta Equation', then the height of connective fracturing would not extend to the surface or interact with the surface fracture network for the majority of the Project area.
- The depth of surface fracturing is assumed to be 10 times the maximum longwall cutting height. This depth is greater than what is assumed in other contemporary groundwater studies.
- The model simulates the connected fracture zone, with model drain boundaries in the model layers from the mined seam up to the top of the assumed connected fracture zone. This maximises the chance that losses via 'Mechanism 2' are simulated, rather than Mechanism 1. In reality, a portion of diverted flow is likely to re-emerge downstream, the likelihood of which is described in Watershed HydroGeo (2019b). This is discussed further in the "Stream Flow Loss from Ephemeral Streams" sub-section in Section 6.3.4.

In addition, surface water is modelled as being available to be lost at all times in ephemeral tributaries overlying the longwall panels, whereas in reality, the streams experience no to low flow much of the time, particularly during dry periods such as those experienced in 2018 and 2019.

The effect of applying these conservative assumptions is significant. If more realistic, but less conservative, assumptions were adopted for the Project then some of the predicted surface water losses associated with Mechanism 2 (1,070 -1,500 ML/day of the total maximum of 1,935 ML/annum) would actually be Mechanism 1, and therefore would not be simulated as lost from the catchment.

Significance of Predicted Losses

Notwithstanding the conservatism of the modelling, the maximum predicted surface water losses for the Project represent a negligible impact to the yields of the Metropolitan Special Area (less than 1% reduction).

In addition, as the majority of the footprint of Area 5 and Area 6 are located downstream of the Avon and Cordeaux Dam catchments, approximately 1,172 ML/annum of the maximum predicted Project surface water loss of 1,935 ML/annum would be lost from catchments downstream of the dam walls (i.e. catchments that report to Pheasants Nest Weir rather than directly to the storages). Therefore, the majority of predicted surface water losses would not affect water supply or security in the storages of the Avon and Cordeaux Dams.

The predicted maximum losses are also insignificant when compared to other losses from the drinking water network. For example, by comparison to the maximum predicted Project losses of 1,935 ML/annum, estimated water losses from the Sydney drinking water pipe network were reported to increase by approximately 5,500 megalitres (ML) in a single year (i.e. Sydney Water estimated losses increased from 41,610 ML to 47,268 ML between financial years 17-18 and 18-19 [Sydney Water, 2017; Sydney Water, 2019]).

Proposed Offset Measures

Part 2 of the IEP Report (2019b) identifies options to 'offset' predicted surface water losses from the catchment, as follows:

- *'purchasing' the water lost from the catchment that can be attributed to mining operations, the financial offset could be used to fund make-up water sources, such as through the operation of desalination plants and borefields, or*
- *treating the water pumped from the mine to a standard that enables it to supplement water that would otherwise be drawn from the Greater Sydney Water Catchment.*

Both of these options are consistent with the measures described in the EIS, namely the beneficial use of mine water reporting to the mine workings, and payment to WaterNSW for any surface water diverted from the Metropolitan Special Area (i.e. water that could no longer be sold to other users).

Since lodgement of the EIS, South32 has continued to consult with stakeholders, and has identified numerous options for offsetting predicted surface water losses from the catchment.

As such, South32 commits to implement or fund works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area.

In addition, South32 already holds water licences to account for the maximum volume of predicted surface and groundwater loss attributed to the Project. However, these licenses are all held in the water sharing plan relevant to groundwater (i.e. the *Water Sharing Plan for the Metropolitan Region Groundwater Sources 2011)*. Consultation with the NSW government has occurred in regard to the ability for proponents to obtain surface water licences in the management zones covering the Metropolitan Special Areas.

South32 commits to implement or fund works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area.

This would include beneficial use of mine water to reduce existing demands on the drinking water system, and/or funding or implementing works that reduce existing losses (e.g. pipe losses or evaporation).

6.3.2 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to surface water losses from the catchment included:

- Potential surface water losses from streams and swamps to the reservoirs.
- Potential losses from reservoirs (including Avon, Cordeaux and Nepean Reservoirs) and effects on security of Sydney's water supply.
- Proposed offsets to compensate for potential water losses.
- Accuracy of surface water modelling and predictions.
- Assessment of worst-case climatic conditions (dry and wet conditions).
- Previous impacts to water catchment (water loss) from the existing Dendrobium Mine.
- Compatibility of mining within the Special Catchment Areas.
- Justification of predicted long-term surface water losses.
- Clarification of existing and proposed surface water monitoring programs.

- Cumulative impacts of mining in the wider catchment.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to surface water losses from the catchment included Department of Planning, Infrastructure and Environment – Biodiversity Conservation Division (DPIE-BCD), WaterNSW, NSW Dams Safety Committee (DSC) and DPIE-Water. These comments included:

- Accuracy of surface water modelling, calibration and predictions.
- Potential surface water losses from streams to the reservoirs during worst case climatic conditions (dry and wet conditions).
- Justification of proposed longwall mining method and consideration of alternative mine designs.
- Potential surface water losses from streams and reservoirs and impacts to water quality.
- Development of appropriate Trigger Action Response Plans (TARPs) and Management Plans for streams and Upland Swamps.
- Consideration of cumulative impacts to predicted surface water flows due to historical mining.
- Accuracy of surface water monitoring at Dendrobium Mine.

6.3.3 Key Aspects

In consideration of the submissions received on the Project EIS, the response to the key aspects raised in the submissions is structured as follows:

1. Accuracy of the prediction of surface water losses.
    a. Groundwater model development.
    b. Conservatism of groundwater model assumptions.
    c. Groundwater model calibration performance.
2. Impacts to Sydney Drinking Water Catchment water supply.
    a. Mechanisms resulting in surface water loss.
    b. Predictions for the catchments of the Avon and Cordeaux Reservoirs.
    c. Significance of predicted surface water losses.
3. Mitigation and management measures for the Project.
    a. Beneficial use of mine water.
    b. Payment for surface water take.
    c. Surface water licensing.
4. Surface water flow monitoring.

The responses in this section are related to potential losses of surface water from the Special Catchment Areas (including from streams and reservoirs). Responses specifically related to physical impacts to streams, mine design and the selection of longwall setbacks, surface water quality, swamps and groundwater and swamps are provided in Sections 6.5, 6.6, 6.7, 6.9 and 6.13, respectively.

6.3.4 Responses

1. Accuracy of the prediction of surface water losses.

a. Groundwater model development.

Potential surface water losses as a result of the Project have been predicted by HydroSimulations (2019), using the groundwater model developed for the Project.

The groundwater model developed for the Project builds on previous groundwater modelling efforts over the last decade in the development of best practice modelling methods, as acknowledged by the IEP (2019a, 2019b), and is an extension of previous groundwater models developed for the Dendrobium Mine.

The Project model domain accounts for historic stresses in the groundwater system by incorporating historical, active and proposed mining operations in the Sydney Drinking Water Catchment.

The model grid or mesh has been refined to incorporate detail in areas where groundwater stresses could occur, such as around longwall panels, or where sensitive natural and built receptors are located (such as reservoirs, along watercourses, Upland Swamps and registered groundwater bores).

b. Conservatism of groundwater model assumptions.

Hydrogeological parameters incorporated into the groundwater model for the Project are well informed by extensive site-specific dataset of hydraulic conductivity and porosity or storage estimates. This includes the consideration of pre- and post-mining observations to constrain parameters such as horizontal and vertical permeability.

The model also has the benefit of over a decade of data measuring the effect of historic mining operations to the groundwater system. The calibration statistics for the model demonstrate that these historic effects (e.g. drawdown and mine inflows) are adequately replicated (refer below for further detail of the model calibration performance).

Some parameters in the groundwater model are unable to be directly measured (e.g. height of fracturing) or are variable (e.g. flows in ephemeral streams and regulated watercourses). In such cases, the groundwater modelling incorporates a range of **conservative assumptions** in consideration of expert reviews of groundwater modelling in the Southern Coalfield and the recommendations of the IEP (2019a, 2019b), including:

- **Height of sub-surface connective fracturing** – conservatively assumed to extend from the seam to the surface and interact with the surface fracture network for the Project longwall panels with void width of 305 m.

  If other recognised methodologies were used to estimate the height of sub-surface connective fracturing, in particular the 'Tammetta Equation', the majority of the Project underground mining area would not be modelled as having a fracture network that extends from the seam to the surface or extend to the surface fracture network (Appendix B of the EIS) (Figure 6-3B).

- **Depth of surface cracking** – the depth of surface cracking is assumed to be 10 times the maximum longwall cutting height, which is greater than modelled depths of surface cracking simulated in other groundwater studies (e.g. 20 – 30 metres [m] for Springvale Mine).

- **Surface water loss from ephemeral tributaries** – all surface water is modelled as 'lost' from the ephemeral drainage lines that overlie the Project areas, as it is assumed to be permanently lost. In reality, a portion is likely to re-emerge downstream. In addition, the ephemeral tributaries overlying the longwall panels are assumed to have water available to be lost at all times (despite these tributaries experiencing no to low flow during dry periods).

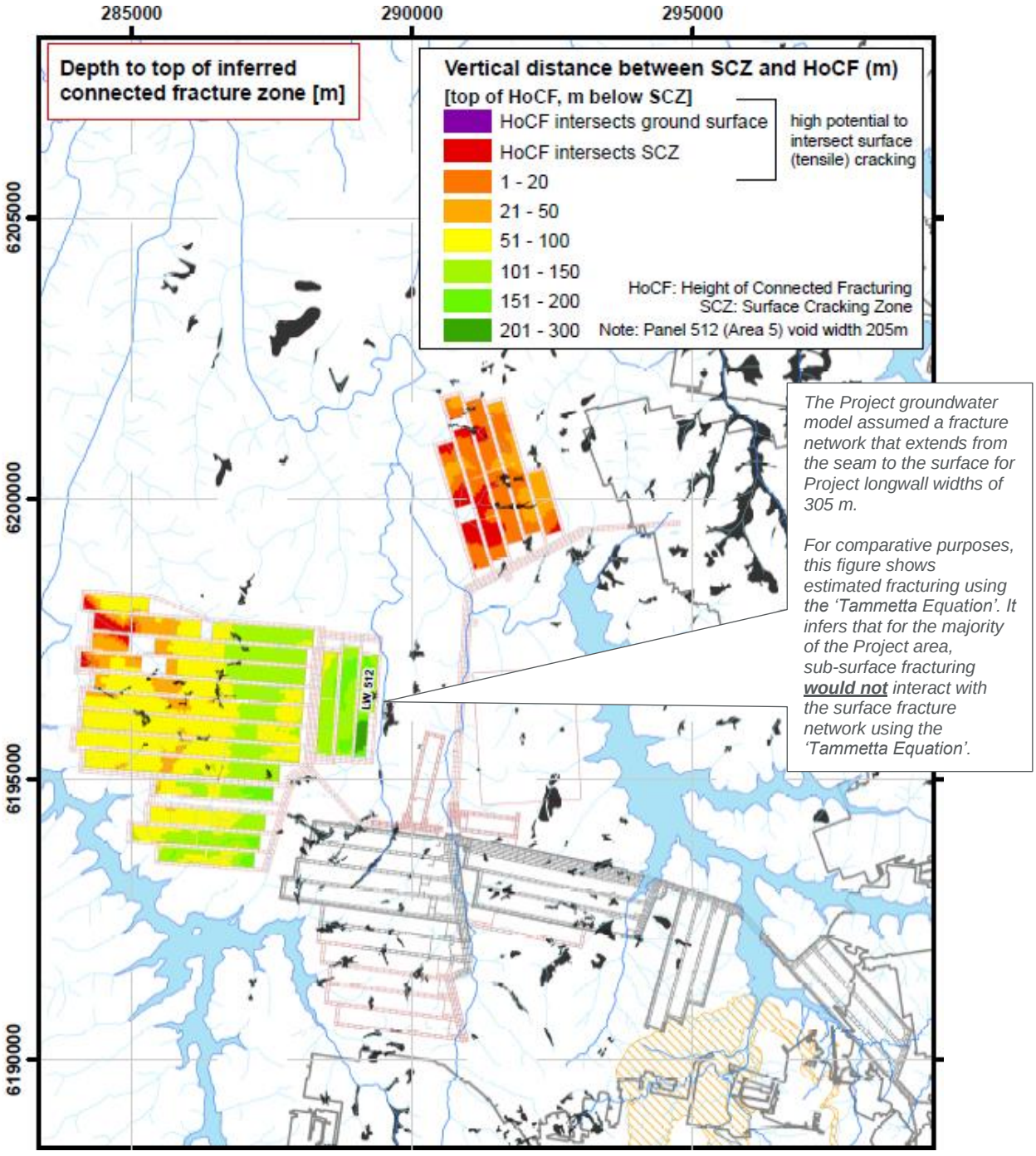


Figure 6-3B – Variation in Inferred Height of Fracturing using the Tammetta Equation

The conservative nature of these assumptions is supported by observed effects. For example:

- Loss of surface flow has been observable and discernible at stream flow gauges located immediately downstream of Area 3B (e.g. WC21, DC13S1 and DCS2). Losses at these sites can be significant, with reductions in median flow being approximately 50-80% of pre-mining median flow. However, corresponding changes in surface water flow at gauges further downstream were not discernible (i.e. DCU and WWL) (Figure 6-3C). This indicates that some portion of localised losses at WC21, DC13S1 and DCS2 re-emerged downstream and/or the volume of water lost was insignificant compared to the total flow at the downstream gauging stations (see Appendix B of the EIS as well as recent analysis in Watershed HydroGeo, 2019b).
- The model simulates drawdown at a similar magnitude and rate near to and above longwalls (e.g. Figures 7-5 and 7-16 of the Groundwater Assessment [Appendix B of the EIS] and reproduced below in Figure 6-3D) when compared to piezometer data, e.g. with significant drawdown at depth (e.g. ~150 m drawdown in Wongawilli Seam at bore S1992) and less drawdown higher above the seam (e.g. S1992 exhibits 80 m drawdown in the Scarborough Sandstone, <40 m drawdown in Bulgo Sandstone and less than 10 m drawdown in the upper Hawkesbury Sandstone). Within the model, most of this drawdown is associated with simulated drainage of groundwater into the mine workings via the 'stacked drains' mechanism, whereas in reality more drawdown might be associated with lateral drainage away from the mine footprint.
- The model has a tendency to overpredict total historic mine inflows to Areas 1-3B by approximately 20%, in comparison to the 30-day average observed inflows (Figure 6-3E).

As the model assumes water is always available to be lost from ephemeral streams in the predictive period, modelled losses exceed total stream flow during no to low flow periods.

On the basis of the above, the risk of actual impacts (i.e. surface water losses) being significantly greater than those predicted from the groundwater model can be considered low. This conclusion was supported by Dr Frans Kalf in the peer review of the Groundwater Assessment for the Project:

> *KA has no objection to the use of this 'Stacked Drain' method as it has been used by MER* [Mackie Environmental Research Pty Ltd] *for a number of years and has proved to be suitable. In addition it has been found on some projects by MER to overestimate the mining effects such as drawdown and overall inflow and therefore can be considered to be a conservative overall methodology for determining fracture propagation and associated draining in the geological profile.*
>
> *…*
>
> *… the 'stacked drains' approach by HS would very likely capture most flow and therefore would indeed be conservative with respect to mine inflow.*

Dam Seepage Model

South32 has previously been requested to provide estimates of seepage from the Avon Dam (i.e. Mechanism 3 losses) as part of its secondary approval processes for the approved Dendrobium Mine longwalls in Area 3B.

HGEO (2018) prepared a local-scale model for the section of the Avon Dam shoreline proximal to approved Longwalls 12 to 16. As any seepage from the Avon Dam cannot be measured directly, the modelling was based on calculations using Darcy's Law. Key inputs to the modelling were informed by measured groundwater levels and permeabilities (based on post-mining packer tests).

It is noted that groundwater levels in the section of sandstone between the Avon Dam shoreline and the longwalls vary, with no apparent relationship between groundwater levels (or depressurisation) and distance from the Avon Dam shoreline (Chart 6-3A).

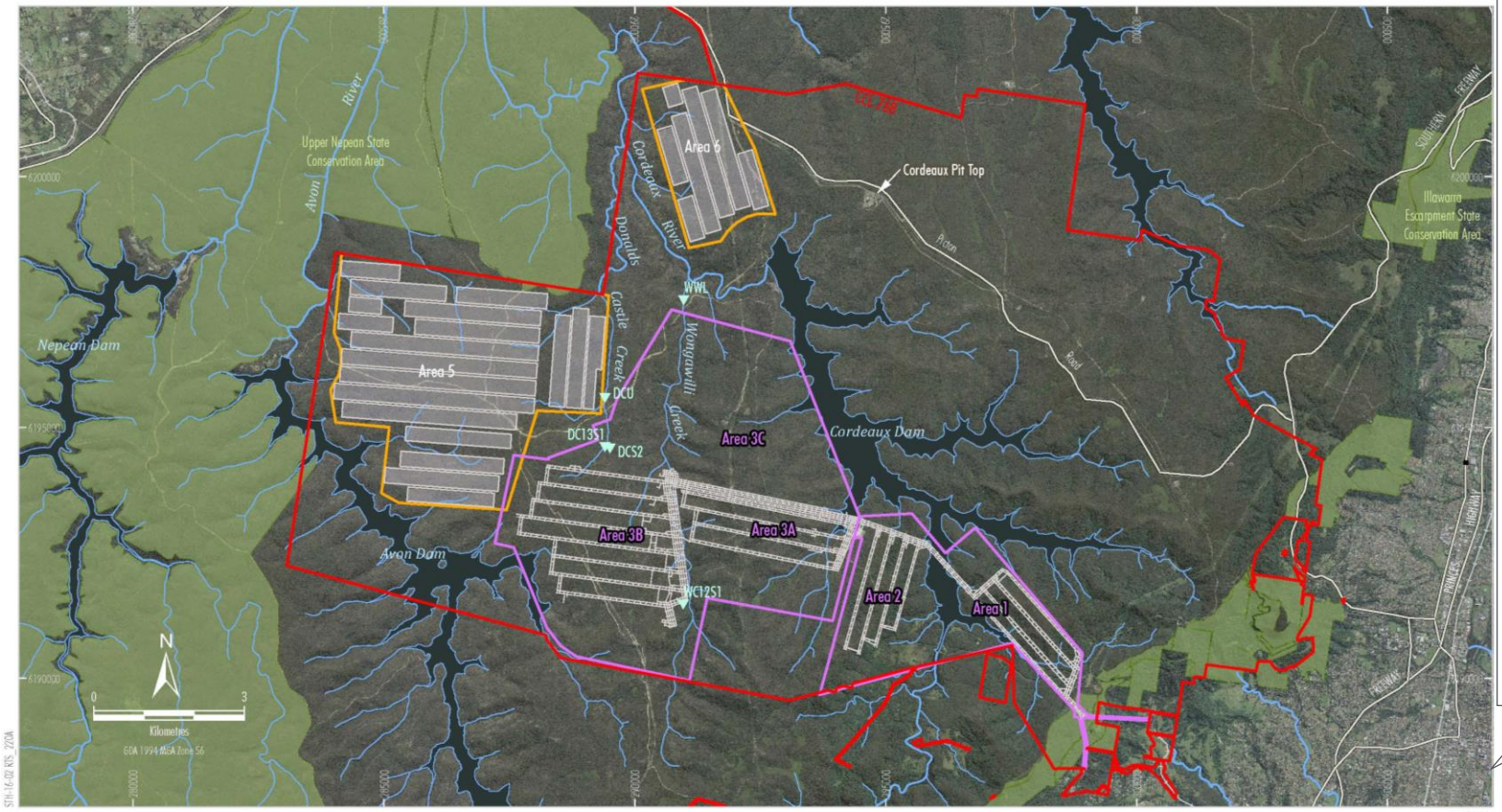


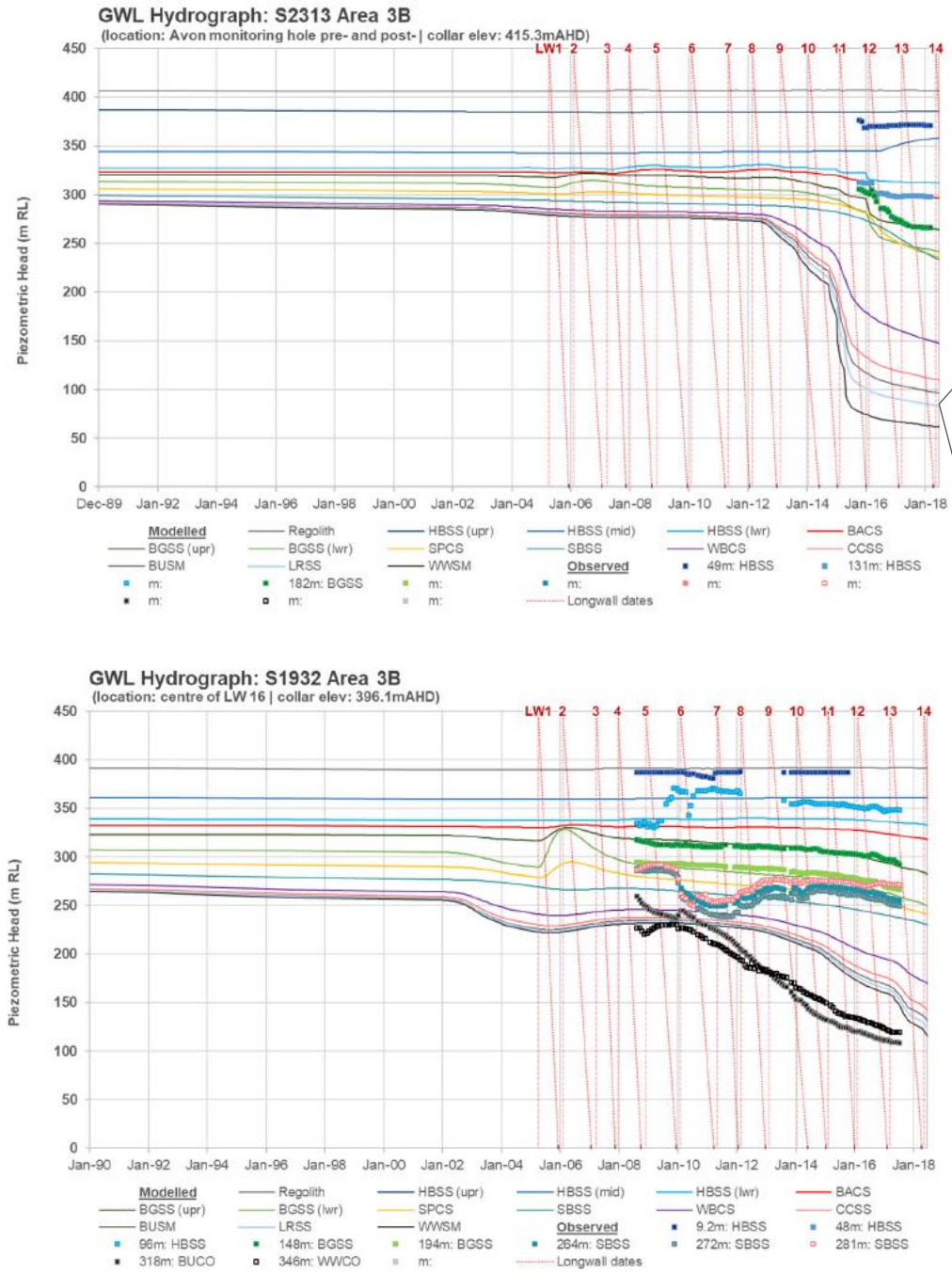
Figure 6-3C

The Project assumed that stream flow diversions would be permanently lost (i.e. Mechanism 2).

*Although loss of surface flow has been observed at stream flow gauges located immediately downstream of Area 3B (WC21S1, DCS2 and DC13S1), corresponding changes in surface water flow at gauges further downstream (DCU and WWL) **were not discernible.***

This indicates that some portion of localised losses re-emerged downstream and/or the volume of water lost was insignificant compared to the total flow at the downstream gauging stations.

Therefore, the model assumption that stream flow diversion is permanently lost is likely conservative.



These graphs compare simulated and measured drawdown of Bores S2313 and S1932 located between Area 3B and Avon Dam.

As can be seen, the model simulates drawdown at similar magnitudes and rates to the measured data, with significant drawdown at depth (~150 m) and less than 10 m drawdown in the Upper Hawkesbury Sandstone.

Figure 6-3D – Modelled vs Observed Groundwater Level Hydrographs – Bores S2313 and S1932

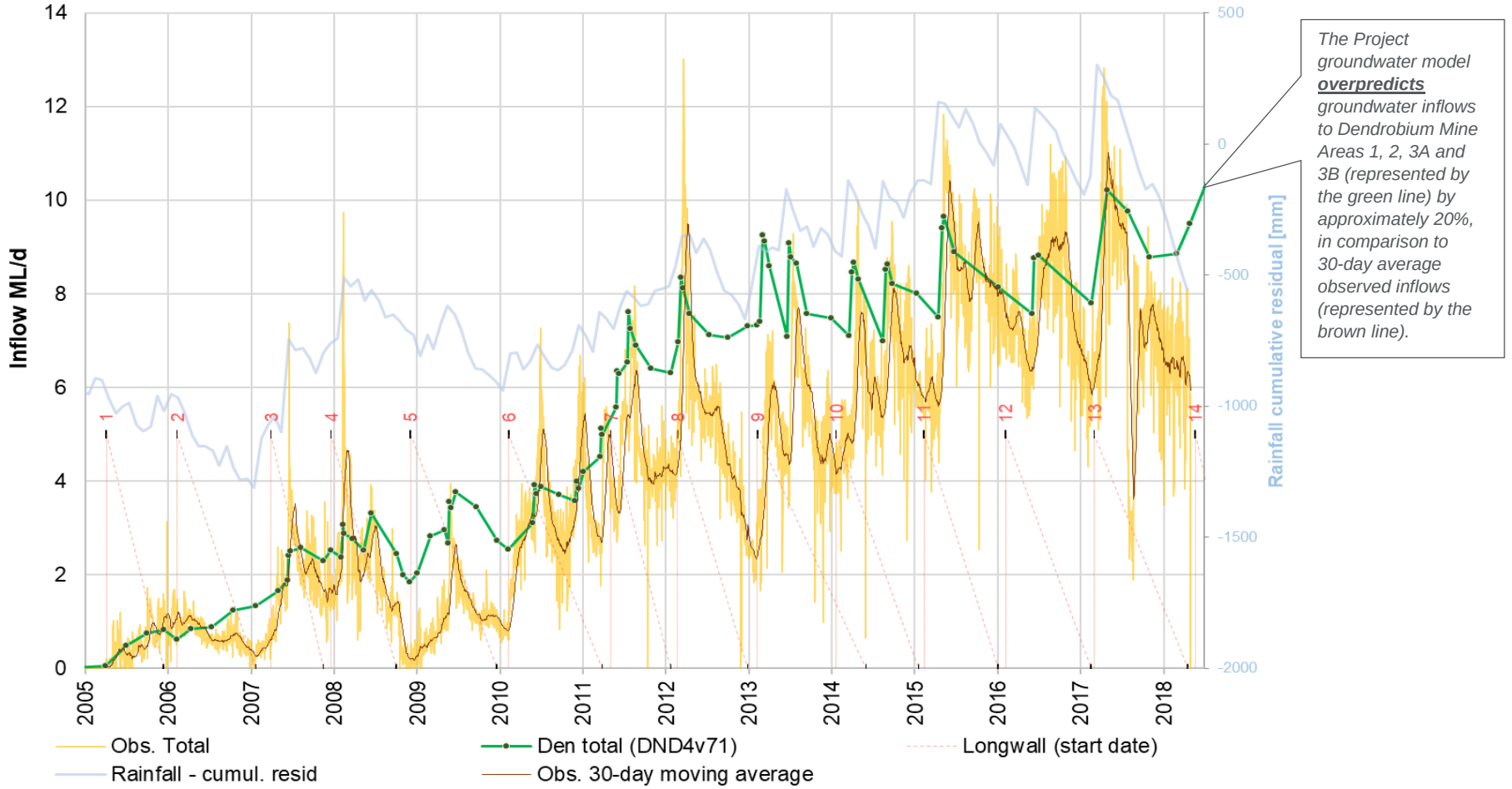


Figure 6-3E – Predicted vs Observed Mine Water Inflow at the Dendrobium Mine

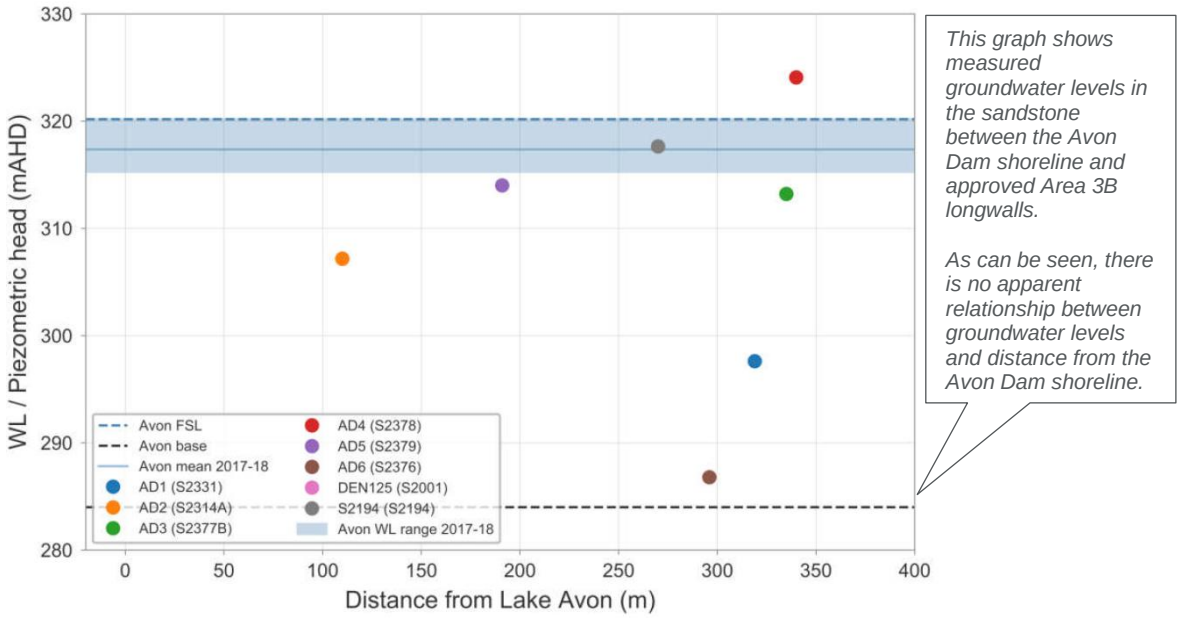


Chart 6-3A – Measured Groundwater Level on Avon Dam Shoreline (After: HGEO [2018])

Similarly, horizontal hydraulic conductivity (measured using packer tests) varies significantly (i.e. orders of magnitude) with no clear trend with distance from the goaf (Chart 6-3B).

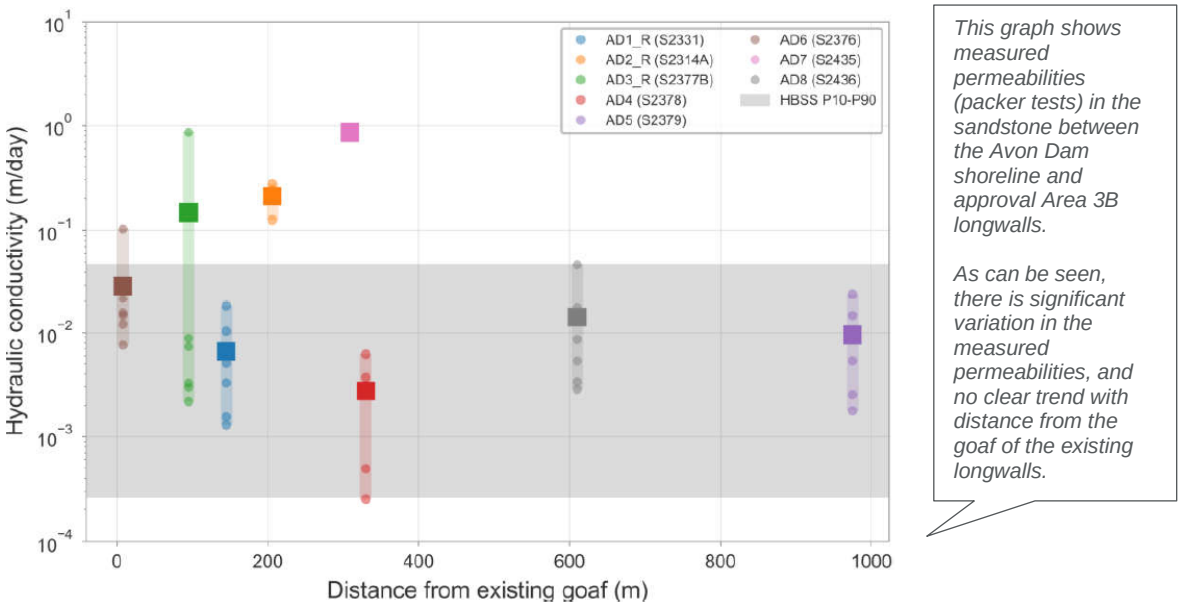


Chart 6-3B – Measured Permeability of Sandstone on Avon Dam Shoreline

The local-scale model estimated losses of 0.44 megalitres per day per kilometre (ML/day/km) (HGEO, 2018), or 0.7 ML/day for the 1.6 km of shoreline proximal to the end of Longwall 16 (located in Dendrobium Mine Area 3B). Previous estimates of seepage for this section of shoreline, based on the post-mining permeability measurements, by SCT (2018) were 0.01 to 1 ML/day/km (i.e. a range of two orders of magnitude).

By comparison, the regional groundwater model developed for the EIS (HydroSimulations, 2019) estimates a maximum loss from Avon Dam (i.e. Mechanism 3 losses) of 0.48 ML/day cumulatively from the Project and the Dendrobium Mine. The estimate from the regional model as presented in the EIS is lower than the estimate of HGEO (2018) using the local-scale model.

It is noted that, unlike the regional model, the local-scale model is not constrained by, or calibrated to, measured mine inflows.

If the regional model was revised to incorporate the seepage estimates from the local-scale model, this would reduce calibration performance against mine inflows (i.e. it would result in greater mine inflows when compared to what has been observed in Area 3B, noting that the regional model already overpredicts these inflows).

On the basis of the above, the calibrated regional groundwater model used for the EIS is considered to be a more robust and appropriate tool to predict the total surface water losses from the catchment from the Project. The local-scale model developed by HGEO is aimed specifically at one particular prediction, and is unconstrained by other data (i.e. is not calibrated to mine inflow or groundwater levels).

Stream Flow Loss from Ephemeral Streams

The Project groundwater model adopts assumptions that mean that most surface water modelled as 'lost' from the ephemeral drainage lines that overlie the Project areas is permanently lost.

The IEP Part 2 Report (2019b) states:

> *The Panel's view is that the depressurisation and loss of baseflow observed further upstream will most likely result in baseflow loss at the WWL gauge and, therefore, the apparent absence of baseflow loss at that gauge is likely due to uncertainty in the surface flow measurement and modelling at WWL.*

South32 does not agree with this view.

Gauging stations DC13S1 and DCS2 are located immediately downstream of mined panels in Area 3B. Flow monitoring at DC13S1 and DCS2 clearly shows a reduction in flow following mining (Figures 6-3F to 6-3I).

The reduction in median flow at DC13S1 and DCS2 represents approximately 45 to 60% of median flow at the downstream gauge DCU. If the losses at DC13S1 and DCS2 were permanently lost from the catchment, then this should be apparent at DCU (which is not the case). This indicates the diverted stream flow does re-emerge downstream.

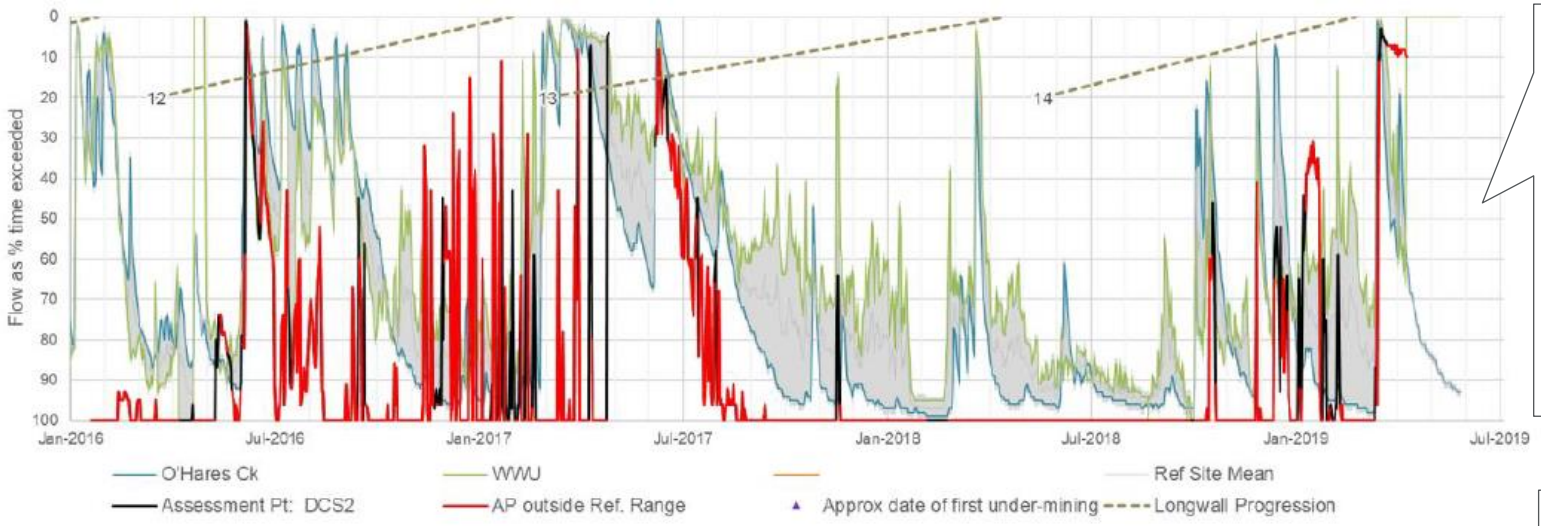
Various analysis methods support this position for both downstream gauges DCU and WWL.

One such method, used in support of analysis for TARPs for the Area 3 SMPs, is comparison of flows to reference sites (i.e. sites unaffected by mining). To account for differences in catchment size (and therefore volume of flow), the analysis compares 'flow percentile' for the various catchments. This is because, while absolute flow values will vary between catchments, it would be expected that median flows (i.e. 50th percentile) would occur at similar times, 95th percentile low flows would occur at similar times during dry periods, 5th percentile wet flows would occur at similar times during wet periods, and so forth.

It can be seen from the graphs below (Figures 6-3F and 6-3G) that changes in flow (as 'flow percentile') at DCS2 clearly differs from the reference sites at WWU (Wongawilli Creek upstream of mining), O'Hares Creek and Bomaderry Creek. This is indicative of mining having impacted flows this site.

By comparison, flow percentiles further downstream at site DCU clearly follows the references sites.

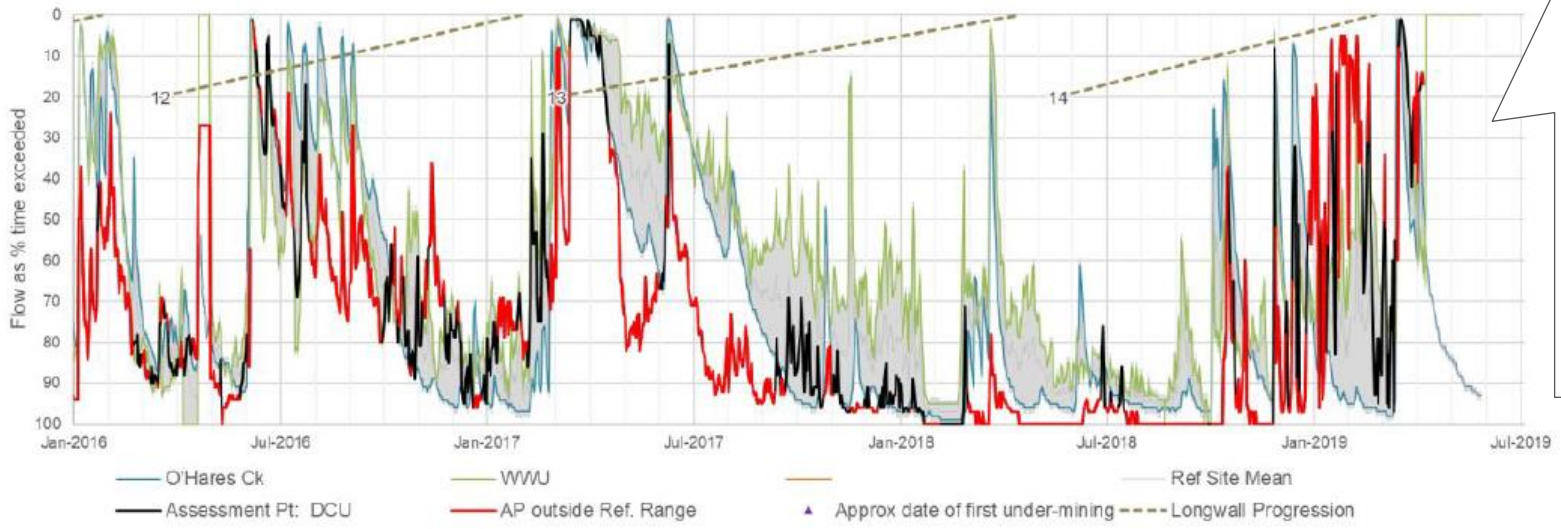
Similarly, flow at WC21S1 (located immediately downstream of the Area 3B longwalls) (Figures 6-3H and 6-3I) clearly differs from the reference sites (indicative of mining having impacted this site), whereas flow at WWL does not.



This figure shows flow (as 'percentile flow') at the DCS2 'assessment site', represented by the red and black lines, in comparison to reference flow gauge sites unaffected by mining (the blue and green lines).

As can be seen, the red/black clearly differs from the reference sites – indicating flow at this stream gauge, located immediately downstream of Area 3B, has been affected by mining.

Figure 6-3F – Flow Monitoring at Gauge Station DCS2



By comparison, this figure shows flow at DCU over the same time period, which is further downstream from DCS2 (above). For the same time period, it shows that flow percentile (red/black line) more closely follows the reference sites. Indicating the flow has not been affected significantly beyond natural variability.

These results indicate that a portion of flow diverted from streams above the longwalls is likely to re-emerge downstream.

Figure 6-3G – Flow Monitoring at Gauge Station DCU

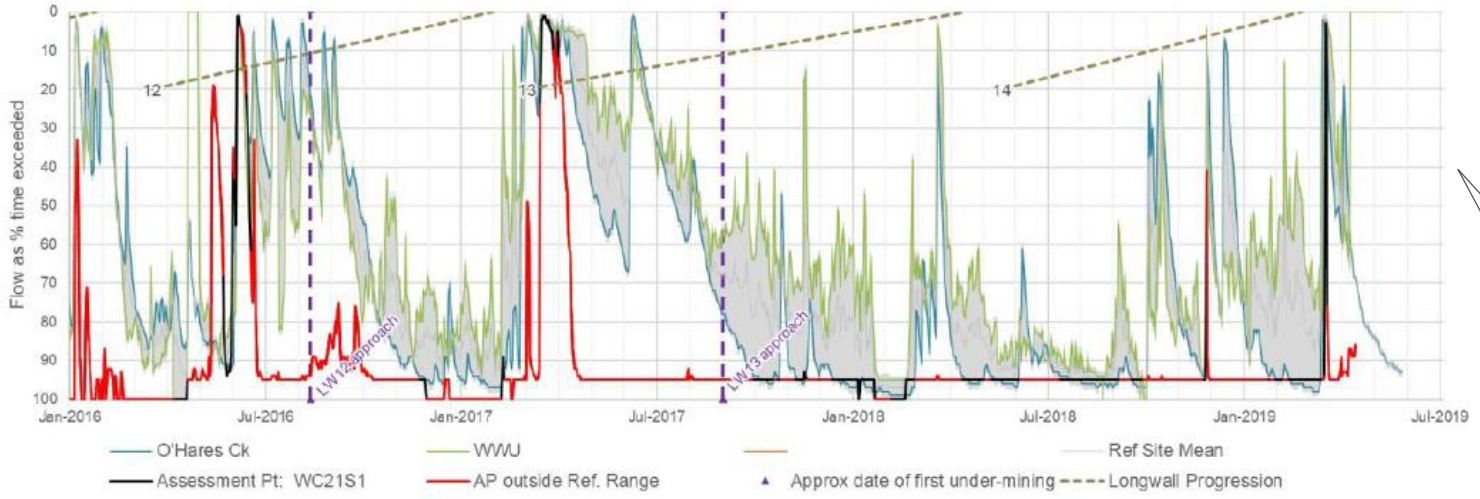


Figure 6-3H – Flow Monitoring at Gauge Station WC21S1

Similar to the above, flow at WC21S1 (located immediately downstream of the Area 3B longwalls) clearly differs from the reference sites, whereas flow at WWL over the same time period, (graph below) (located further downstream from WC21S1) does not.

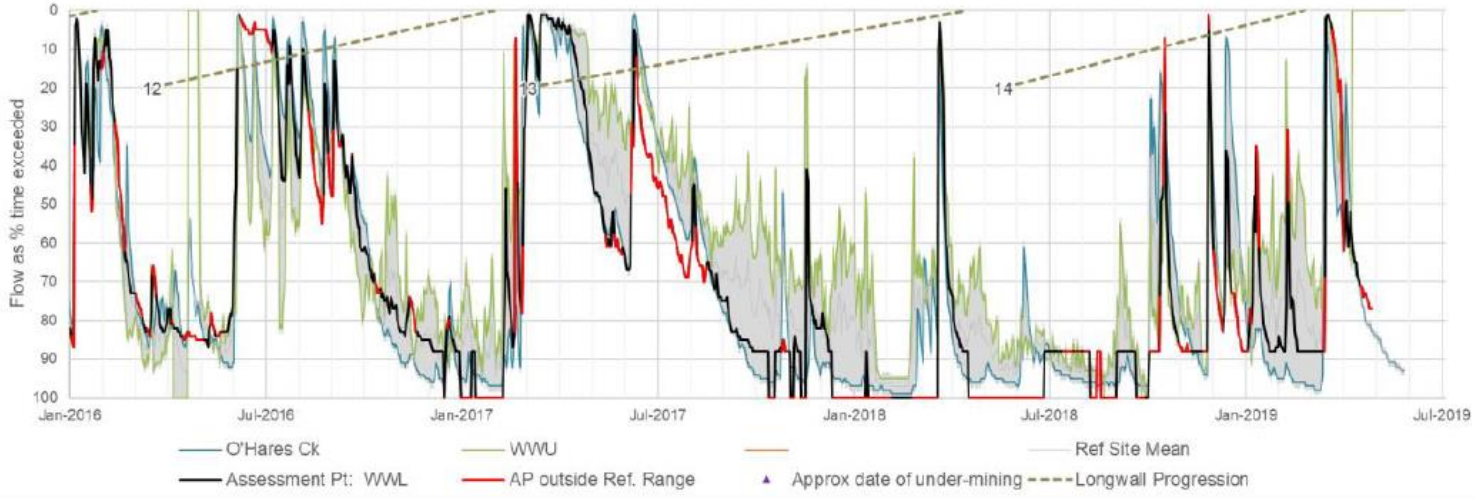


Figure 6-3I – Flow Monitoring at Gauge Station WWL

Similar analysis was presented in Watershed HydroGeo (2019a) for other flow parameters, being median flow and a measure of the number of cease-to-flow days at gauging stations around Area 3B. These showed a consistent pattern – clearly discernible mining effects in headwater catchments overlying or near to extracted panels, but little effect observed downstream.

For example, the reduction in median flow at DC13S1 and DCS2 represents approximately 45 to 60% of median flow at the downstream gauge DCU. If the losses at DC13S1 and DCS2 were permanently lost from the catchment, then this should be apparent at DCU (which is not the case). This indicates the diverted stream flow does re-emerge downstream. This does not equate to a finding that there is no change in the pattern of flow at DCU, because some changes to very low flows are likely, however the consistency of median flow is an indicator that the overall volume of flow is the same.

Therefore, in reality, a significant portion of surface water is likely to re-emerge downstream of the mine footprint as shown by the Area 3B gauging stations.

c. Groundwater model calibration performance.

The conceptual model of the groundwater system has been developed over time in consideration of one of the largest databases of groundwater-related data for a mine in NSW and considering the findings made in external studies (e.g. Advisian *et al,* 2016; PSM, 2017; IEPMC, 2018). The conceptualisation has been translated into a groundwater model with the inclusion of a number of conservative assumptions around the depth of surface cracking, the development of permeability beyond the longwall footprint, and, most importantly, the height and degree of vertical fracturing above the goaf.

The numerical model has been calibrated against a significant database of groundwater levels and to fluxes (mine inflow and baseflow) and for unstressed and stressed conditions, which being constrained by considerable amount of pre- and post-mining permeability data and independently determined recharge estimates.

The conceptualisation and numerical modelling have been reviewed by an independent and experienced peer-reviewer considering the Australian Groundwater Modelling Guidelines.

This model has then been used to provide forecasts considering the results of a set of deterministic scenarios to inform uncertainty of key predictions.

- **The groundwater model builds on previous groundwater modelling efforts over the last decade in the development of best practice modelling methods acknowledged by the IEP.**
- **The model is informed and constrained by measured data, and is calibrated to historic mining stresses to the groundwater system.**
- **The groundwater model incorporates a range of conservative assumptions in the prediction of surface water losses.**
- **The prediction of surface water losses from the catchment is, therefore, inherently conservative, with the risk of actual impacts to surface water losses being significantly greater than those predicted from the groundwater model considered to be very low.**

2. Impacts to Sydney Drinking Water Catchment water supply.

a. Mechanisms resulting in surface water loss.

Part 2 of the IEP Report (2019b) identifies mechanisms via which surface water can be lost from the catchment. Three mechanisms relevant to the Project are summarised below and in Table 6-3A:

- **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) 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 transferred to the groundwater system or mine workings) and therefore is no longer available as surface water supply in 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 associated with subsidence (or other physical) impacts to the beds of the surface water bodies, rather, losses are a result of changes in the gradient of surface water and groundwater interactions.

A breakdown of the modelled surface water losses by mechanism is provided in Table 6-3A. The majority of the predicted losses are associated with Mechanism 2. If realistic, but less conservative, assumptions were adopted for groundwater modelling some of the Mechanism 2 losses would actually be Mechanism 1 losses, and therefore, would not be permanently lost from the catchment.

b. Predictions for the catchments of the Avon and Cordeaux Reservoirs.

The Project underground mining area is wholly located within the Metropolitan Special Area (Figure 6-3J).

As shown in Table 6-3B and Figure 6-3J, only a small portion of the Project underground mining area is located within the catchments of the storages within the Metropolitan Special Area (i.e. the Avon and Cordeaux Dams) (Figure 6-3J). The majority of the Project underground mining area is located in the catchment downstream of the dam (Figure 6-3J).

As noted above, the majority of Project surface water losses are associated with permanent surface water diversion due to subsidence-related impacts (i.e. Mechanism 2).

The majority of predicted Mechanism 2 losses would not affect surface water supply to the Avon and Cordeaux Dams, as only 34% of Area 5 is located within the Avon Dam catchment area and 4% of Area 6 is located within the Cordeaux Dam catchment area (Figure 6-3J).

A breakdown of predicted losses per catchment area is provided in Tables 6-3C and 6-3D. As shown, only approximately 709 ML/annum of the 1,935 ML/annum (i.e. 35%) of total predicted surface water losses would potentially affect water supply and security of the Avon and Cordeaux Dams.

c. Significance of predicted surface water losses

Water Storage Security Yield

Part 2 of the IEP Report (2019b) notes that consideration of the significance and tolerability of predicted surface water losses should primarily be based on impacts to 'security yield':

> *Assessment of the significance and tolerability of cumulative water supply losses due to mining should be based primarily on the degree to which they reduce security yield, including consideration of whether the reduction would require compensatory investments or other management actions. WaterNSW presented to the Panel the initial stages of work towards a framework that will support this assessment. Predicted water losses used in this assessment should be conservatively high, ideally with stated probabilities of non-exceedance, to allow for prediction uncertainty.*

'Security yield' is described by the IEP (2019b) as follows (emphasis added):

> *The security criterion is the most relevant in the context of assessing the potential consequences of mining for water supply. It is that **storage** should not fall below 5% of **storage** capacity in more than one in every 100,000 months (WaterNSW, 2018).*

Table 6-3A
Summary of Total Project Surface Water Losses

Mechanism	Description	Examples for Project	Maximum Predicted Surface Water Loss for the Project (ML/annum)	Implication of Conservative Model Assumptions
Mechanism 1	Surface Water Diversion (that re-emerges downstream)	N/A	N/A	Most surface water from headwater streams above workings is assumed to be permanently lost
Mechanism 2	Surface Water Diversion (that does not re-emerge downstream)	Losses from ephemeral streams overlying Project longwalls	~ 1,070 – 1,500	Conservative estimate of surface water losses as surface water assumed to be available to be lost at all times from streams
Mechanism 3	Groundwater Depressurisation	Modelled increases in leakages from dams and named watercourses	~ 435 - 865	Model is likely to simulate more leakage from watercourses than would occur in reality, and more water within shallow strata entering the conservatively-represented fracture network and being lost from the catchment
		Total	***1,935***	

Table 6-3B
Summary of Catchment Areas

Catchment		Catchment Area	Project	
			Area of Project Longwall Footprint Located within Catchment	Project as a Portion of Catchment
Storages	Avon Reservoir	143 km²	6.9 km² (34% of Area 5)	4.8%
	Cordeaux Reservoir	86 km²	0.2 km² (4% of Area 6)	0.2%
	Nepean Reservoir	320 km²	~ 0 km²	-
	Cataract Reservoir	130 km²	~ 0 km²	-
Downstream of Storages	Pheasants Nest Weir (Downstream of Nepean, Avon and Cordeaux Reservoirs)	137 km²	18 km² (66% of Area 5 and 96% of Area 6)	13.1%
	Broughtons Pass Weir (Downstream of Cataract Reservoir)	86 km²	-	-
	Total – Metropolitan Special Area	***902* km²**	***25.1 km²***	***2.8%***

Table 6-3C
Breakdown of Total Maximum Predicted Surface Water Losses from the Metropolitan Special Area – Project-only (ML/annum)

Mechanism	Storages				Downstream of Storages	
	Avon Reservoir	Cordeaux Reservoir	Nepean Reservoir	Cataract Reservoir	Pheasants Nest Weir	Broughtons Pass Weir
Mechanism 1	0	0	0	0	0	0
Mechanism 2 (% of total)	19-25%	1-3%	0%	0%	35-50%	0%
Mechanism 3 (% of total)	6-12%	1-3%	1%	0%	13-28%	1%
Sub-total [ML/annum]	630	79	27	0	1,172	28
Total	1,935 ML/annum (max)					

Mechanism 1 = Surface water diversion that re-emerges downstream

Mechanism 2 = Surface water diversion that does not re-emerge downstream

Mechanism 3 = Groundwater depressurisation (e.g. modelled increases in leakages from dams and named watercourses)

Note: Figures 6-3K and 6-3L show the maximum predicted surface water losses in Project year 30

Note: estimates of losses due to Mechanisms 2 and 3 are based on modelled losses occurring directly above the longwalls (Mechanism 2) and >300 m from the longwalls (Mechanism 3). Losses within 0-300 m of the longwalls could be attributed to either mechanism, hence the range in estimates

Table 6-3D
Breakdown of Total Maximum Predicted Surface Water Losses from the Metropolitan Special Area – Cumulative Dendrobium Mine Areas 1 – 6 (ML/annum)

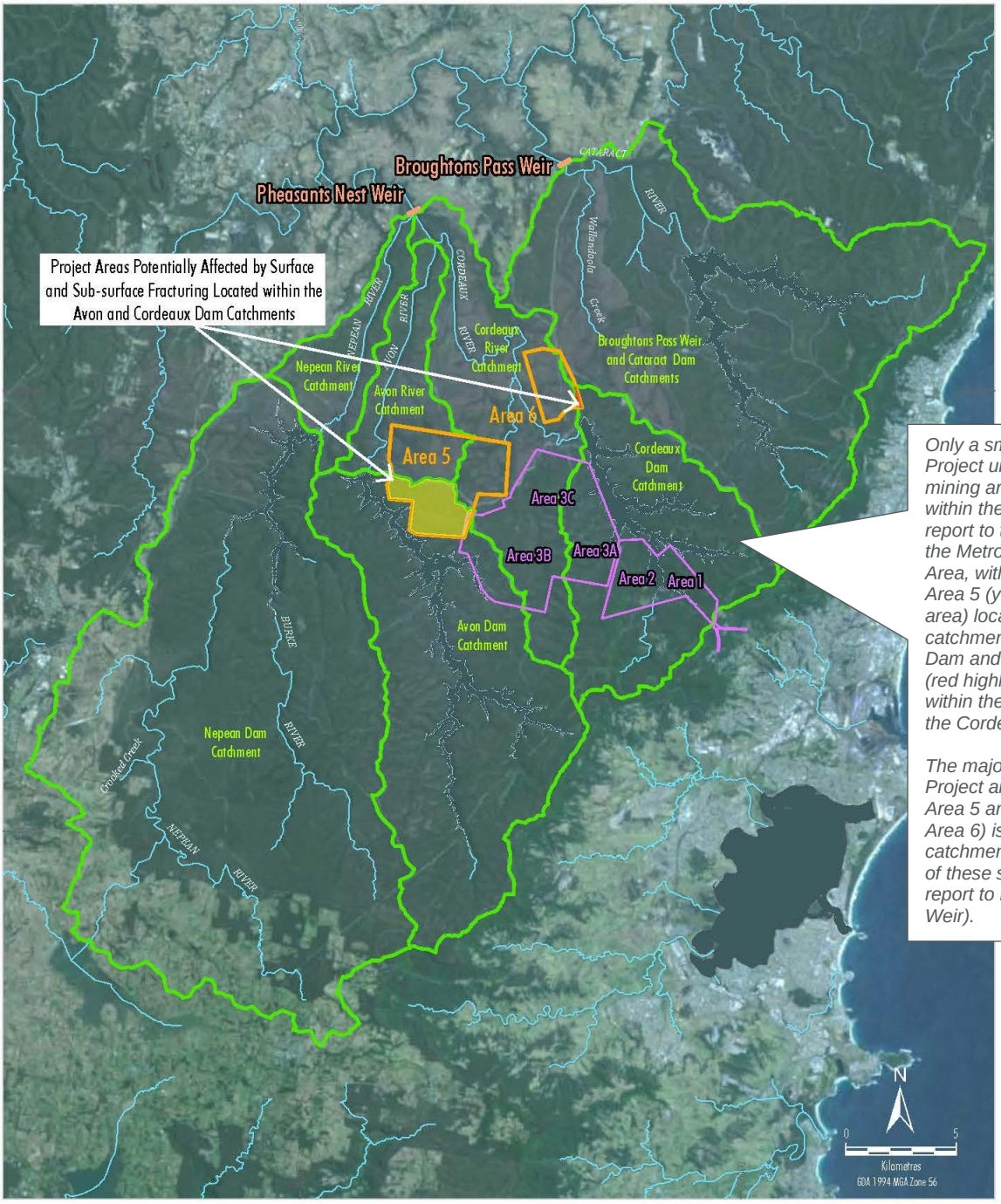
	Storages				Downstream of Storages	
Mechanism	Avon Reservoir	Cordeaux Reservoir	Nepean Reservoir	Cataract Reservoir	Pheasants Nest Weir	Broughtons Pass Weir
Mechanism 1	0	0	0	0	0	0
Mechanism 2 (% of total)	16-21%	4-8%	0%	0%	39-53%	0%
Mechanism 3 (% of total)	5-10%	3-7%	0%	0%	10-24%	0%
Total	3,330 ML/annum					

Mechanism 1 = Surface water diversion that re-emerges downstream

Mechanism 2 = Surface water diversion that does not re-emerge downstream

Mechanism 3 = Groundwater depressurisation

Note: estimates of losses due to Mechanisms 2 and 3 are based on modelled losses occurring directly above the longwalls (Mechanism 2) and >300 m from the longwalls (Mechanism 3). Losses within 0-300 m of the longwalls could be attributed to either mechanism, hence the range in estimates



Only a small portion of the Project underground mining area is located within the catchments that report to the storages of the Metropolitan Special Area, with only 34% of Area 5 (yellow highlighted area) located within the catchment of the Avon Dam and 4% of Area 6 (red highlighted area) within the catchment of the Cordeaux Dam.

The majority of the Project area (i.e. 66% of Area 5 and 96% of Area 6) is located in catchments downstream of these storages (i.e. report to Pheasants Nest Weir).

STH-16-02 RTS_2010

LEGEND
- Dendrobium Underground Mining Area - Proposed Project
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Catchment Boundaries of the Metropolitan Special Area
- Project Area Located within Avon Dam Catchment
- Project Area Located within Cordeaux Dam Catchment

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

SOUTH32
Illawarra Coal

DENDROBIUM MINE

Portions of Project Area Located within Catchment Areas Reporting to Reservoirs

Figure 6-3J

WaterNSW has previously outlined to South32 that project-induced water losses of a volume greater than 20% of the security yield of a downstream storage would significantly hamper its ability to maintain Greater Sydney's water supply system (WaterNSW, 2018a).

The loss that would equate to a greater than 20% loss of the security yields is 4,200 ML/annum for Avon Dam and 2,800 ML/annum for Cordeaux Dam (WaterNSW, 2018a) (Table 6-3E). By comparison, the security yield of the Sydney water supply system in 2018 was approximately 570,000 ML/annum (WaterNSW, 2018b).

Pheasants Nest Weir and Broughtons Pass Weir are small storages that function as water supply diversion weirs, unlike the upstream storages (e.g. Avon and Cordeaux Dams), WaterNSW does not report these weirs as having a 'security yield'.

Table 6-3E
Security Yield and Storage Capacity of Reservoirs Within the Metropolitan Special Area

Storage	Total Operating Capacity (ML)	Security Yield (ML/annum)	>20% Security Yield (ML/annum)
Cataract Reservoir	97,190	20,000	4,000
Cordeaux Reservoir	93,460	14,000	2,800
Avon Reservoir	146,700	20,800	4,200
Nepean Reservoir	67,730	19,000	3,800
Broughtons Pass Weir	50	N/A	N/A
Pheasants Nest Weir	25	N/A	N/A

Source: (WaterNSW, 2018a).

The maximum volume of surface water predicted to be diverted from the Avon and Cordeaux Dams (630 ML/annum and 79 ML/annum) is less than the 20% threshold values due to the Project and cumulatively (Figure 6-3K).

Significance of Predicted Surface Water Losses to Catchment Yields

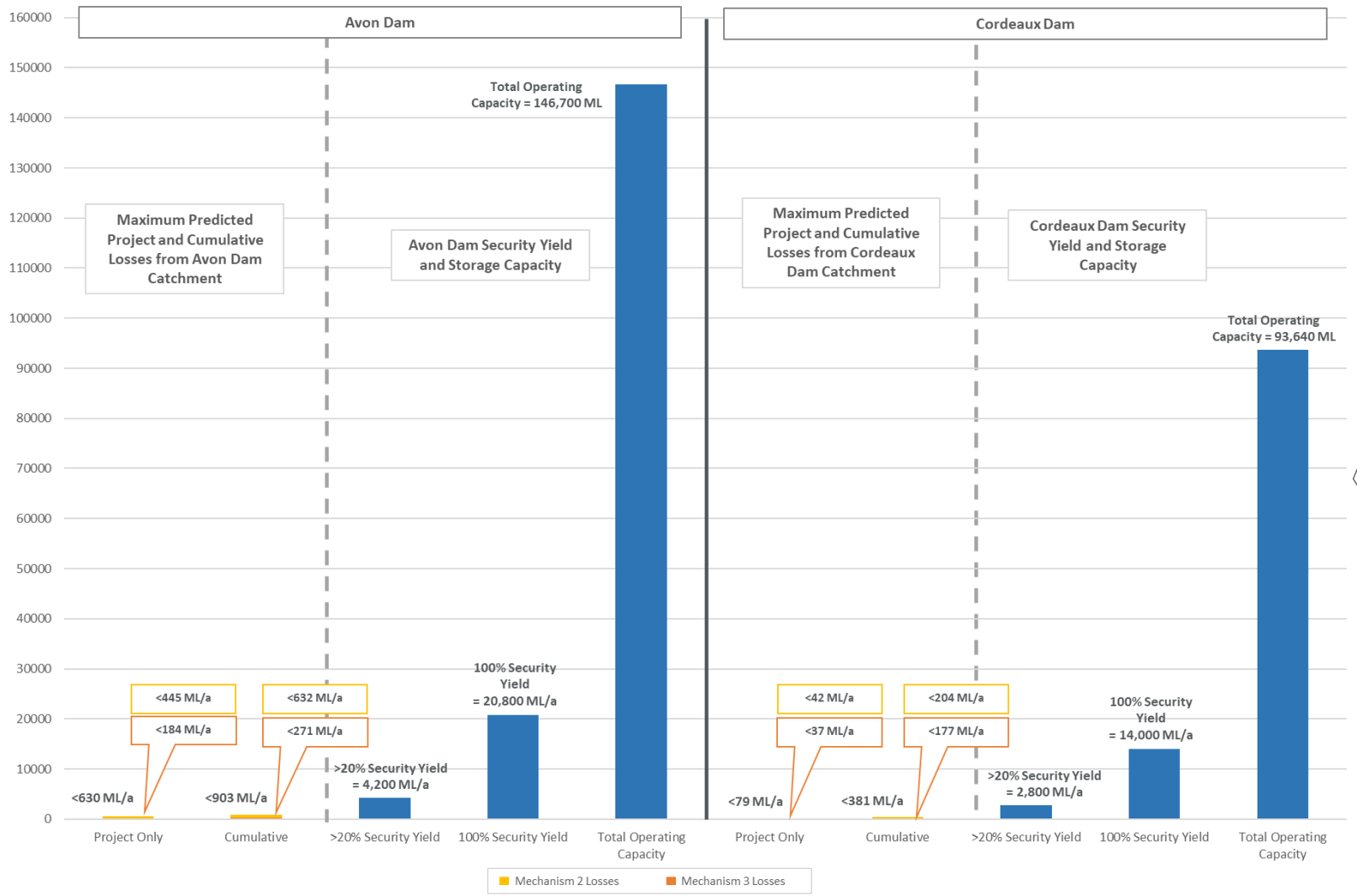
The predicted surface water losses due to the Project are estimated to reduce total yields of the Metropolitan Special Area by less than 1% under median climate conditions. Figure 6-3L compares the predicted surface water losses to catchment rainfall, rainfall net evaporation and yields (i.e. estimated runoff).

The IESC (2019) states in its advice in regard to the Project EIS (emphasis added):

> *The IESC notes that **reductions to Sydney's drinking water supply is predicted to be relatively small**, where yields to Lake Avon and Pheasants Nest Weir are predicted to be reduced by 0.55% and 0.39% respectively in median years. These impacts are **unlikely to be of material concern even in drought years or under expected future climate projections**.*

Comparison of Predicted Surface Water Losses to Drinking Water Network Losses and Components

The predicted maximum losses are insignificant when compared to other losses from the drinking water network. For example, by comparison to the maximum predicted Project losses of 1,935 ML/annum for wet climatic conditions, estimated water losses from the Sydney drinking water pipe network were reported to increase by approximately 5,500 ML in a single year (i.e. Sydney Water estimated losses increased from 41,610 ML to 47,268 ML between financial years 16-17 and 17-18).

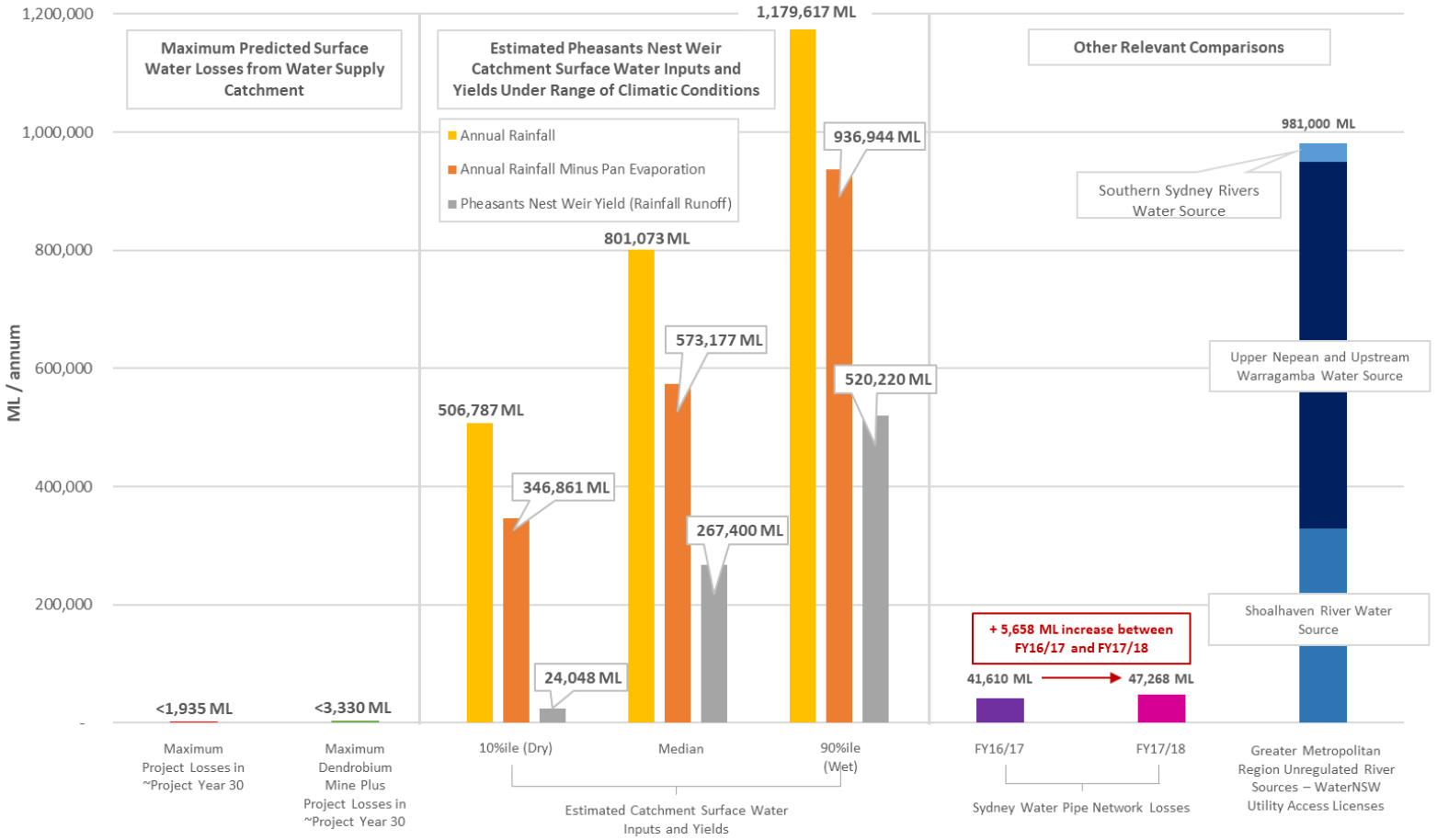


Only a small portion of the Project underground mining area is located within the catchments of the Avon and Cordeaux Dams.

This graph shows a comparison of the maximum predicted surface water losses from the Avon and Cordeaux Dam catchments as a result of the Project (the yellow and orange boxes) to the security yields of these storages, consistent with the recommendations of the IEP.

As shown on the graph, the maximum predicted surface water losses from the Avon and Cordeaux Dam catchments as a result of the Project are significantly less than the >20% security yields, and total operating capacities of these storages.

Figure 6-3K – Comparison of Maximum Predicted Surface Water Losses to Dam Operating Capacities and Security Yields



Notes:

a) Estimated yields based on rainfall runoff do not consider regulated flows downstream of the Nepean, Avon and Cordeaux Dams – as these flows are not dependent on rainfall.

b) Project surface water losses would be significantly lower than 1,935 ML/annum (Project) or 3,300 ML/annum (cumulative) during 10%ile dry climatic conditions, as there would be limited water available in the ephemeral tributaries overlying Areas 5 and 6 to be lost during dry periods. The groundwater model conservatively assumes water is always available to be lost from these ephemeral tributaries (up to approximately 1,600 ML/annum).

Figure 6-3L – Comparison of Predicted Surface Water Losses

The IEP (2019b) notes that its estimates of cumulative losses from Sydney's drinking water catchment from the Dendrobium, Russell Vale and Wongawilli mines of 8 ML/day are "low" when compared to other components of the drinking water network (emphasis added):

> *The* [surface water] *losses referred to in Section 3.2.3* ***are low*** *compared to other components of Sydney's supply and demand, for example recent losses from the Dendrobium, Russell Vale and Wongawilli mines of less than 8 ML/day on average compare to the Sydney Desalination Plant capacity of approximately 250 ML/day (Sydney Desalination Plant, 2019) and estimated leaks from the Sydney Water supply infrastructure of approximately 130 ML/day (Sydney Water, 2018).*

A comparison of the maximum predicted surface water losses as a result of the Project, to these other losses/components is provided in Figure 6-3K.

In summary:

- The IEP identifies impacts of predicted surface water loss to 'security yield' as a component of the assessment of significance and tolerability.
- Predicted maximum surface water losses due to the Project are:
  - Less than 20% of security yields for the Avon and Cordeaux Dams.
  - Negligible compared to the total yields of the Metropolitan Special Area.
  - Insignificant compared to other network losses and demands.
- These conclusions are based on conservative assumptions adopted in the groundwater modelling.
- If more realistic but less conservative assumptions were adopted, predicted surface water losses would be lower than those presented in the EIS.

3. Mitigation and management measures for the Project.

To offset predicted surface water impacts, South32 commits to implement or fund works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area, including:

- beneficial use of mine water to reduce existing demands on the drinking water system, and/or funding or implementing works that reduce existing losses (e.g. pipe losses or evaporation);
- payment to WaterNSW for the maximum predicted take; and
- holding of sufficient licences to account for this take.

This is consistent with the recommendations of the IEP (2019b), who state:

> *Options identified for offsetting water loss from the Special Areas include:*
>
> - *'purchasing' the water lost from the catchment that can be attributed to mining operations, the financial offset could be used to fund make-up water sources, such as through the operation of desalination plants and borefields, or*
> - *treating the water pumped from the mine to a standard that enables it to supplement water that would otherwise be drawn from the Greater Sydney Water Catchment.*

a. Beneficial use of mine water

South32 proposes to implement a beneficial mine water use scheme for excess mine water for industrial and/or other users. The intention of the beneficial mine water use scheme is that the volume used matches or exceeds maximum predicted Project surface water take, therefore, achieving no net reduction (or a net gain) in the total drinking water supply system.

This commitment is also consistent with Condition 11, Schedule 4 included in the Dendrobium Mine Longwall 17 approval, which requires South32 to offset the reduction in surface water reporting to WaterNSW storages as a result of the extraction of Longwall 17.

South32 has investigated options for the beneficial use of excess mine water and undertaken consultation with water infrastructure stakeholders and water users, which indicates that there is demand for excess mine water from the Project (subject to treatment to a comparable quality of raw water from the storages).

The investigation has identified a number of potential mine water use options for Project mine-water and for a variety of use volumes, including:

- direct discharge back into the Sydney Drinking Water Catchment (subject to treatment);
- discharge to the Illawarra Filtration Plant for end-use potable water supply, which would offset the current direct water take from the Avon Dam via the existing raw water supply pipeline; and
- supply for industrial water use which would also offset the existing direct water take from the Avon Dam, including:
  - direct input into the existing raw water supply pipeline from Avon Dam to the Sydney Water-BlueScope Steel recycled water network;
  - discharge to the Berkeley Storage Tanks (which supply the Sydney Water-BlueScope Steel recycled water network); and
  - direct supply to the final industrial end-user(s).

Other options under investigation include the use of the mine water for greenspace irrigation as well as funding works to increase Sydney Water's ability to treat water and meet industrial user demands (e.g. funding of upgrade works at the Wollongong Recycled Water Plant) and funding water works that would reduce losses from the drinking water system (e.g. such as pipe losses and evaporation).

All options being considered would account for predicted losses via either direct offset of treated water or through funding of works to reduce network losses.

In addition, any option that would directly offset existing raw water take from the Avon Reservoir would have a positive effect on storage security yield, consistent with WaterNSW (2018b):

> *Any action which slows the rate of depletion of the dams in the latter stages of a drought will have a positive effect on Security Yield.*

Sydney Water is working collaboratively with South32 to investigate opportunities to beneficially use mine water. While no commitments have been made, and any final proposal would be subject to confirmation by Sydney Water, the implementation of such options to use treated mine water would have a **net positive** effect on the total water budget, as the volume of surface water loss from the Metropolitan Special Area storages would be met, or exceeded by this use.

South32 commits to implement or fund works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area.

This would include beneficial use of mine water to reduce existing demands on the drinking water system, and/or funding or implementing works that reduce existing losses (e.g. pipe losses or evaporation).

b. Payment for predicted surface water take.

In addition to the beneficial use of excess mine water, South32 would pay WaterNSW for the volume of surface water diverted from the Sydney Drinking Water Catchment (i.e. as it would be no longer available for sale to other water users).

It is proposed that payment would be calculated based on the following:

- Price per megalitres ($53.85 per ML) consistent with the Independent Pricing and Regulatory Tribunal (IPART) determination for WaterNSW's prices for bulk water operations in the Greater Sydney area for Council use of bulk water (IPART, 2016).
- To account for climate variability and the progressive stage of longwall mining, actual losses would be quantified annually using a combination of streamflow, mine inflow and climate data, and predictive groundwater and catchment runoff modelling.

It is expected that this would result in payment of approximately $100,000 per annum during peak predicted surface water losses for the Project.

It is noted that some submissions raised that the price per megalitre of payment be independently determined. South32 considers that the price determined by IPART, which by definition is an independent pricing tribunal, is appropriate.

Other submissions raised that WaterNSW has previously stated that the 'replacement' value of water was $2,276/ML. It is unclear how this value has been derived, however, it is more than an order of magnitude higher than the maximum price IPART has determined WaterNSW can sell water to Councils ($53.85/ML) or Sydney Water ($73.77/ML) (IPART, 2016).

The purpose of the commitment to pay WaterNSW for predicted surface water loss is to compensate WaterNSW for lost revenue for water it may otherwise be able to sell. As such, South32 considers the price independently determined by the IPART to be reasonable.

This is in addition to the commitment to beneficially use mine water and/or funding or implementing works that reduce existing losses such that there is no net loss to the drinking water system.

South32 commits to paying WaterNSW for the maximum predicted surface water take at the rate independently determined for bulk water by the Independent Pricing and Regulatory Tribunal.

c. Surface water licensing.

South32 would hold the required surface water licences for the maximum predicted surface water take for the Project.

South32 currently holds sufficient volumetric licences to account for the maximum predicted mine water inflow (i.e. the combined groundwater and surface water take).

Although these licences cover the volumetric take, these licences are not currently distributed to all of the administrative water sources required for the Project.

Due to existing restrictions on the availability of licences, South32 is reliant on the NSW Government creating additional licences/entitlements and/or amending transfer rules to facilitate the development of the Project in the applicable adjoining water sharing plan management areas and zones.

South32 commits to holding sufficient water licences to account for the maximum predicted surface water take of the Project.

Any additional licences required under the NSW *Water Management Act, 2000* would be sought and obtained by South32 in consultation with DPIE-Water. Refer to Section 6.4 for further detail.

4. Surface Water Flow Monitoring.

South32 maintains a surface water monitoring and management program for the approved Dendrobium Mine.

The existing program includes stream flow monitoring of a number of ephemeral drainage lines proximal to Area 5, Area 6 and Donalds Castle Creek.

Consistent with the recommendations of Hydro Engineering & Consulting (HEC) (2019), the existing Area 5 and Area 6 surface water monitoring networks would be expanded and augmented for the Project as follows:

- implementation of additional water level/flow rate monitoring sites at the downstream end of swamps (monitoring locations to be selected during the review and update of the Dendrobium Mine Water Management Plan [WMP] for the Project);
- pool water level monitoring of pools associated with key stream features, including four additional pools as 'control' pools in areas outside of the Project mining area; and
- continuation and further development of existing surface water quality monitoring sites.

TARPs would be developed incorporating baseline data and predicted impacts, and would build on mining experience to date at the Dendrobium Mine. TARPs would be developed during the Extraction Plan stage of the Project and would be outlined in the relevant management plans for the Project.

6.4 SURFACE WATER LICENSING

6.4.1 Submissions

Public and Special Interest Group Submissions

Comments were made in public and organisation submissions relevant to the ability for the Project to licence predicted surface water losses.

Agency, Local Council and Service Provider Submissions

Similarly, agencies, local government and service providers commented on the ability of the Project to obtain licences for surface water take.

6.4.2 Key Aspects

The responses in this section are related to water licencing requirements under the NSW *Water Management Act, 2000* for predicted surface water take. Responses related to surface water losses (and associated mitigation offsets), surface water quality and groundwater licencing are provided in Sections 6.3, 6.7 and 6.13, respectively.

6.4.3 Responses

South32 will hold appropriate licences for the maximum predicted surface water take for the Project as required under the NSW *Water Management Act, 2000*.

As described in Section 6.3, the maximum predicted surface water take that would require licencing due to the Project is estimated to be approximately 1,935 ML/annum. When considered cumulatively (i.e. including approved Dendrobium Mine mining), predicted surface water losses are up to 3,330 ML/annum.

This predicted volume represents the peak surface water licencing requirement, based on conservative assumptions of the groundwater model, which would occur toward the end of the Project life. The predicted surface water take would be less than this maximum for the majority of the Project life.

South32 currently holds sufficient volumetric licences to account for the maximum predicted mine water inflow of both the Dendrobium Mine and the Project, which includes combined groundwater **and** surface water take (Table 6-4A).

Although these licences account for peak surface water (and groundwater) take on a volumetric basis, they are not currently distributed to all of the required administrative water sources required for the Project (i.e. all are held within the water sharing plan relevant to groundwater sources, rather than surface water sources) (Figure 6-4A).

This is because when the Dendrobium Mine was approved in 2001, applicable water sharing plans under the NSW *Water Management Act, 2000* were not developed, or in force. The water sharing plans applicable to the surface water losses for the Dendrobium Mine came into force in mid-2011 (Figures 6-4B and 6-4C).

The Dendrobium Mine, therefore, originally obtained relevant water licencing requirements via the previous applicable legislation under the NSW *Water Act, 1912*. These licences simply accounted for the modelled take reporting to the Dendrobium Mine underground workings.

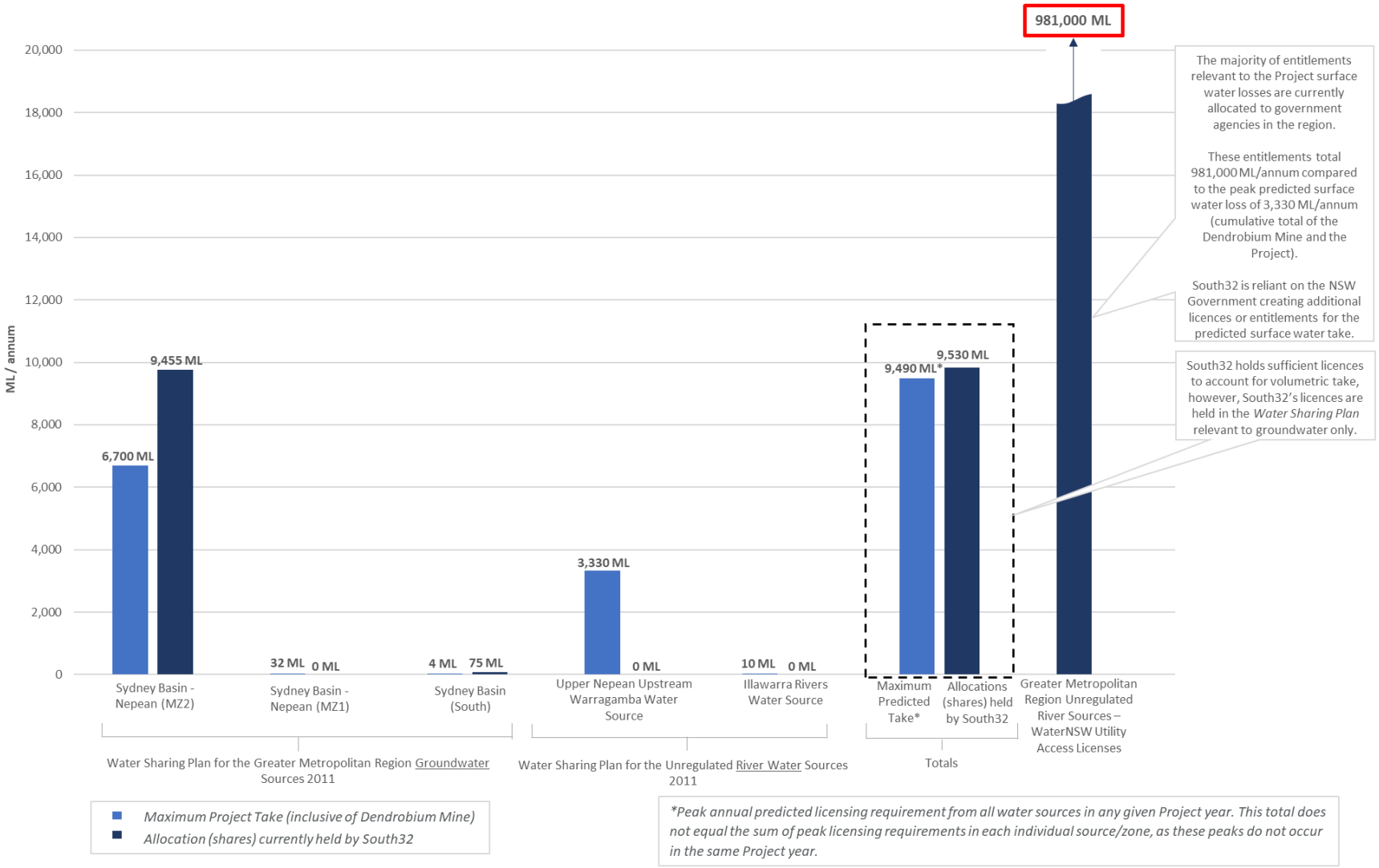
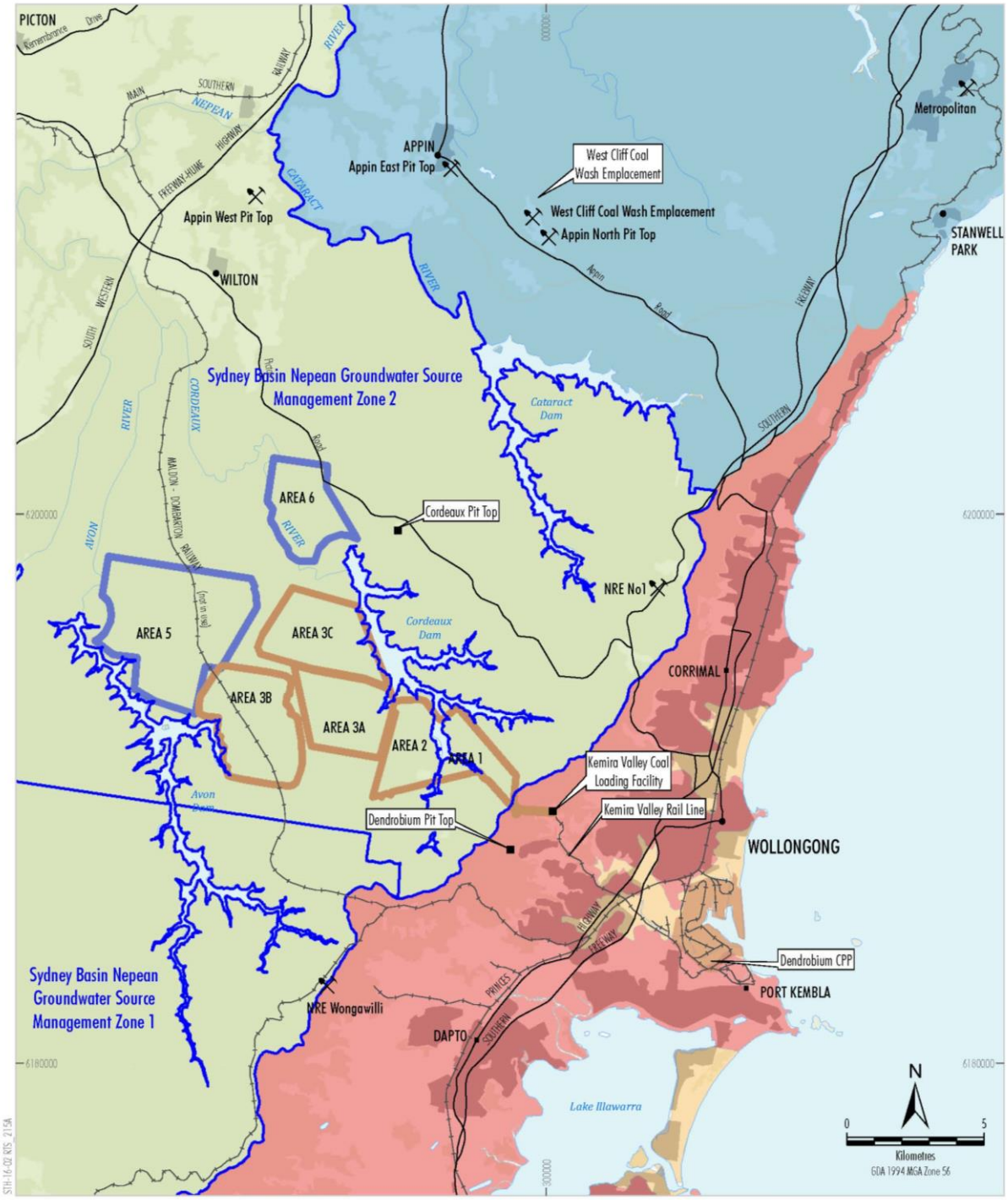


Figure 6-4A – Project Surface Water Licensing Requirements and Water Sharing Plan Allocations


PICTON
APPIN
Appin East Pit Top
West Cliff Coal Wash Emplacement
West Cliff Coal Wash Emplacement
Appin North Pit Top
Appin West Pit Top
WILTON
Metropolitan
STANWELL PARK
Sydney Basin Nepean Groundwater Source Management Zone 2
Cataract Dam
AREA 6
Cordeaux Pit Top
NRE No1
AREA 5
AREA 3C
Cordeaux Dam
AREA 3B
AREA 3A
AREA 2
AREA 1
CORRIMAL
Kemira Valley Coal Loading Facility
Kemira Valley Rail Line
Dendrobium Pit Top
WOLLONGONG
Dendrobium CPP
PORT KEMBLA
Sydney Basin Nepean Groundwater Source Management Zone 1
NRE Wongawilli
DAPTO
Lake Illawarra
N
0
5
Kilometres
GDA 1994 MGA Zone 56
LEGEND
Road
Railway
Urban Area
Dendrobium Underground Mining Area - Proposed Project
Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
Nepean Management Zones
Sydney Basin Nepean Groundwater Source
Sydney Basin South Groundwater Source
Sydney Basin Central Groundwater Source
Metropolitan Coastal Sands Groundwater Source
Source: Geoscience Australia, (2006); Department of Industry (2018); Department of Finance, Services & Innovation (2018);
SOUTH32
Illawarra Coal
DENDROBIUM MINE
Relevant Management Zones - Greater Metropolitan Region Groundwater Source 2011
Figure 6-4B

LEGEND

- Road
- Railway
- Urban Area
- Dendrobium Underground Mining Area - Proposed Project
- Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
- Management Zone
- Illawarra Rivers Water Source
- Upper Nepean and Upstream Warragamba Water Source

Source: Geoscience Australia (2006); Department of Industry (2018); Department of Finance, Services & Innovation (2018); DI Water (2017);

SOUTH32
Illawarra Coal

DENDROBIUM MINE

Relevant Mangement Zones - Greater Metropolitan Region Unregulated River Water Sources 2011

Figure 6-4C

Table 6-4A
Estimated Water Licensing Requirements for the Project

Water Sharing Plan	Water Source (Management Zone)	Allocation (Shares) currently held by South32	Maximum Dendrobium (inclusive of Project) Licensing Requirement (ML/annum)	Maximum Project Increment
Water Sharing Plan for the Greater Metropolitan Region ***Groundwater*** *Sources 2011*	Sydney Basin – Nepean (MZ2)	9,455	6,700	5,700
	Sydney Basin – Nepean (MZ1)	-	32	7
	Sydney Basin – South	75	4	3
Water Sharing Plan for the Greater Metropolitan Region Unregulated ***River Water*** *Sources 2011*	Upper Nepean and Upstream Warragamba Water Source	-	3,330	1,935
	Illawarra Rivers Water Source	-	10	3
Total – all water sources		**9,530**	**9,490[1]**	**-**

[1] Peak annual predicted licensing requirements from all water sources in any given Project year. This total does not equal the sum of peak licensing requirements in each individual source/zone, as these peaks do not occur in the same Project year.

This table shows that South32 ***currently*** *holds licences (9,530 ML) sufficient to account for the maximum volume of licences required for Areas 1 to 6 groundwater* ***and*** *surface water inflow (9,490 ML/annum).*

However, the government has established water sharing plans in a manner such that South32 cannot hold licences across all the various administrative water sources relevant to the Project.

More recently, the requirement to account for modelled induced take from surrounding water sources (i.e. not the source in which the mine is physically located) became relevant with the apportionment of water resources throughout NSW into a series of adjoining and/or overlying water sources via the NSW *Water Management Act, 2000* and the subsequent requirements of the *NSW Aquifer Interference Policy* (AIP) (NSW Government, 2012). This included the appointment of water sharing plans applicable to the Dendrobium Mine.

This change requires the Project to now licence all modelled **incidental** water take from adjoining sources (i.e. not just those sources that the Project is physically located within), including incidental surface water take using these new allocations for each water source (i.e. water sharing plan).

The majority of entitlements for surface water in the water sharing plan (a total of 981,000 ML/annum) are associated with unregulated river licences and are currently held by government authorities in the region.

Due to the existing restrictions on the availability of licences within the Metropolitan Special Areas, South32 is reliant on the NSW Government creating additional licences or entitlements available to facilitate the development of the Project in the applicable adjoining water sharing plan management areas and zones.

The estimated annual peak surface water losses due to the Project is equivalent to approximately 0.2% of the 981,000 ML/annum entitlement for unregulated river licences allocated to government authorities under the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* (Figure 6-4A).

South32 will hold the appropriate licences for predicted surface water take for the Project, and will continue to consult with Government throughout the assessment phase in regard to mechanisms to secure these licences or entitlements.

6.5 PHYSICAL IMPACTS TO STREAMS FROM SUBSIDENCE RELATED IMPACTS

6.5.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to physical impacts to streams included:

- Accuracy of the subsidence predictions in the Subsidence Assessment.
- Potential impacts to vegetation and fauna habitat in streams.
- Adequacy of proposed stream mitigation, remediation and management measures.
- Justification of proposed setbacks from key built and natural features.
- Potential surface impacts to streams overlying and near the longwalls.
- Potential for permanent loss of stream function above and near the longwalls following mining.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to physical impacts to streams included WaterNSW, Wollondilly Shire Council and DPIE-Water. These comments included:

- Magnitude of subsidence predictions relative to other mining operations in the Southern Coalfield.
- Justification of proposed mining method, layout and alternative mine designs.
- Assessment of potential impacts to streams (considering streams of all stream orders).
- Consideration of potential impacts of near-surface cracking and near-surface ground movement in the Subsidence Assessment.
- Justification for the criteria used to characterise significant surface water features.
- Observed subsidence impacts at Dendrobium Mine.

6.5.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects that relate to potential subsidence-related impacts to streams are provided below:

1. Accuracy of subsidence modelling and predictions.
    a. Development of subsidence model.
    b. Conservatism of subsidence model assumptions.
    c. Comparison of subsidence predictions to other mines in the Southern Coalfield.
2. Proposed mining geometry.
    a. Consideration of alternative mine methods and layouts.
    b. Justification of proposed mining geometry.
3. Justification of proposed setbacks from watercourses and key stream features.
    a. Named watercourses.
    b. Drainage lines and key stream features.

4. Residual subsidence-related impacts to streams.
    a. Expected subsidence impacts.
    b. Consequences to stream flow and catchment yield.
    c. Consequences to aquatic ecology.
5. Proposed stream mitigation, management and remediation measures.

The responses in this section are related to potential physical impacts to streams from subsidence-related impacts. Responses related to surface water losses, surface water quality and biodiversity are provided in Sections 6.3, 6.7 and 6.10, respectively.

Responses regarding subsidence impacts to WaterNSW built assets (e.g. dam walls) and other built features are provided in Sections 6.6 and 6.14, respectively.

6.5.3 Responses

1. Accuracy of subsidence modelling and predictions.

a. Development of subsidence model.

Predictions of the conventional subsidence effects for the Project were made using the Incremental Profile Method (IPM), which is a model based on a large database of observed monitoring data from collieries within the NSW coalfields, including the Southern Coalfield.

The IPM has been used throughout the life of the Dendrobium Mine, and as the mine has developed, has undergone a number of calibrations to incorporate the latest available monitoring data, including:

- monitoring data from underground mining operations specifically in the Bulli Seam in the Southern Coalfield for development of the initial model used for Dendrobium Mine Areas 1, 2 and 3A;
- monitoring data obtained from mining in Area 2 and Area 3A for the calibration of the model for Area 3A; and
- monitoring data obtained from mining in Area 3B for the calibration of the model for Area 5 and Area 6.

Non-conventional subsidence effects have also been predicted using historical data from the Dendrobium Mine and elsewhere in the NSW coalfields, notably the frequency of past occurrence of both conventional and non-conventional ground movements and observed impacts (Appendix A of the EIS). The prediction of non-conventional subsidence effects are therefore considered to be best practice, despite the complex site-specific nature of predicting non-conventional subsidence movements.

The approach for subsidence predictions, and calibration of the model to monitoring data from the Dendrobium Mine for the Project, was supported by the IESC (2019) who noted in their submission on the Project EIS (emphasis added):

> '*the subsidence assessments have been completed to a good standard, **particularly with respect to the use of existing observations of impacts** at other areas of the Dendrobium Mine*'.

b. Conservatism of subsidence model assumptions.

Use of the IPM to date for various mining operations has shown that the IPM tends to over-predict conventional subsidence effects and is, therefore, generally conservative.

Historically, measured vertical subsidence, in some cases, exceeded the subsidence predictions using earlier calibrations of the subsidence model by up to approximately 30% (due to increased pillar compression from the thicker Wongawilli Seam for Area 3A and Area 3B). To account for these historical underpredictions, the subsidence predictions for Area 6 have been increased by 30%, as Area 6 is also proposed to mine the Wongawilli Seam.

This correction has not been applied to Area 5, proposed to be mined in the Bulli Seam, due to the thinner Bulli Seam thickness. Notwithstanding, the component of pillar compression in the model has been increased for Area 5 so that the maximum predicted subsidence values are similar to the maximum achievable subsidence that is expected to occur for any single-seam mining in the Bulli Seam. This conclusion is supported by ground monitoring data from NSW coalfields.

Although some observed subsidence movements have historically exceeded the predictions at the Dendrobium Mine, these occurrences are limited to a local scale. While measured movements can be greater than predictions, exceedances are also expected to be within the orders of accuracy of the predictive methods (Appendix A of the EIS).

Since model re-calibration to account for historical underpredictions, the IPM model used at the Dendrobium Mine has shown that subsidence movements observed at Dendrobium Mine are typically less than the subsidence predictions, and provides reasonable, if not, conservative predictions of the conventional and non-conventional subsidence effects (Mine Subsidence Engineering Consultants [MSEC], 2019).

- **The subsidence model builds on previous subsidence modelling efforts at Dendrobium Mine, incorporating monitoring data from Areas 1, 2, 3A and 3B.**
- **The model is informed by and calibrated to monitoring data from the Dendrobium Mine and considers previous observations of subsidence impacts at the Dendrobium Mine in the prediction methodology.**
- **The prediction of subsidence effects is generally conservative, with subsidence movements observed at Dendrobium Mine typically less than the subsidence predictions of the model.**

c. Comparison of subsidence predictions to other mining operations in the Southern Coalfield.

WaterNSW, in their submission on the Project EIS noted that "*the Project is predicted to cause subsidence that would be higher than recorded figures at any other mine in the Southern Coalfield*."

Analysis by MSEC indicates that the predicted subsidence effects for the Project are similar to various mining operations in the Southern Coalfield (Table 6-5A).

Maximum predicted subsidence effects for the proposed longwalls in Area 5 and Area 6 for the Project are also less than the maximum predicted for the existing longwalls in Area 3A and Area 3B, which have predicted total subsidence of up to 3,600 millimetres (mm) in comparison to a Project maximum of 2,450 mm in Area 6 (Table 6-5A).

These predictions are also likely to be conservative, with subsidence monitoring in Area 3A and Area 3B showing subsidence movements are typically less than the subsidence predictions for these areas.

2. Proposed mining geometry.

a. Consideration of alternative mining methods and layouts.

South32 has considered alternative mining methods and layouts in the design of the Project.

Underground mining via the longwall method is considered by South32 to be the only viable mining method for the Project, as bord and pillar mining is uneconomic for the Project, and open cut mining would be incompatible with the Metropolitan Special Area.

WaterNSW in their submission on the Project EIS stated (WaterNSW, 2019):

> *… the mining company has not provided adequate information about alternative mine design options … In contrast, the recently amended Russell Vale Project proposed a mine design based on first workings only, which would result in negligible subsidence impacts.*

Table 6-5A
Comparison of Predicted Conventional Subsidence Effects for the Project Underground Mining Areas and Other Mining Operations in the Southern Coalfield

Mining Operation	Location	Maximum Predicted Total Subsidence (mm)	Maximum Measured Total Subsidence (mm)
Project			
Dendrobium Mine (Project)	Area 5	2,050	-
	Area 6	2,450	-
Other Mining Operations			
Dendrobium Mine (approved)	Area 1	2,800*	~ 2,500*
	Area 2	2,450	~ 2,200
	Area 3A	3,000**	~ 2,000
	Area 3B	3,600	~ 2,500
Kemira Colliery	(Bulli and Wongawilli Seams)	-	~ 2,000-2,500
Wongawilli Colliery	(Bulli and Wongawilli Seams)	-	~ 2,100

Note: * denotes maximum predicted and measured vertical subsidence for Area 1 due to LW1 and LW2 in the Wongawilli Seam only. The predicted subsidence including the existing overlying workings in the Bulli Seam is greater than 3,000 mm.
** Value updated based on revised predictions from the Longwall 19 SMP report.

Source: MSEC (2019)

South32 notes that coal extraction via first workings only is not an economically viable option for the Project. Consideration of the "no Project" alternative is presented in the EIS and would result in the forfeiting of net significant benefits to NSW ($1,073.2 million NPV) and local ($116.1 million NPV) economies, including in the form of lost royalties and employment benefits (Section 6.1).

In addition, South32 has considered a number of alternative mine layouts: both a 'maximum' and 'minimum' case longwall layout.

As noted in Section 6.3, South32's decision not to propose mining beneath reservoirs (as occurs elsewhere in the Special Catchment Areas) results in the sterilisation of 25 Mt of ROM coal (worth some $3.58 billion and $222 million in associated royalties) within CCL 768.

The 'maximum case' layout incorporated setbacks from the reservoirs, but did not incorporate any specific setbacks from named watercourses or key stream features. While the maximum case would increase coal extraction and, therefore, associated benefits to NSW (approximately $82 million in NPV terms), South32 elected not to progress this option due to the potential increase in environmental impacts.

Conversely, the 'minimum case' incorporated the mine setbacks from named watercourses, key stream features, dam walls and the Full Supply Levels (FSLs), and in addition avoided direct undermining of Upland Swamps.

While technically feasible, the minimum case is not considered reasonable given the significant reduction in resource recovery and associated reduction in benefits to NSW (approximately $220 million in NPV terms). Furthermore, potential impacts to Upland Swamps from the proposed longwall layout for the Project would be offset by South32 as part of the Biodiversity Offset Strategy for the Project in accordance with State and Commonwealth legislation. It is noted the net benefit of the Project to NSW ($1,073.2 million NPV) are net of the costs associated with the establishment and management of environmental offsets.

b. Justification for proposed mining geometry.

South32 has considered various mining geometries in the Project mine design, including panel widths of less than the proposed 305 m wide panels.

The key potential environmental impact of wider longwall panels is the height of fracturing above the coal seam, as this affects the 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 either panel width or cutting height could reduce the height of fracturing in Area 5 and Area 6 (particularly in areas of relatively lower depths of cover).

As noted in Section 6.3, potential surface water losses from the catchment are predicted to result in negligible impacts to catchment yield, and would be offset such that the Project results in no net loss to the drinking water catchment (as per the existing requirement of the SMP for Longwall 17).

However, 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. 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.

While narrower longwall panels would reduce total vertical subsidence, and correspondingly reduce predicted tilts and strains in narrower panels, the 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. Accordingly, adverse environmental impacts are still anticipated for reduced longwall widths down to approximately 150 m.

In addition, the continuation of 305 m wide panels avoids further Project value loss and coal sterilisation when compared to mining with narrower longwall panels (e.g. due to reduced operational costs and increased coal recovery).

Based on the above and in consideration of proposed offset measures for predicted surface water losses, South32 considers the proposed 305 m wide longwall panels can be mined with acceptable impacts.

3. Justification of proposed setbacks from watercourses and key stream features.

South32 incorporated a number of setbacks from streams and stream features considered to be relatively more ‘significant’ in the design of the Project longwall layout.

South32 has considered the significance of streams on the basis of the following characteristics, (generally consistent with the *Bulli Seam Operations NSW Planning Assessment Commission* [PAC] *Report* [PAC, 2010]), as a component of the Stream Risk Assessment (Appendix B of Appendix C of the EIS) undertaken for the Project, including:

- permanence of flow (i.e. if the stream is ephemeral or perennial in nature);
- whether the stream is a regulated watercourse for water supply transfer;
- individual stream catchment area;
- importance to catchment yield;
- Strahler stream order;
- environmental quality (e.g. pristine, modified or severely modified); and
- ecological importance (e.g. presence of mapped Key Fish Habitat as per the habitat mapping provided by the NSW DPIE which was confirmed during field surveys, where possible).

As a consequence of the above, and in consideration of stakeholder feedback (particularly from the findings of the investigation into potential subsidence-related impacts to tributary WC21 at Dendrobium Mine Area 3B), South32 has identified and adopted longwall setbacks from the following features considered to be relatively more significant:

- named watercourses (i.e. the Avon River, Cordeaux River and Donalds Castle Creek); and
- key stream features identified by South32, which are defined as:
  - pools with volume greater than 100 m^3 and holding water; and
  - steps/waterfalls greater than 5 m height with a permanent pool at the base.

Further justification for the selection of these streams and features is provided below.

It is noted the *Bulli Seam Operations NSW Planning Assessment Commission Report* (PAC, 2010) acknowledged that determination of 'significance' of features was inherently difficult and subjective:

> *… the range of use and non use values of the waterways: water supply, ecological significance, conservation value, community value and recreational value are all recognised. However little progress is made in the EA toward interpreting the catalogue of raw data to provide any link to the significance of an individual stream or a collective of streams in a catchment. Furthermore, only a subset of the values appear to be carried forward for assessment of the acceptability of impacts. The difficulty of these steps is acknowledged by the Panel and it is not suggested that any deterministic process can be called upon to deliver incontestable outcomes. However, without an assignment of values to streams or groups of streams, and without consistent appreciation of all the values in the system, it becomes impossible to make an holistic assessment of the risks to those values from mining.*

There are a number of unnamed tributaries located above the Project longwalls that are proposed to be directly undermined. These tributaries are considered to be less significant than the named watercourses, on the basis that they:

- are ephemeral (i.e. do not exhibit permanent flow);
- are not mapped Key Fish Habitat;
- have relatively small sub-catchments and therefore small associated contributions to total catchment yields; and
- are of lower stream order (generally first and second order with small sections of third order), are common throughout the catchment area and are not regulated watercourses for water supply transfer.

The following sections provide further detail regarding the setbacks adopted from significant streams and stream features, as well as potential subsidence-related impacts from the Project.

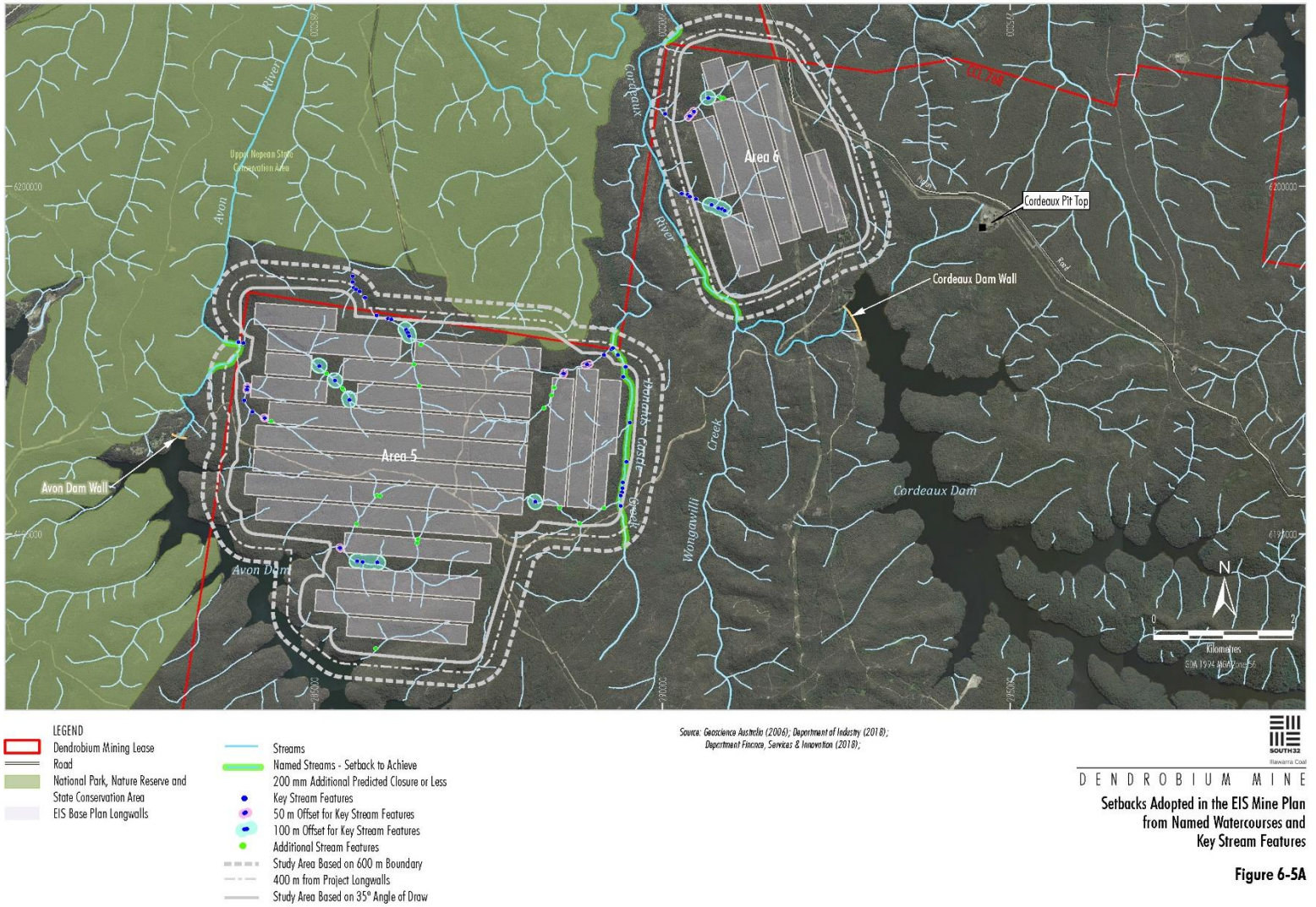
c. Named watercourses.

Justification for setbacks from named watercourses.

South32 has designed the Project mine layout to reduce the potential subsidence impacts on named (and perennial) watercourses located proximal to the Project underground mining areas.

The proposed longwalls in Area 5 and Area 6 are located proximal to the Avon River, Cordeaux River and Donalds Castle Creek. The longwalls have been setback from these named watercourses so that the maximum predicted additional closure is limited to 200 mm (i.e. via the application of the 'rockbar model') (Figure 6-5A). These streams were considered to be relatively significant (and, therefore setbacks proposed) as they:

- are perennial (i.e. exhibit permanent flow);
- are regulated watercourses (for Avon and Cordeaux Rivers only, downstream of the Avon and Cordeaux Dams respectively);
- have relatively large catchments; and
- comprise Key Fish Habitat.



The Project proposes longwall setbacks from named watercourses and key stream features (in addition to dam walls and FSLs).

Direct undermining of named watercourses and key stream features has been avoided because:

- *named streams are:*
  - *perennial (i.e. exhibit permanent flow);*
  - *regulated watercourses (Avon and Cordeaux Rivers);*
  - *have relatively large catchments; and*
  - *comprise Key Fish Habitat.*
- *key stream features are those with relatively larger permanent pools, aesthetic value, and/or potential to provide aquatic ecology habitat along unnamed ephemeral drainage lines that overlie Area 5 and Area 6.*

These setbacks would avoid named watercourses from being directly undermined and being affected by the seam to surface fracturing assumed to occur for the Project (i.e. as assumed in the groundwater model), thereby minimising potential surface water losses and reducing physical impacts.

The rockbar model design tool relates the likelihood of subsidence impact with predicted valley closure along the stream using data from longwall mining in the Southern Coalfield, including an extensive database from Dendrobium Mine.

The rockbar model predicts that restricting predicted additional valley closure at Dendrobium Mine to a target value of 200 mm represents low-likelihood of impacts occurring, where impacts are defined as fracturing in a rockbar or upstream pool resulting in reduction in standing water level (i.e. “Type 3” impacts) based on current rainfall and surface water flow.

Based on observations from the Southern Coalfield, subsidence impacts to stream features resulting in fracturing and diversion of flow have not been observed beyond 400 m from longwalls.

In summary, the rockbar model design tool predicts an impact rate at pools/rockbars along sections of named watercourses as outlined in Table 6-5B.

Table 6-5B
Likelihood of Potential Type 3 Impacts on Avon River, Cordeaux River and Donalds Castle Creek

Watercourse	Total Stream Length	Length of Watercourse Located within 400 m of Project Longwalls	Percentage of Total Stream Length	% of Pools and Channels Predicted to Experience Type 3 Impacts[1]
Avon River	38.4 km	0.4 km	1%	7% (for 0.4 km section)
Cordeaux River	37.7 km	0.25 km	0.7%	5% (for 0.25 km section)
Donalds Castle Creek	8.8 km	2.9 km	4.5%	9% (for 2.9 km section)

Source: MSEC (2019)

[1] Predicted % of impacted pools and channels along stream reaches within 400 m of proposed longwalls.

Feedback received on setbacks from named watercourses.

The IEP Part 2 Report recommended that the concept of restricting predicted valley closure to a maximum of 200 mm to avoid significant environmental consequences as a design tool be revised for watercourses (IEP, 2019b).

South32 agrees that the rockbar model should be revised to cater for specific streams (using relevant empirical data), noting the rockbar model has been applied as a successful design tool to Wongawilli Creek during the mining of Area 3A and Area 3B at the Dendrobium Mine. Along the 2 km length of Wongawilli Creek that is located within 400 m of the longwall panels, only one Type 3 impact was observed (MSEC, 2019). It is therefore considered that the rate of observed Type 3 impacts along Wongawilli Creek is consistent with the assessments (i.e. the rate of impacts is **very low**).

While South32 acknowledges that in some localised cases, in Area 3B, impacts have been observed at predicted total closure values of less than 200 mm (as is predicted by the rockbar model, albeit at a likelihood of between 0 to 10%), the application of restricting target total closure to 200 mm as a setback design tool has been successfully used at Dendrobium Mine to date and at other mines in the Southern Coalfield to significantly minimise the likelihood of impacts.

As a result, the likelihood of potential impacts resulting in fracturing and observable stream flow diversion are predicted to be low (less than 10%) for the small sections Avon River, Cordeaux River and Donalds Castle Creek within 400 m the Project longwalls (Table 6-5A).

On this basis, the 200 mm closure model has been applied for the Project for the Avon River, Cordeaux River and Donalds Castle Creek, and when applied on a case-by-case basis, would continue to be refined to achieve a specified level of impact likelihood for the Project.

d. Drainage lines and key stream features.

Identification of key stream features.

There are a number of unnamed drainage lines that overlie Area 5 and Area 6. These are expected to experience the full range of predicted subsidence movements and potential subsidence impacts.

The drainage lines proposed to be undermined are considered to be less significant than the named watercourses, on the basis that they (Plates 6-5A and 6-5B):

- are ephemeral (i.e. do not exhibit permanent flow);
- have relatively small sub-catchments and therefore small associated contributions to total catchment yields; and
- are of lower stream order (generally first and second order with small sections of third order), are common throughout the catchment area and are not regulated watercourses for water supply transfer.

It is not economically feasible to avoid the direct undermining of all ephemeral drainage lines. However, South32 has identified relatively significant stream features (e.g. pools and waterfalls) within the unnamed ephemeral drainage lines overlying Area 5 and Area 6, for which longwall setbacks of 50 m to 100 m would be implemented to minimise potential subsidence impacts.

These key stream features to be setback from for the Project are defined as:

- pools with volume greater than 100 cubic metres (m^3) and holding water; and
- steps/waterfalls greater than 5 m height with a permanent pool at the base.

Plates 6-5A and 6-5B – Example of Ephemeral Drainage Lines (LA13A and DC8) Proposed to be Undermined
Source: South32 (2019a)

The criteria for key stream features have been inferred by previous feedback from stakeholders for the Dendrobium Mine, and on the basis of:

- permanence of water for relatively larger pools;
- aesthetic value; and
- relatively increased potential for providing aquatic ecology habitat.

Setbacks from key stream features.

The setbacks developed for these key stream features have been derived from observations from longwall mining at Dendrobium Mine Area 3B.

Monitoring has shown that the impacts (i.e. Type 3 impacts) at key stream features generally occurred after they have been directly undermined, and were not observed prior to longwalls approaching within 50 m of the feature (MSEC, 2019). While Type 3 impacts have been observed along unnamed streams outside the mining area in Area 3B, the overall levels of impact are considerably less than those directly above the longwalls.

Therefore, the proposed longwalls in Area 5 and Area 6 have been setback from the key stream features by a minimum distance of 50 m. When longwall mining is proposed on two or more side, these setbacks have been conservatively increased to 100 m, to reduce the likelihood of subsidence-related impacts (MSEC, 2019).

The overall effect of these setbacks is that a number of additional stream features, although not identified as key stream features, would also not be directly undermined by the Project longwalls.

If physical damage to named streams and key stream features occurs due to the Project as a result of subsidence impacts, remediation techniques would be implemented to repair the damage where possible.

4. Residual subsidence-related impacts to streams.

a. Expected subsidence impacts.

The proposed setbacks would reduce potential physical impacts to named watercourses as a result of Project-related subsidence (including fracturing of bedrock and stream flow diversion) to a likelihood of less than 10% for the relatively short sections of these watercourses located within 400 m of the Project longwalls) (MSEC, 2019).

Proposed setbacks from key stream features would reduce the likelihood of Project-related subsidence resulting in fracturing of bedrock and loss of water at these features.

The ephemeral drainage lines located above the Project longwalls are expected to experience the full range of predicted subsidence movements and potential subsidence impacts (MSEC, 2019).

Potential impacts due to Project-related subsidence may include increased levels of ponding, flooding and scouring due to mining induced tilt, and cracking, fracturing and dilation of bedrock in creek beds resulting in surface water diversion and reduced pool water levels (MSEC, 2019).

b. Consequences to stream flow and catchment yield.

The residual impact of undermining sections of ephemeral drainage lines is an increase in low flow days and potential localised water quality impacts and iron staining. At the water supply catchment scale (i.e. the Metropolitan Special Area catchment) these impacts are expected to be negligible.

Predicted stream flow losses from ephemeral drainage lines due to the Project have been considered in the context of the catchment and are predicted to result in a negligible reduction in catchment yields (Section 6.3).

It is noted the IESC (2019) in its advice in regard to the Project EIS states (emphasis added):

> *The IESC notes that **reductions to Sydney's drinking water supply is predicted to be relatively small**, where yields to Lake Avon and Pheasants Nest Weir are predicted to be reduced by 0.55% and 0.39% respectively in median years. These impacts are **unlikely to be of material concern even in drought years or under expected future climate projections**.*

c. Consequences to aquatic ecology.

Potential impacts to aquatic ecology due to Project-related subsidence are expected to be localised and relatively minor compared to the overall extent of aquatic habitat in the broader region (Cardno, 2019).
Potential impacts to aquatic ecology in the ephemeral drainage lines located directly above the proposed longwalls have been assessed on the basis that the full range of subsidence movements and subsidence impacts may occur. Potential subsidence impacts resulting in changes to the availability of ephemeral aquatic habitat are not expected to result in any significant impacts to overall aquatic ecology, due to the limited value of habitat within ephemeral drainage lines (Cardno, 2019).

No significant impacts to aquatic ecology in watercourses downstream of the Project area or Avon Dam are predicted as a result of subsidence-related diversion (Appendix E of the EIS), noting that flows in the Avon River and Cordeaux River are controlled by releases from the Avon Dam and Cordeaux Dam, respectively.

Potential subsidence-related impacts to aquatic ecology, as a result of changes in surface water quality would be minor and short-term (Cardno, 2019).

For relevant fauna species listed under the NSW *Biodiversity Conservation Act, 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) that potentially have habitat along streams/swamps overlying the Project underground areas, biodiversity offsets are proposed to account for potential subsidence-related impacts to streams and the associated consequences to streamflow and habitat for these species. Section 6.10 provides further information in regard to the Project Biodiversity Offset Strategy.

5. Proposed stream mitigation, management and remediation measures.

South32 would implement remediation measures to mitigate physical damage to the named watercourses and key stream features where monitoring indicates that subsidence-related impacts have occurred as a result of the Project.

Relevant performance measures and TARPs for subsidence impacts on streams would be developed in consideration of the following:

- monitoring data from the Dendrobium Mine;
- existing SMP approvals; and
- in consideration of any Development Consent issued for the Project.

These performance measures and TARPs would be outlined in Extraction Plans developed for the Project longwalls.

Remediation measures would be consistent with the existing mitigation and remediation measures described in the approved *Watercourse Impact, Monitoring, Management and Contingency Plan* (South32, 2019b), which would be reviewed and updated for the Project.

South32 would also use an adaptive management approach to incorporate any learnings and experience from existing Dendrobium Mine operations (e.g. results from rehabilitation trials) and other mining operations in the implementation of Project remediation and management works.

Examples of potential remediation works for physical impacts to streams that would be undertaken by South32 include remediation of surface and bedrock fracturing through surface sealing and injection grouting.

The works would be implemented for the Project as required, and where it is practicable to do so (e.g. works would not be considered practicable if significant additional vegetation clearance is required to provide access for materials and equipment to the remediation site).

The Project mine design incorporates setbacks to protect named watercourses, in particular because they are perennial, and for the Avon and Cordeaux Rivers, regulated.

It is uneconomic for the Project to avoid undermining all ephemeral drainage lines.

Notwithstanding, direct undermining of key stream features along ephemeral drainage lines would be avoided through Project setbacks. These key stream features have been selected due to permanence of water in relatively larger pools and/or aesthetic values.

The residual impact of undermining sections of ephemeral drainage lines is an increase in low flow days and potential localised water quality impacts and iron staining. At the catchment scale these impacts are expected to be negligible.

The consequences of subsidence-related impacts to relevant BC Act and EPBC Act listed species would be offset, as the Project Biodiversity Offset Strategy accounts for potential losses of habitat due to hydrological changes to ephemeral drainage lines overlying the Project underground mining areas.

6.6 IMPACTS TO WATERNSW ASSETS

6.6.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to impacts to WaterNSW assets included:

- Potential impacts to dam walls and surface cracking of reservoirs beds.
- Potential for sub-surface fracturing beneath reservoirs.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers provided comments on the Project relevant to WaterNSW assets included WaterNSW and DSC. These comments included:

- Potential impacts to dam walls.
- Assessment of dam walls by an engineer to assess potential subsidence impacts and adequacy of setbacks.
- Development of management plans for dam walls.
- Potential impacts to dam walls and beneath reservoirs due to geological structures.
- Risk assessment focussing on dam wall safety and security of reservoirs.
- Potential overlap of Project area with proposed future WaterNSW dam.

6.6.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Justification of proposed longwall setbacks from Avon and Cordeaux Reservoirs.
    a. Dam walls.
    b. Reservoir full supply levels.
    c. Sterilisation of coal resources due to setbacks.
2. Potential subsidence impacts to Avon and Cordeaux Reservoirs.
    a. Predicted subsidence movements for the Avon and Cordeaux dam walls.
    b. Effect of previous mining proximal to reservoirs at Dendrobium Mine.
    c. Consideration of geological structures.
3. Proposed monitoring and management measures for the dam walls.
4. Consideration of the proposed future WaterNSW dam.

The responses in this section are related to potential impacts to WaterNSW assets. Responses related to surface water losses, physical impacts to streams (including justification for stream setbacks), surface water quality and geology are provided in Sections 6.3, 6.5, 6.7 and 6.12, respectively.

6.6.3 Responses

1. Justification of proposed longwall setbacks from Avon and Cordeaux Reservoirs.

a. Dam walls.

South32 is not seeking to damage or compromise the Avon Dam or Cordeaux Dam walls, and as such, agrees with stakeholder comments about the importance of protecting this infrastructure.

In the Southern Coalfield, historical underground mining has occurred proximal to dam walls.

South32 has incorporated setbacks in the Project mine design to avoid potential subsidence related impacts to the dam walls, namely setbacks from the Avon and Cordeaux dam walls to the Project longwalls by a **minimum** distance of 1,000 m (Figures 6-6A and 6-6B).

This setback distance has been developed based on previous longwall setbacks adopted at the Dendrobium Mine, as well as previous recommendations of the DSC. The DSC states that extraction of 'full-sized' longwalls within 1.7 times the depth of cover would be unlikely to be tolerable (DSC, 2010). The proposed setback distance of 1,000 m is greater than 1.7 times the depth of cover for the Project (i.e. would be approximately 750 m).

b. Reservoir full supply levels.

Unlike other current mining operations in the Southern Coalfield, South32 has committed to not directly undermine the waterbodies of reservoirs.

South32 has incorporated setbacks in the Project mine design from the FSLs of both the Avon and Cordeaux Reservoirs of 300 m from the Project longwalls (Figures 6-6A and 6-6B).

The setback from the FSLs of the reservoirs is consistent with longwall setbacks adopted previously at the Dendrobium Mine, including in the conditions of the Longwall 17 SMP, approved in July 2019 (Condition 8, Schedule 4):

> *The Applicant must set back the installation gate road of Longwall 17 a minimum distance of 300 metres from the Full Supply Level of the Lake Avon reservoir.*

The effect of these setbacks is that the Project would avoid the direct undermining of reservoir beds, therefore reducing the potential for any surface fracturing to occur, and potential for any interaction with the sub-surface fracture network associated with the longwalls.

c. Sterilisation of coal resources due to setbacks.

As previously noted, to minimise potential surface water losses, the Project mine layout has been designed to incorporate setbacks from the Metropolitan Special Area water storages (Avon and Cordeaux Dams), named watercourses and key stream features. The consequence of this decision is the sterilisation of approximately 25 Mt of ROM coal within South32's existing mining tenement (CCL 768) (adjacent to Area 5), worth some $3.58 billion and $222 million in associated royalties (Figure 6-6A).

For the remaining areas within the CCL 768, South32 seeks to maximise value for the Project through the continuation of mining 305 m wide longwall in Area 5 and Area 6.

The Project longwall setbacks adopted by South32 of 1,000 m from the dam walls and 300 m from the reservoir FSLs are designed to protect the integrity of WaterNSW assets. These setbacks result in significant sterilisation of coal resource, therefore, South32 seeks to maximise the value of the Project through the mining of proposed 305 m wide panels.

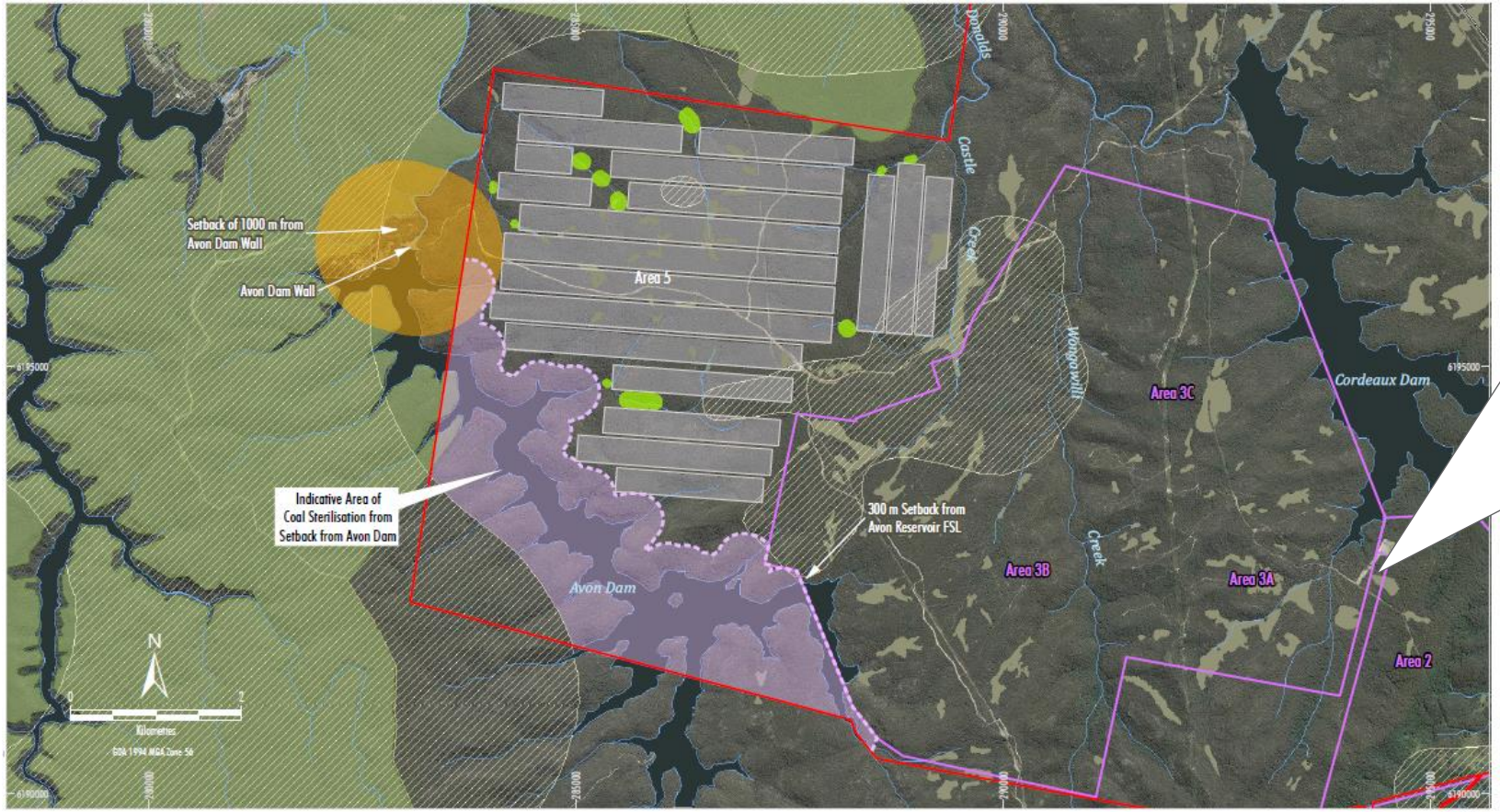
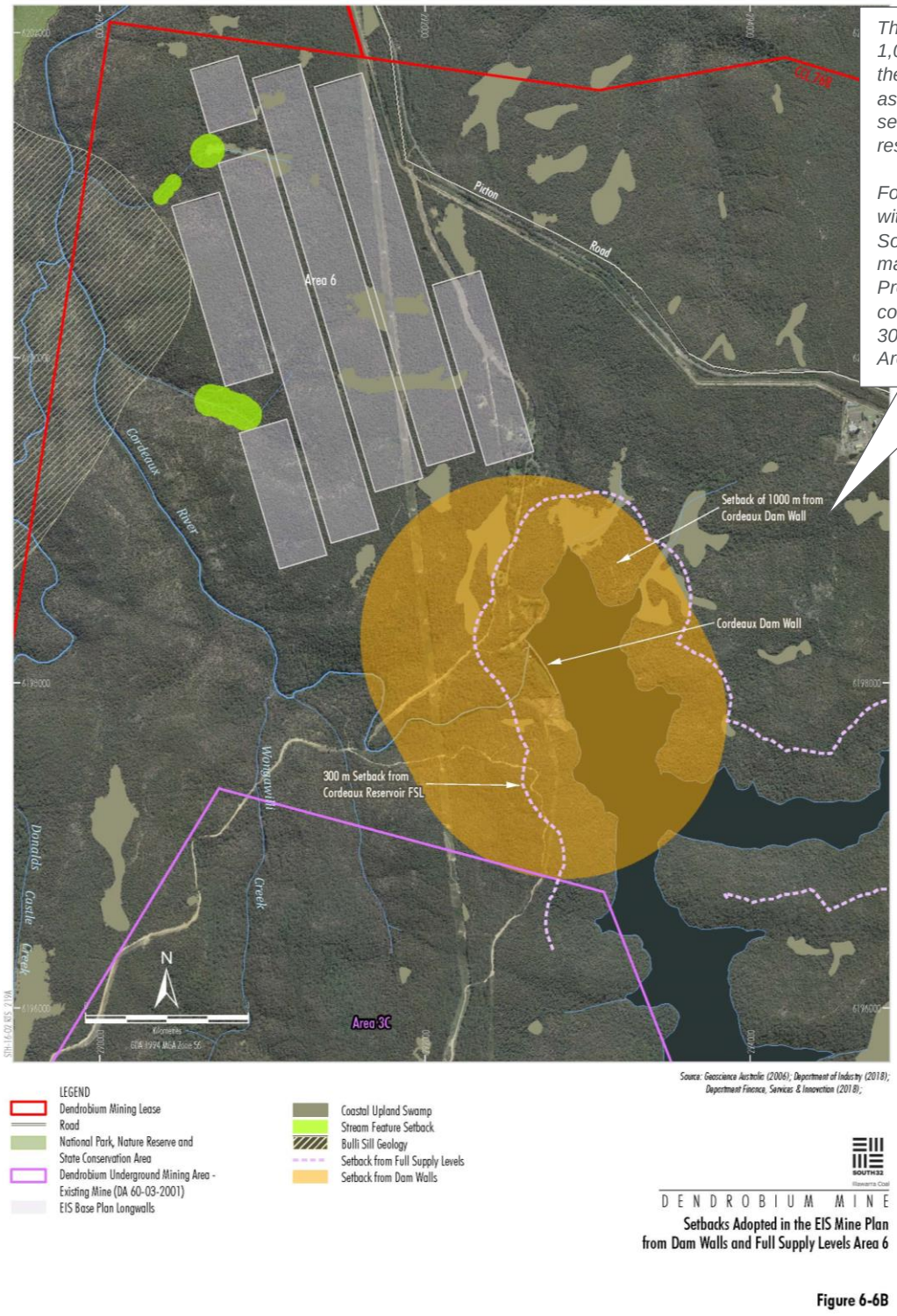


Figure 6-6A

This figure illustrates the 1,000 m setbacks from the Avon Dam wall, as well as 300 m setbacks from the reservoir FSL.

The figure also shows the area of coal within the CCL 768 that would be sterilised as a result of the setbacks (25 Mt with a value of $3.58 billion and royalties of $222 million).

For the remaining areas within the CCL 768, South32 seeks to maximise value for the Project through the continuation of mining 305 m wide longwall in Area 5 and Area 6.



This figure illustrates the 1,000 m setbacks from the Cordeaux Dam wall, as well as 300 m setbacks from the reservoir FSL.

For the remaining areas within the CCL 768, South32 seeks to maximise value for the Project through the continuation of mining 305 m wide longwall in Area 5 and Area 6.

Figure 6-6B

2. Potential subsidence impacts to the Avon and Cordeaux Reservoirs.

a. Predicted subsidence movements for the Avon and Cordeaux dam walls.

MSEC (2019) predicted the potential conventional and non-conventional subsidence movements for the Avon and Cordeaux dam walls, incorporating the conservative setbacks adopted in the Project mine design from the features.

The predicted absolute subsidence movements at both the Cordeaux and Avon Dam walls are expected to be very small, with differential movements expected to be negligible and within the range of survey tolerance (i.e. are not anticipated to be measurable).

The predicted subsidence movements of the Avon and Cordeaux dam walls as a result of the Project are supported by observations at the Dendrobium Mine and from the Southern Coalfield. At distances of 1,000 m or greater previously mined longwalls at Dendrobium Mine, measured absolute far-field horizontal movements were largely within survey tolerance (MSEC, 2019).

In addition, the far-field horizontal movements measured at the Dendrobium Mine are also typically less than those measured elsewhere in the Southern Coalfield, due to the shallower depths of cover. This results in greater movements directly above the longwalls, however, **reduced** movements further afield (i.e. reduced movements at the dam walls and reservoir water bodies) (MSEC, 2019).

b. Effect of previous mining proximal to reservoirs at Dendrobium Mine.

The Dendrobium Mine Area 1 and Area 2 have also previously mined proximal to other dam walls. At its closest point, longwall mining approached to within approximately 900 m from the dam wall of the Upper Cordeaux No. 2 reservoir.

The previous mining in Area 1 and Area 2 at the Dendrobium Mine has not resulted in adverse impacts to the Upper Cordeaux No. 2 reservoir dam wall.

WaterNSW (then the Sydney Catchment Authority [SCA]) undertook measurements of subsidence movements to determine if dam wall movement had occurred as a result of mining at Dendrobium Mine.

The recorded measurements of potential subsidence movements were found to be within the order of survey tolerance (the maximum movements recorded were approximately ±3 mm).

WaterNSW concluded the following (SCA, 2010) (emphasis added):

> *"this change is **very probably** caused by the overall change in dam wall temperature as well as the change in the temperature gradient ... The fact that both ground and dam wall are vertically stable **reduces the likelihood** that mining is a factor in the measured horizontal movement."*

c. Consideration of geological structures.

Geological structures identified in Area 5 and Area 6 are unlikely to affect subsidence predictions for these mining areas (MSEC, 2019).

This is supported by evidence from Dendrobium Mine Area 3B, where the effects of lineaments and geological structures on the measured subsidence effects were reviewed based on the ground monitoring data from Area 3B (MSEC, 2019).

It was subsequently identified that there was no apparent increase in subsidence and closure movements measured at the locations where mapped lineaments and geological structures were present, when compared with the predictions and measurements at locations where these mapped features were not present (MSEC, 2019).

The geological structures mapped above Area 5 and Area 6 are of a similar nature to those mapped in Area 3B, therefore, it is unlikely that these structures would affect the subsidence predictions for the Project (MSEC, 2019).

South32 would continue to refine the identification of geological structures based on the ongoing investigations at the Dendrobium Mine and during the development of first workings for the Project. The Project longwall layout would be reviewed based on the progressive update to the geological information available and, if required, will be modified to avoid the major geological features during the preparation of the Extraction Plans for the Project.

3. Proposed monitoring and management measures for dam walls.

South32 would develop a monitoring and adaptive management approach for the management of potential subsidence movements at the dam walls, which would involve the monitoring of subsidence movements as the longwalls are extracted. The longwall series in Area 5 will be mined from the south to the north and the longwall series in Area 6 will be mined from west to east. The successive longwalls in each series will be progressively mined towards to the dam walls and, therefore, allowing for a monitoring and adaptive management approach.

South32 would develop prescribed triggers for the dam walls for both Area 5 and Area 6 based on detailed assessment by a specialist dam engineer, which would be incorporated into relevant TARPs as part of the Extraction Plan process.

These TARPs would be developed to prevent measured movements exceeding the defined allowable limits for the dam walls.

The TARPs would include a number of monitoring measures and relevant triggers, including:

- monitoring of ground movements along and near the dam walls as the longwalls are progressively mined towards and then away from these structures; and
- in the event that relevant TARP measures are exceeded, implementing contingency measures, such as shortening of longwalls.

It is proposed that a Technical Committee would review the monitoring data during active subsidence and to recommend potential actions in accordance with the TARPs for the dam walls, as described above.

South32 is committed to protecting dam structures from adverse subsidence impacts.

South32 would develop appropriate monitoring and adaptive management measures to manage subsidence during active longwall mining, including the development of appropriate TARPs in consultation with Government and dam safety engineers as part of the Extraction Plan process for the Project.

4. Consideration of the proposed future WaterNSW dam.

WaterNSW advised South32 during the preparation of the Project EIS that one of the long-term water supply options under consideration by WaterNSW is the “Lower Cordeaux Scheme”, comprising a potential new water supply reservoir known as the Lower Cordeaux Dam.

Based on the information provided to South32 by WaterNSW, the Project is not expected to be incompatible with the potential future reservoir.

The potential Lower Cordeaux Dam Wall would be located on the Cordeaux River approximately 2.8 km west of the proposed longwalls in Area 6 and approximately 3.7 km north of the proposed longwalls in Area 5, and is not expected to experience measurable far-field horizontal or valley-related effects at these distances.

Although the FSL of the potential Lower Cordeaux Dam could overlap small portions of the Area 5 and Area 6 longwalls (as well as previously mined areas associated with Area 2, Area 3 and other historic mining operations), the mining setbacks proposed for the Project in relation to named watercourses and key stream features already limit the potential for overlap between the Project longwalls and the potential FSL.

Notwithstanding, the FSL of the potential Lower Cordeaux Dam would flood a number of features the Project seeks to protect via its mine design constraints (e.g. sections of Wongawilli Creek and Donalds Castle Creek would be inundated).

It is understood that the potential Lower Cordeaux Dam would still be subject to further analysis and assessment, and as such, there is still significant residual uncertainty in regard to the feasibility, environmental assessment, design, approvability and timing of the potential infrastructure.

As noted in the IEP Part 2 Report (2019b), the *EP&A Regulation, 2000* requires that a *"cumulative environmental effect [of a proposed development] with other existing or **likely** future activities*" must be taken into consideration when assessing the environmental impacts of that development. On the basis that there are no publicly available design details, indication of funding or environmental assessment of the potential Lower Cordeaux Dam, it is not considered to be 'likely' for the purpose of further cumulative assessment at this time.

6.7 SURFACE WATER QUALITY IN THE CATCHMENT

6.7.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to surface water quality related to:

- Impacts to surface water quality in watercourses and swamps due to surface fracturing.
- Impacts to reservoir water quality.
- Justification that the 'Net Neutral or Beneficial Effects (NorBE)' test would be satisfied.
- Proposed water quality offsets measures.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to surface water quality included EPA, WaterNSW and DPIE-Water. These comments related to:

- Development of erosion and sediment controls in accordance with relevant guidelines.
- Justification the NorBE test would be satisfied.
- Potential impacts to surface water quality due to surface fracturing.
- Potential long-term impacts to surface water quality as a result of groundwater recovery.

6.7.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Potential impacts to surface water quality in the Special Catchment Areas.
    a. Effects of historical mining.
    b. Potential impacts to surface water quality due to the Project during mining and post-mining.
2. Details of how the Project will satisfy the NorBE test.
3. Surface water quality monitoring and management measures for the Project.

The responses in this section are related to potential impacts to surface water quality. Responses related to surface water losses (including details of beneficial use), physical impacts to streams (including remediation) and biodiversity are provided in Sections 6.3, 6.5 and 6.10, respectively.

6.7.3 Responses

1. Potential impacts to surface water quality in the Special Catchment Areas.

a. Effects of historical mining.

Subsidence effects due to longwall mining can, in isolated instances, result in impacts to surface water quality in watercourses and streams.

These subsidence-related impacts to water quality can include temporary increases in dissolved iron, manganese and other metal concentrations, increases in pH and localised iron staining in creek beds at locations immediately downstream of where subsidence impacts have occurred.

Similar spikes in concentrations of iron and manganese have been observed to occur naturally in the areas of the Special Catchment Areas (i.e. in areas that are outside the influence of historic mining) (HEC, 2019), as presented in Table 6-7A. Figure 6-7A depicts the locations of these water quality monitoring sites.

Table 6-7A
Measured Concentrations of Iron and Manganese at Monitoring Sites in Catchment not Previously Affected by Mining

Parameter	Water Quality Objective (WQOs)	Project Area				
			Area 5		Area 6	
		AR19_S1	LA13_2	LA13_S1	CR29_S1	CR31_S1
Total Iron Concentration (mg/L)	Aesthetic*	0.3				
	Health**	n/a				
	Maximum Measured	5.73	1.21	2.18	0.68	9.17
Total Manganese Concentration (mg/L)	Aesthetic*	0.1				
	Health**	0.5				
	Maximum Measured	0.5***	0.093	0.108***	0.184***	0.886***

Note: milligrams per litre (mg/L)

* Australian Drinking Water Guideline (Commonwealth of Australia, 2011) 'aesthetic' water quality objective.

** Australian Drinking Water Guideline (Commonwealth of Australia, 2011) 'health' water quality objective.

*** Exceedance of aesthetic water quality objective criteria only.

Source: After HEC (2019)

This table shows baseline water quality results in catchments not previously affected by approved Dendrobium Mine subsidence-related impacts.

As shown, concentrations of iron and manganese can be naturally elevated (based on maximum measurements) when compared to the relevant Water Quality Objectives (WQOs).

Localised and short-term subsidence-related impacts to water quality in watercourses have not resulted in discernible changes in water quality downstream at the reservoirs in the Special Catchment Areas that would significantly affect treatment requirements for drinking water.

This conclusion was supported by the IEP Part 2 Report (2019b) (emphasis added):

> *Although surface fracturing elevates metal loads in watercourses, **there is no evidence** that mining in the Special Areas is currently compromising the ability of WaterNSW to meet raw water supply agreement standards.*

Similarly, this conclusion was supported by Advisian as part of a literature review undertaken into the effects of underground mining beneath the catchment areas for WaterNSW (emphasis added) (Advisian, 2016):

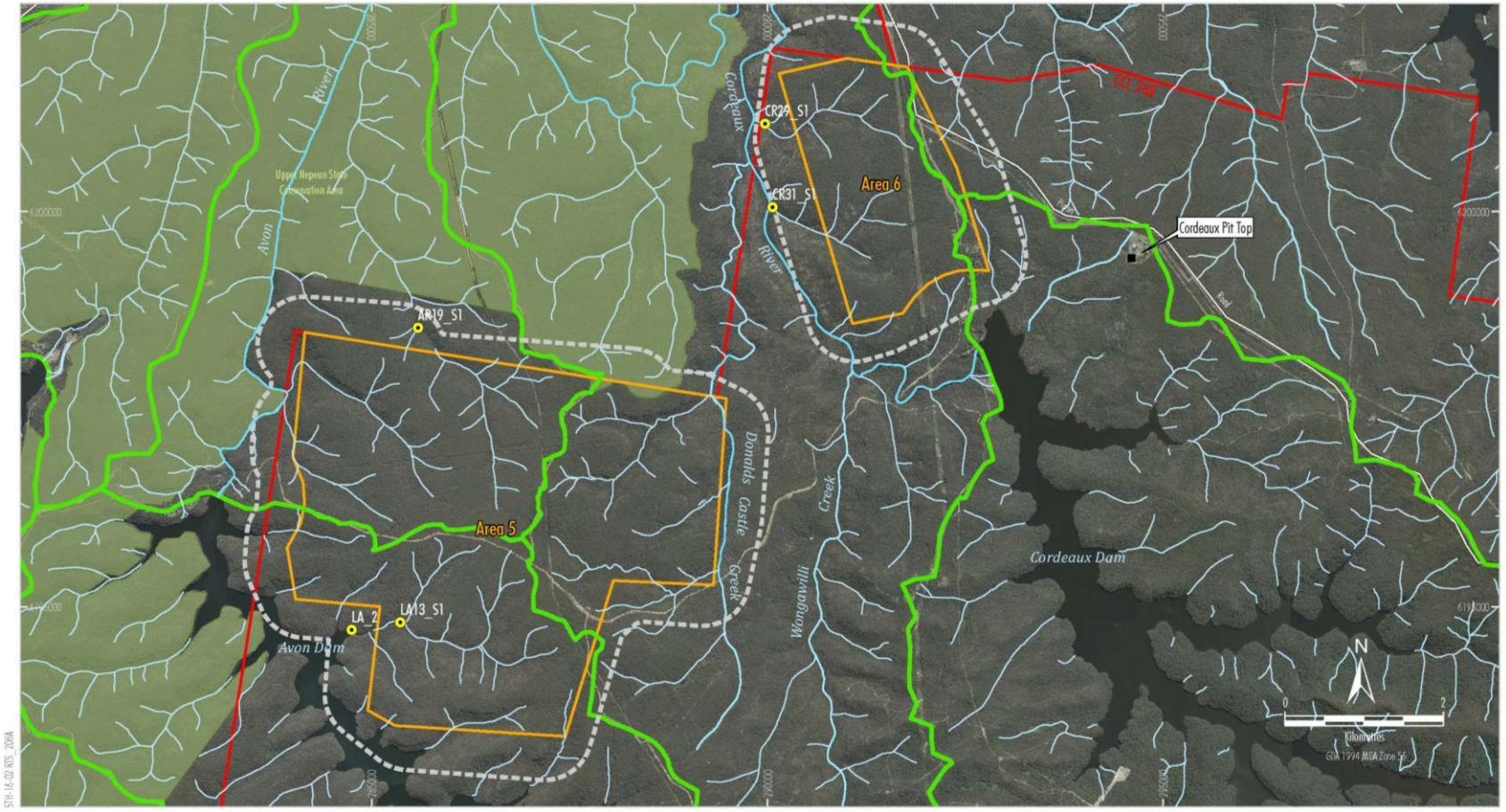
> *… although some consequences on water quality within the watercourses in the study are documented in the literature, these consequences are likely to be **short term, sporadic and localised**… Any consequences on water quality at the reservoirs **would be treatable** by the existing Sydney Water treatment plants.*

The conclusions of Advisian are also reflected by previous analysis from Professor Chris Fell AM, in the discussion paper regarding water treatment and the Sydney Drinking Water Catchment for the Office of the NSW Chief Scientist and Engineer (Fell, 2014) (emphasis added):

> *Although the impact of underground long-wall mining in the catchment could lead to small changes in the levels of impurities in water entering SCA's dams, these changes can be coped with by SW's* [Sydney Water's] *treatment plants as evidence to date **does not suggest** a sufficiently large change in soluble organic concentrations to be of concern.*

b. Potential impacts to water quality due to the Project during mining and post-mining.

The potential impacts on surface water quality as a result of Project-related subsidence are predicted to be localised and temporary in nature, consistent with impacts observed due to historical mining (including post-mining). In the ephemeral drainage lines overlying Area 5 and Area 6, localised and temporary spikes in concentrations of iron and manganese are expected, similar to the spikes that have been observed to occur naturally (Table 6-7A).



LEGEND

- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Proposed Project
- Catchment Boundaries of the Metropolitan Special Area
- Water Quality Monitoring Location
- Streams
- Study Area Based on 600 m Boundary

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

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Water Quality Monitoring Locations

Figure 6-7A

Potential downstream impacts to the water quality of the reservoirs are expected to be negligible, consistent with previous observations and the findings of expert reviews previously conducted by the IEP (2019a, 2019b), Advisian (2016) and Fell (2014).

2. Details of how the Project will satisfy the NorBE test.

The *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (Sydney Drinking Water Catchment SEPP) requires the consent authority (i.e. the IPC or the Minister) for the Project to be satisfied that the carrying out of the proposed development would have a neutral or beneficial effect on water quality.

A neutral or beneficial effect on water quality is relevantly defined by the Sydney Drinking Water Catchment SEPP as (emphasis added):

> *… the **same or a lesser adverse impact** on water quality when compared to the adverse impact that the continuing development would have if it were extended or expanded under similar conditions as the existing development consent.*

The Project EIS predicted that potential localised changes to surface water quality (i.e. potential increases in iron and manganese concentrations, or changes in pH) would result in **negligible** impacts to the water quality of the reservoirs.

In addition, Fell (2014) identifies that:

> *… High levels of iron and manganese very occasionally manifest themselves, primarily as a result of water inversion due to seasonal changes in reservoir temperatures. SCA has a number of procedures for dealing with such occurrences, including switching feed reservoirs, withdrawing from different levels in the reservoir and chemical treatment.*
>
> *…*
>
> *… iron and manganese (both of which do not impose a health threat but can lead to unpleasant characteristics in drinking water) …*

By comparison, Fell (2014) identifies that sedimentation is a parameter of concern to drinking water supplies. Similarly, the *Special Areas Strategic Plan of Management 2015* (WaterNSW and Office of Environment and Heritage [OEH], 2015) identifies sedimentation as a key water quality risk to the Special Catchment Areas.

Therefore, South32 proposes a number of additional water quality improvement actions as part of the Project that target sedimentation control, such that there would be a **benefit** to the overall water quality of the catchment.

The consent authority can be confident that the proposed water quality improvement actions would benefit water quality in the catchment, as the actions are based on (but additional to) the funding and works outlined in the *Special Areas Strategic Plan of Management 2015* (WaterNSW and OEH, 2015) to improve water quality.

The water quality improvement actions proposed by South32 are:

1. Transfer of 28.5 hectares (ha) of South32-owned land within the Metropolitan Special Area to WaterNSW, which would enable WaterNSW to manage and protect this land to maintain water quality values.
2. Direct implementation (by South32), or funding (to WaterNSW), of water quality improvement works within the Special Catchment Areas, including:
    - fire management works;
    - maintaining the unsealed road network (i.e. to reduce sediment runoff); and
    - installation and maintenance of appropriate barriers and fencing (i.e. to prevent any unauthorised access to the Metropolitan Special Areas which may adversely impact surface water quality).

Given the above, the Project would have a **net neutral or beneficial effect** on the surface water quality of the Special Catchment Area for the following reasons:

- the potential localised effects to surface water quality as a result of Project-related subsidence can themselves be considered environmentally neutral, given spikes in metal concentrations occur naturally (Table 6-7A) in the catchment, and the lack of evidence that localised effects to date have resulted in adverse impacts to drinking water supplies;
- water quality parameters that would potentially be impacted by Project-related subsidence (e.g. iron and manganese) are not identified as priority parameters when considering the potential impacts to the quality of drinking water supplies; and
- by comparison, South32's proposed water quality improvement works target sedimentation, which is identified as a priority surface water quality risk, resulting in overall benefit to the water quality of drinking water supplies as a result of the Project.

In addition, South32 would develop sediment control measures for the new surface infrastructure for the Project (i.e. primarily the proposed Ventilation Shaft Sites) which would have a neutral impact on surface water quality as demonstrated via the *Model for Urban Stormwater Improvement Conceptualisation* (MUSIC) modelling (HEC, 2019).

South32 commits to implement or fund water quality improvement works such that the Project results in net neutral or net beneficial effects to Sydney's drinking water supplies.

3. Surface water quality monitoring and management measures for the Project.

In addition to the water quality improvement works proposed for the Project, which would have a net neutral or beneficial effect on the surface water quality on the Special Catchment Area, South32 would also implement surface water quality monitoring and management measures for the Project.

Existing water quality monitoring would continue at existing surface water storages as part of the Project. Additional water quality monitoring would also be conducted in new water management storages required for the Project (e.g. at the Ventilation Shaft Sites).

The existing water quality monitoring network for Area 5 and Area 6 in the Metropolitan Special Area would be continued and expanded for the Project, where relevant.

The existing surface water management systems, including erosion and sediment control, for Dendrobium Mine surface facilities would continue for the Project, which have been designed to minimise the potential for downstream water quality impacts in the Metropolitan Special Area, and are outlined in the existing Water Management Plan (South32, 2018).

Additional management measures that would be implemented for the Project would include sediment controls for surface disturbance activities (i.e. the Ventilation Shaft Sites), designed to be consistent with *Managing Urban Stormwater Soils and Construction – Volume 2E – Mines and Quarries* (Department of Energy and Climate Change [DECC], 2008).

6.8 EPL DISCHARGES TO ALLANS CREEK

6.8.1 Submissions

Public and Organisations Submissions

No comments were made in public and organisation submissions in relation to continued EPL discharges to Allans Creek.

Agency, Local Council and Service Provider Submissions

The EPA provided comments on the Project relevant to EPL discharges to Allans Creek. These comments included:

- Potential use options for excess mine water.
- Justification for use of existing EPL licence limits.
- Potential impacts to water quality at Licenced Discharge Point (LDP) 5 to aquatic ecology.
- Potential changes in brine discharge (from the Bulli Seam Operations).
- Potential quality of Project mine water.

6.8.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Potential impacts of mine water discharge to Allans Creek.
    a. Existing discharge at LDP5.
    b. Potential changes in brine discharge due to Bulli Seam Operations.
    c. Proposed discharge at LDP5 for the Project.
2. Proposed mitigation and management measures for excess Project mine water.

The responses in this section are related to EPL discharges to Allans Creek and associated water quality impacts. Responses related to beneficial use of mine water, surface water quality in the catchment and ecology are provided in Sections 6.3, 6.7 and 6.9, respectively.

6.8.3 Responses

1. Potential impacts of mine water discharge to Allans Creek.

a. Existing discharge of LDP5.

South32 currently discharges excess mine water from the Dendrobium Mine at LDP5 at Allans Creek (Figure 6-8A), in accordance with the existing discharge limits for water quality specified in EPL 3241.

Brine from the Bulli Seam Operations is also discharged at LDP5, where it is diluted with mine water from the Dendrobium Mine. Although this brine component is a result of the operational activities of the Bulli Seam Operations, discharge at LDP5 is undertaken in accordance with EPL 3241.

EPL 3241 specifies existing water quality concentration limits for discharge at LDP5 (i.e. for the Dendrobium Mine water inclusive of Bulli Seam Operations brine). The existing EPL does not include limits for volumetric discharge at LDP5.

LEGEND
Licenced Discharge Point 5
Allans Creek

The Dendrobium Mine is currently authorised under EPL 3241 to discharge excess mine water via LDP5 to Allans Creek.

Allans Creek is a heavily-modified waterway, with the upper reaches constituting a concrete lined drain, before joining the downstream tidal zone where mixing/dilution with sea water is available at Port Kembla and the Pacific Ocean.

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

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Licenced Discharge Point 5 and Allans Creek

Figure 6-8A

The receiving environment of LDP5 is a heavily-modified waterway, with the upper reaches of Port Kembla and Allans Creek constituting a concrete lined drain, before joining the downstream tidal zone where mixing/dilution is available within Port Kembla and the Pacific Ocean.

Further downstream, Allans Creek flows into the wider Port Kembla area, which is surrounded by various industrial complexes (Figure 6-8A). Relevantly, EPL 3241 does not specify limits for salinity given the receiving environment of mine water discharge is the ocean.

To date, South32 has generally demonstrated compliance with the existing LDP5 discharge limits in accordance with Dendrobium Mine EPL 3241.

b. Potential changes in brine discharge due to Bulli Seam Operations.

The Bulli Seam Operations are authorised to discharge water to the Nepean River system, subject to the concentration limit specified in EPL 2504.

The EPA recently required South32 to reduce salinity discharge limits for releases to the Nepean River system.

The more onerous licencing conditions imposed on the Bulli Seam Operations by the EPA result in the requirement to increase the treatment of the Bulli Seam Operations mine water to reduce salinity levels below current EPL requirements to enable licenced discharge to the Nepean River System.

The consequence of this increased treatment is an increase in brine volume required to be discharged at LDP5.

It is noted that although this activity is not part of the Project, this discharge of brine would likely continue to occur under EPL 3241 for the Dendrobium Mine.

Separate to the EIS, the EPA has requested an investigation into the potential consequences of increased brine discharge at LDP5 as part of the proposal to change the licence conditions of EPL 2504 for the Bulli Seam Operations.

In response, South32 has undertaken an assessment of increased brine discharges at LDP5, which has been prepared by EGi and considers the cumulative release of increased brine from the Bulli Seam Operations and mine water from the Dendrobium Mine.

This study was provided by South32 to the EPA in November 2019, and consultation with EPA regarding the outcomes of the assessment will occur in parallel to assessment of the Project.

c. Proposed discharge at LDP5 for the Project.

South32 proposes that releases of Project mine water at LDP5 would comply with the requirements of EPL 3241, including in consideration of the EPA's recommendations with respect to the outcomes of the current study for the cumulative release of brine (sourced from the treatment of mine water at the Bulli Seam Operations) and Dendrobium Mine water.

Although the Project would result in a potential increase in the volume of mine water to be discharged at LDP5, this is not anticipated to have any adverse effect on the receiving environment of Allans Creek for the following reasons:

- for the short section of Allans Creek located above the tidal zone, the reach is a concrete lined drain (Plate 6-8A) and therefore would not be susceptible to erosion or bank instability as a consequence of increased discharge volume or flow velocity;
- downstream of the tidal zone, the volume of discharged water would be inconsequential (i.e. in comparison to sea water); and
- the quality of mine water to be discharged for the Project is expected to continue to comply with the existing LDP5 quality concentration limits.

Plates 6-8A: Typical Upstream Reach of Allans Creek
Source: South32 (2019a)

As such, no volumetric limits on mine water discharge (inclusive of brine) at LDP5 are considered to be required, consistent with the existing licenced discharge regime. Rather, any increase in mine water discharge volume from the Project via LDP5 would dilute brine produced at the Bulli Seam Operations that is authorised to be discharged via LDP5.

2. Proposed mitigation and management measures for excess Project mine water.

South32 would continue to maximise the on-site use of excess mine water to meet operational demands at the Dendrobium Mine and for the Project and minimise the requirement for licenced discharge.

Use of excess mine water would include the following:

- portal road dust suppression systems;
- coal stockpile dust suppression systems;
- use in wash down bay areas; and
- general hose down purposes.

The volume of mine water to be released at LDP5 would also be minimised as far as practical through the proposed beneficial use of excess mine water.

As described in Section 6.3, since lodgement of the Project EIS, South32 has investigated potential options for a portion of the Project mine water to be used by other water infrastructure stakeholders and end water users.

6.9 BIODIVERSITY IMPACTS

6.9.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to potential impacts to biodiversity included:

- Vegetation clearing and associated impacts to fauna habitat and threatened vegetation communities.
- Potential impacts to Coastal Upland Swamp Threatened Ecological Communities (TECs) (Upland Swamps) and associated fauna habitat.
- Potential impacts to vegetation and associated habitat due to subsidence-induced changes in hydrology of watercourses and Upland Swamps.
- Consideration of avoidance of Upland Swamps in the Project underground mining area.
- Justification that no impacts would occur to Upland Swamps further than 60 m from proposed longwalls.
- Proposed Upland Swamp monitoring, management and remediation measures.
- Proposed biodiversity management measures, including bushfire management.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to potential impacts to biodiversity included DPIE-BCD, DPIE-Water, WaterNSW, Wollondilly Shire Council and the NSW Rural Fire Service (RFS). These comments included:

- Justification of threatened fauna survey effort and associated species polygons, in particular for the Koala (*Phascolarctos cinereus*), Powerful Owl (*Ninox strenua*) and Rosenberg's Goanna (*Varanus rosenbergi*).
- Clarification of aquatic ecology survey effort and assessment of potential impacts, in particular for the Macquarie Perch (*Macquaria australasica*), macroinvertebrates and Freshwater Crayfish (*Euastacus sp.*).
- Clarification of assessment of Koala habitat corridors and linkage to populations outside of the Project area.
- Justification of baseline recording of Upland Swamps and accuracy of monitoring data.
- Consideration of potential avoidance and minimisation measures for impacts to Upland Swamps in the Project underground mining area.
- Potential impacts to Upland Swamp vegetation and hydrological function.
- Clarification of the determination of the Upland Swamp "maximum offset liability" in consideration of the *Addendum to NSW Biodiversity Offsets Policy for Major Projects: Upland swamps impacted by longwall mining subsidence* (OEH, 2016) (the Swamp Offset Policy).
- Proposed Upland Swamp monitoring and management measures.
- Proposed biodiversity monitoring and management measures, including rehabilitation and bushfire management.
- Rehabilitation and remediation of Upland Swamps and streams impacted by subsidence.

6.9.2 Key Aspects

In consideration of the submissions described above, detailed responses to the following key aspects are provided below:

1. Aquatic ecology assessment (biodiversity listed under the NSW *Fisheries Management Act, 1994* [FM Act]):
    a. Justification of aquatic ecology survey effort.

   b. Clarification of potential impacts to aquatic ecology.
2. Biodiversity assessment (biodiversity listed under the BC Act and EPBC Act):
   a. Clarification of threatened fauna survey effort for Project disturbance areas.
   b. Justification of habitat assessment and species polygons for Project disturbance areas.
   c. Clarification of threatened fauna survey effort and habitat assessment of potential subsidence impact areas.
3. Potential subsidence impacts to Upland Swamps.
4. Clarification of NSW and Commonwealth Offset Liability.
5. Proposed monitoring, management and mitigation measures:
   a. Biodiversity.
   b. Upland Swamps.
   c. Remediation of streams and Upland Swamps.

Responses relating to the Project Biodiversity Offset Strategy are provided in Section 6.10.

6.9.3 Responses

1. Aquatic ecology assessment (biodiversity listed under the FM Act):

a. Justification of aquatic ecology survey effort.

An Aquatic Ecology Assessment (Appendix E of the EIS) was undertaken for the Project area to assess potential impacts to threatened aquatic ecology listed under the FM Act.

Due to the different assessment and offset consideration methodologies, potential impacts, and mitigation and adaptive management measures for threatened aquatic ecology species listed under the BC Act (i.e. the Giant Dragonfly [*Petalura gigantea*]) have been considered in the Biodiversity Assessment Report and Biodiversity Offset Strategy (Appendix D of the EIS) (BARBOS). Potential impacts to threatened species habitat associated with hydrological changes to streams and Upland Swamps have been offset consistent with NSW and Commonwealth offset policies.

Baseline aquatic ecology surveys for the Project were undertaken at a total of seven sites within, as well as upstream and downstream of the Project area across the Avon River, Cordeaux River and Donalds Castle Creek. The surveys were undertaken consistent with relevant guidelines and methodologies, and included (Appendix E of the EIS):

- characterisation of aquatic habitat, aquatic flora, macroinvertebrates and fish; and
- targeted surveys of Macquarie Perch.

First and second order ephemeral drainage lines which overlie the Project underground mining areas consist generally of disconnected pools, some also separated by waterfalls, providing barriers to fish movement and limiting the value of this habitat for fish.

Macroinvertebrate sampling was undertaken in accordance with the Australian River Assessment System (AUSRIVAS) Rapid Assessment Protocol (RAM) (Turak *et al.*, 2004) and results were assessed against AUSRIVAS modelling software, which concluded the populations area somewhat impaired. There is no evidence that this is mining-related as the catchment is largely undisturbed. No threatened aquatic ecology species under the FM Act or EPBC Act were recorded during the baseline surveys.

b. Clarification of potential impacts to aquatic ecology.

Direct surface disturbance of aquatic habitat would be avoided where possible and any required works would have a negligible impact to aquatic ecology in the Project area.

Associated changes in the availability of ephemeral aquatic habitat that would occur are not expected to result in any significant impacts to overall aquatic ecology, due to the limited value of habitat within ephemeral drainage lines. The abundance of drainage line habitat in the wider catchment would also suggest such impacts would be very small to negligible in the context of the local and regional area (Appendix E of the EIS).

MSEC (2019) predicted that there would be a low likelihood (less than 10%) of subsidence-related fracturing resulting in diversion of flow in the short sections of the Avon River, Cordeaux River and Donalds Castle Creek within 400 m of the proposed longwalls. Associated impacts to aquatic ecology are expected to be localised and relatively minor compared to the extensive aquatic habitat in the broader region (Appendix E of the EIS).

No significant impacts to aquatic ecology in watercourses downstream of the Project area are predicted as reductions in streamflow are predicted to result in negligible changes in water yields to Avon Dam and downstream of Pheasants Nest Weir (Appendix C of the EIS).

Macquarie Perch have been historically recorded within the Dendrobium Mine area within Wongawilli Creek. Wongawilli Creek is further than 600 m from the Project longwalls and, therefore, is not predicted to experience impacts to aquatic ecology as a result of the proposed underground mining. Limited suitable Macquarie Perch habitat exists within the proposed underground mining area and, therefore, the Project is not expected to have a significant impact on the Macquarie Perch or any other threatened aquatic ecology species.

South32 would continue to conduct aquatic ecology monitoring within the Project underground mining area throughout the Project life, incorporating the recommendations of the Aquatic Ecology Assessment (Appendix E of the EIS).

2. Biodiversity assessment (biodiversity listed under the BC Act and EPBC Act).

The Project disturbance area (total of 28.5 ha of native vegetation) comprises:

- sites with fixed locations (i.e. 19 ha associated with Ventilation Shaft Sites and the Dendrobium Pit Top Carpark Extension); and
- other infrastructure, the location of which cannot be defined at this stage (such as electricity supply infrastructure to Ventilation Shaft Sites and gas management infrastructure, which is dependent on final longwall design and in-seam drilling activities that cannot occur prior to approval and development of the Project). Accordingly, an allowance of 9.5 ha has been included in the Project offset liability (and incorporated in offset calculations).

Table 6-9A provides a summary of the Project biodiversity impact mechanisms and associated potential areas of impact.

a. Clarification of threatened fauna survey effort for Project disturbance areas.

Disturbance at Ventilation Shaft Sites and Dendrobium Pit Top Carpark Extension Area.

Threatened fauna survey for the Project was undertaken generally in accordance with the OEH's working draft *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC, 2004) (the Survey Guidelines), as well as in consideration of other relevant standards and guidelines.

Table 5.8 of the Survey Guidelines prescribes requirements for survey effort for threatened mammals per stratification unit up to 50 ha, and every additional 100 ha, as well as suggested survey methods for particular animals.

The Ventilation Shaft Sites contain a single ecological community (PCT1083 Red Bloodwood – scribbly gum heathy woodland [HN566]) and as such were treated as a single stratification unit for the purposes of determining the required survey effort. The results of other surveys conducted throughout the Project area within the same stratification unit informed the outcomes of the threatened fauna habitat assessment within the Ventilation Shaft Sites.

Table 6-9A
Biodiversity Impact Mechanisms and Potential Area of Impact

Biodiversity Impact Mechanism	Vegetation Communities	Ecosystem Credits	Species Credits	Species Polygon
Disturbance – fixed: • Ventilation Shaft Sites and Dendrobium Pit Top Carpark Extension	18.8 ha of HN566 0.2 ha of ME044 **= 19 ha total**	✓	Based on surveys and habitat associations no species credit species identified that would require offsetting.	N/A
Disturbance – not fixed: • electricity supply infrastructure and service boreholes	7 ha of HN566 1 ha of HN651 1.5 ha of HN556 **= 9.5 ha total**	✓	1.5 ha of Koala habitat associated with HN556	Not provided as location of this infrastructure is not fixed and cannot yet be defined.
Subsidence – Upland Swamps: • Upland Swamps directly above and within 60 m of proposed longwalls	**21.6 ha of Coastal Upland Swamp TECs** (HN560 and HN662)	✓	13.9 ha of Giant Dragonfly habitat 21.6 ha of Giant Burrowing Frog and Littlejohn's Tree Frog habitat	Figure 17 of the BARBOS (Appendix D of the EIS) Figure 15 of the BARBOS (Appendix D of the EIS)
Subsidence – streams (mapping provided by South32): • 100% of stream length above proposed longwalls • 50% of stream length within 400 m of longwalls • 9% of Donalds Castle Creek within 400 m of longwalls • 7% of Avon River within 400 m of longwalls • 5% of Cordeaux River within 400 m of longwalls	N/A	×	7.2 ha of Red-crowned Toadlet habitat 11.1 ha of Giant Burrowing Frog and Littlejohn's Tree Frog	Figure 16 of the BARBOS (Appendix D of the EIS) Figure 15 of the BARBOS (Appendix D of the EIS)
Subsidence – cliffs: • between 7 and 10% of the total length, or between 3 and 5% of the total face area of the cliffs	N/A	×	0.3 ha of Broad Headed Snake habitat	Habit modelling provided on Figure 14 of the BARBOS (Appendix D of the EIS)

Source: After Niche Environment and Heritage (Niche) (2019a)

Survey of the Dendrobium Pit Top Carpark Extension area was limited to habitat, flora and vegetation survey. Targeted fauna survey was not required due to the degraded nature of the habitat present and small area of disturbance.

It is considered that the combined survey effort within the known surface disturbance areas is adequate for the purposes of informing the BARBOS with respect to potentially occurring threatened fauna species.

Disturbance for Infrastructure where Location is Not Currently Fixed

The location of service boreholes and other infrastructure (e.g. for gas management) and electricity supply infrastructure cannot be defined at this stage as it is dependent on design development, final longwall design and in-seam drilling activities that cannot occur prior to approval and development of the Project.

An allowance for 9.5 ha of native vegetation clearance as a result of this infrastructure has been included in the biodiversity assessment, which includes allowance for clearance of 1.5 ha of Shale Sandstone Transition Forest TEC. The presence of relevant threatened species habitat has been assumed within the clearance allowance and offset requirements for species and ecosystem credits calculated accordingly.

A Surface Services Management Plan (refer to Section 3.10.4 of the Project EIS) would be prepared for installation of this infrastructure and would include vegetation validation surveys to confirm the proposed disturbance areas are within the allowance made in the BARBOS.

The gas drainage infrastructure is typically not required for the entirety of the mine life and therefore would be rehabilitated progressively over the life of the Project.

b. Justification of habitat assessment and species polygons for Project disturbance areas.

Consistent with the requirements of the Project SEARs, the BARBOS was prepared in accordance with the *NSW Biodiversity Offset Policy for Major Projects* (OEH, 2014a) (the NSW Offset Policy), and supporting *Framework for Biodiversity Assessment* (FBA). The FBA requires the use of an online calculator to assess biodiversity impacts and determine offset requirements, namely the *Credit Calculator for Major Projects and BioBanking* (version 4.0) (BioBanking Credit Calculator) which was used for the Project.

DPIE-BCD, in their submission on the Project EIS, requested further justification of the assessment of particular threatened fauna, including:

- Koala;
- Giant Dragonfly;
- Powerful Owl;
- Rosenberg's Goanna;
- Eastern Pygmy-possum (*Cercartetus nanus*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*); and
- Glossy Black Cockatoo (*Calyptorhynchus lathami*).

Further discussion of the assessment undertaken for these species is provided below.

Koala

Fixed Infrastructure

DPIE-BCD, in their submission on the Project EIS, requested that the Koala species polygon be revised to include all areas of Plant Community Type (PCT) 1083 Red Bloodwood – scribbly gum heath woodland (HN566) that occur within Project surface disturbance areas (i.e. an additional 25.8 ha of habitat).

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) provides a list of preferred Koala feed trees, the presence of which indicates whether vegetation is considered 'core' or 'potential' habitat. PCT 1083 does not contain preferred Koala feed trees and on that basis is not considered to be 'core' or 'potential' habitat as defined in SEPP 44. Increasing the Koala species polygon to include PCT 1083 is not considered to be justified as this would be inconsistent with SEPP 44.

The Koala does not require species credits due to disturbance of the Ventilation Shaft Sites and Dendrobium Pit Top Carpark Extension area as threatened fauna surveys undertaken for the BARBOS did not identify any Koalas. A Koala was heard calling from the outside of Ventilation Shaft Site 5A, however Niche (2019a) concluded that this record was likely to be a male moving through the area, rather than a resident as no preferred feed trees are present in the vicinity.

Potential impacts to habitat within the fixed infrastructure areas have been offset using ecosystem credits.

A Koala Plan of Management (Niche, 2019a) (KPoM) has been prepared for the Project (Appendix 11 of the Appendix D of the EIS) in accordance with the requirements of SEPP 44. The KPoM outlines management strategies to be implemented to minimise impacts to the Koala for the Project.

As a component of the KPoM, an analysis was undertaken of Koala records in the wider region, including the Upper Nepean State Conservation Area, as well as existing corridors and habitat connectivity with areas surrounding the Project. The results of this analysis were considered in the assessment of potential impacts to Koala habitat in the BARBOS.

Infrastructure with Location Not Currently Fixed

Koalas have been assumed to be present in the allowance of disturbance of 1.5 ha of Shale Sandstone Transition Forest TEC associated with infrastructure that does not currently have a fixed location. Accordingly, species credits have been generated for this disturbance allowance area. The Koala species polygon was not mapped in the BARBOS as the exact location of the disturbance cannot be defined at this stage.

Powerful Owl

The Powerful Owl has recorded breeding and foraging habitat within 5 km of the Project area.

Note that the OEH databases used by the BioBanking Credit Calculator (i.e. Archived BioMetric and Threatened Species Profiles Datasets, current at the time that the calculator was submitted for the EIS) do not list PCT 1083 Red Bloodwood – scribbly gum heath woodland (HN566), which occurs within the Ventilation Shaft Sites, as Powerful Owl habitat.

Vegetation surveys undertaken for the BARBOS identified trees with hollows within the ventilation shaft areas. The *NSW Recovery Plan for the Large Forest Owls: Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae)* (DEC, 2006) describes Powerful Owl roosting and nesting habitat as follows:

- Roosting: groves of dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls.
- Nesting: old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter and greater than 100 cm deep; surrounded by canopy trees and subcanopy or understorey trees or tall shrubs.

On this basis, Niche (2019a) concluded it is highly unlikely the Powerful Owl would roost in the identified hollows due to the landscape positioning of the surface disturbance areas on hilltops. As such, breeding habitat was not considered to be present in the ventilation shaft areas and Dendrobium Pit Top Carpark Extension area and would not require species credits for this disturbance.

Powerful Owl habitat was assumed to be present in 1.5 ha of Shale Sandstone Transition Forest TEC associated with the infrastructure that does not currently have a fixed location. Potential impacts to Powerful Owl habitat have therefore been offset using ecosystem credits for this 1.5 ha of Shale Sandstone Transition Forest TEC.

Rosenberg's Goanna

OEH databases used by the BioBanking Credit Calculator (i.e. Archived BioMetric and Threatened Species Profiles Datasets, current at the time that the calculator was submitted for the EIS) list the Rosenberg's Goanna as a species credit species. The Rosenberg's Goanna has been previously identified during surveys within the Project area and was also recorded during surveys undertaken for the BARBOS within the Project surface disturbance areas.

A species polygon for the Rosenberg's Goanna could have been included in the BARBOS based on the species credit status under the FBA (at the time of the EIS) and presence of known records within Project surface disturbance areas.

However, the FBA and BioBanking Credit Calculator have been superseded by the *NSW Biodiversity Assessment Method* (OEH, 2017) (BAM). Under the BAM, the credit status for the Rosenberg's Goanna has been revised to an ecosystem credit species. Therefore, it is understood that species credits for the Rosenberg's Goanna would not be able to be generated using the BAM within potential offset areas in order to satisfy any species credit offset requirement for the Project.

On this basis, a species polygon is not considered reasonable for the Rosenberg's Goanna. South32 will continue to consult with DPIE-BCD regarding consideration of the 'reasonable equivalence' of species credits for the Rosenberg's Goanna.

Note that potential impacts to relevant Rosenberg's Goanna habitat as a result of surface disturbance would be satisfied by ecosystem credits.

Eastern Pygmy-possum

The Eastern Pygmy-possum was not detected during targeted surveys of the Ventilation Shaft Sites undertaken for the Project and the presence of the species was not considered likely within the Dendrobium Pit Top Carpark Extension area due to degraded habitat.

Note that there are no survey guidelines specific to the Eastern Pygmy-possum, however survey methods used relevant to this particular species (i.e. nest boxes) have been demonstrated as effective and are adopted by relevant agencies as best practice. Other accepted survey methods, such as trapping, are not appropriate for identifying the Eastern Pygmy-possum within the Project area given the access restrictions associated with the Special Catchment Area and the risk of not being able to confidently check traps.

Further survey and assessment for the Eastern Pygmy-possum is not required as the combined survey effort across the Project area was considered sufficient to confirm no presence of the species and/or relevant habitat within the Project disturbance areas or surrounds.

Gang-gang Cockatoo and Glossy Black Cockatoo

OEH databases used by the BioBanking Credit Calculator (i.e. Archived BioMetric and Threatened Species Profiles Datasets, current at the time that the calculator was submitted for the EIS) list the credit status of the Gang-gang Cockatoo and Glossy Black Cockatoo as ecosystem species.

As described above, the FBA and BioBanking Credit Calculator have been superseded by the BAM. Under the BAM the credit status for the Gang-gang Cockatoo and Glossy Black Cockatoo have been revised to dual credit species. This dual credit status was used for the assessment of potential impacts to these species in the BARBOS. Surveys undertaken relevant to the Gang-gang Cockatoo and Glossy Black Cockatoo considered the potential for direct impacts to breeding habitat. The surveys identified that offset requirements for these species would be satisfied by ecosystem credits due to the absence of species sightings in surface disturbance areas with appropriately sized tree hollows.

It is noted that if the credit status of the Gang-gang Cockatoo and Glossy Black Cockatoo were revised consistent with the FBA and BioBanking Credit Calculator (i.e. to ecosystem species) no update would be required to the Project offset liability presented in the BARBOS.

c. Clarification of threatened fauna survey effort and habitat assessment of potential subsidence impact areas.

Targeted threatened fauna survey of habitat with a high likelihood of potential subsidence-related impacts was limited due to access restrictions associated with the Special Catchment Area and terrain, as well as a lack of ideal survey conditions (e.g. volume of rainfall). As a result, the presence of threatened fauna species in potential subsidence impact areas was assumed where previous records existed and suitable habitat was available within the Project area.

Potential subsidence impacts to habitat for the following threatened species were considered in the Project BARBOS (Appendix D of the EIS):

- Giant Burrowing Frog (*Heleioporus australiacus*) and Littlejohn's Tree Frog (*Litoria littlejohni*) (for both streams and swamps);
- Giant Dragonfly (for relevant swamps);
- Red-crowned Toadlet (*Pseudophryne australis*) (for relevant streams); and
- Broad-headed Snake (*Hoplocephalus bungaroides*) (for cliffs).

Further discussion of the assessment undertaken for these species is provided below.

Giant Burrowing Frog and Littlejohn's Tree Frog

In consideration of previous records within the Project area and presence of suitable habitat within Upland Swamps within 60 m of proposed longwalls, first, second and third order streams and named watercourses within 400 m of the proposed longwalls, the Giant Burrowing Frog and Littlejohn's Tree Frog were considered to have a high likelihood of occurrence within the Project area.

The extent of potential subsidence impacts to relevant habitat were informed by predictions from MSEC (2019) and the associated offset liability incorporated in the Project Biodiversity Offset Strategy (Table 6-9A).

Giant Dragonfly

Targeted surveys undertaken by Cardno (2019) within Upland Swamps in Areas 5 and 6 aimed to identify potential Giant Dragonfly breeding and foraging habitat. Recorded presence of adult Giant Dragonflies, potential burrows and indicator vegetation species, as well as consideration of the existing hydrological regime, were used to inform the classification of potential habitat within Upland Swamps.

The results of the surveys and classification of Upland Swamps as breeding or foraging habitat provided the species polygon for the Giant Dragonfly of approximately 13.9 ha (Table 6-9A).

Red-crowned Toadlet

In consideration of previous records within the Project area, the Red-crowned Toadlet was considered to have a high likelihood of occurrence within first order streams within 400 m of the proposed longwalls. The extent of potential subsidence impacts to relevant habitat were informed by predictions from MSEC (2019) and the offset liability associated with the determined species polygon incorporated in the Project Biodiversity Offset Strategy (Table 6-9A).

Broad-headed Snake

Potential habitat for the Broad-headed Snake was conservatively modelled by mapping areas with a west to north-easterly aspect with a slope of 30° or greater. During surveys of the modelled habitat it was observed that much of the modelled area would not support preferred habitat for this species.

Based on previous experience at the Dendrobium Mine, MSEC (2019) predicts that on average between 7 and 10% of the total length, or between 3 and 5% of the total face area of the cliffs located directly or partially above the proposed longwalls in Areas 5 and 6 would be potentially impacted by subsidence. Therefore, species credits were estimated based on potential loss of habitat (e.g. 10% of the total areas of cliffs and steep slopes predicted to be affected by subsidence) (Table 6-9A). A specific species polygon is not presented for the Broad-headed Snake as the location of potential impacts would be spread across the area of modelled habitat.

To account for potential hydrological changes to swamps and streams, and associated potential impacts to habitat due to the Project, biodiversity offsets are proposed for relevant aquatic ecology species listed under the BC Act and EPBC Act to maintain or improve biodiversity values for these species in the medium to long term.

3. Potential subsidence impacts to Upland Swamps.

Swamp Monitoring Data

South32 has undertaken monitoring of Upland Swamps within 400 m of longwalls since 2003, as well as monitoring of relevant control swamps. This monitoring focuses on vegetation change (floristic plots and photo monitoring) augmented with piezometer water level data and Airborne Laser Survey. This monitoring program collects data for 20 Upland Swamps at the Dendrobium Mine.

An assessment of monitoring data for impacted swamps within Dendrobium Area 3B is presented in Section 4.3 of the Surface Water Assessment (Appendix C of the EIS).

Extensive baseline water level (including both perched aquifer and Hawkesbury Sandstone groundwater level) and soil moisture monitoring has also been undertaken by South32 within underground mining Areas 5 and 6 since 2017. Monitoring results are presented in Appendix A of the Surface Water Assessment (Appendix C of the EIS).

HEC has undertaken further analysis of the baseline monitoring data within Areas 5 and 6 to confirm the validity of monitoring data, in particular to demonstrate the monitoring data responds to rainfall events.

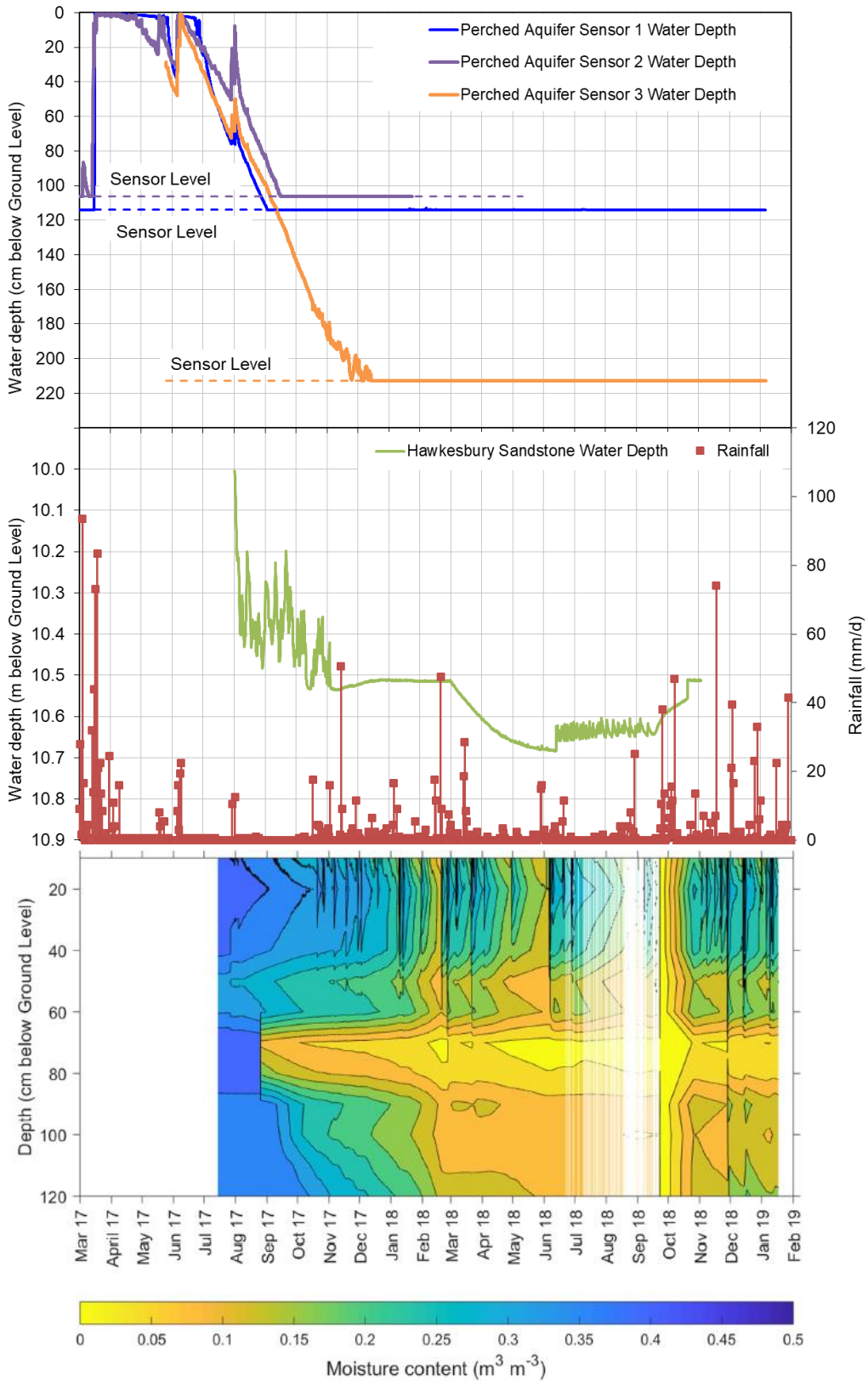
At the commencement of monitoring in 2017, a perched aquifer was present in 14 of the 24 monitored Upland Swamps in Areas 5 and 6 due to the volume of rainfall experienced in the preceding months. Low rainfall conditions since monitoring commenced contributed to water levels falling consistently in all Upland Swamps below the level of shallow groundwater piezometer sensors, in most cases to the base of the swamp. This, and groundwater level data, indicates that Upland Swamp perched aquifers are not sustained by groundwater levels within the Hawkesbury Sandstone.

A direct response to rainfall events is evidenced in monitoring data by a rise in shallow groundwater level recorded within perched swamp aquifers. Where this does not occur, response to rainfall events is evident in the data by responses in the swamp soil moisture profile. A rise in water level does not necessarily occur following a rainfall event if the volume of rainfall is insufficient to saturate the soil profile and raise the water level of the perched aquifer above the shallow groundwater piezometer sensors.

It is noted the need to analyse both piezometer and soil moisture data is consistent with the following from Part 2 of the IEP Report (2019b), which stated:

> *… while piezometer levels give clear early evidence of hydrological change in response to mining, the consequences for ecology and hydrology are more complicated and require complementary soil moisture data at multiple depths.*

An example of baseline water level and soil moisture monitoring results (from 2017) within Upland Swamp Den85 in Area 5 is presented in Figure 6-9A. The swamp perched aquifer water level is at ground level when monitoring starts and steadily falls until below the sensor levels, which is reflected in the rapid decline of soil moisture that occurs in February 2018. Small increases in soil moisture can be observed following isolated rainfall events, however these increases are not sufficient to result in saturated conditions and therefore there is no rise in perched aquifer water level for the remainder of the monitoring period.



These graphs show (from top to bottom) water level monitoring, rainfall and soil moisture monitoring results in Swamp Den85 located above Area 5 (i.e. unaffected by mining to date).

As shown, reducing swamp water levels during dry periods correspond with reduced soil moisture, until the water level is at the base of the swamp.

When subsequent isolated rainfall occurs, a response is evident in the soil moisture monitoring, but there is not sufficient saturation to result in a rise in the swamp water level.

The monitoring data demonstrates that swamps naturally have extended periods where the swamp is dry.

Figure 6-9A – Swamp Den85 Groundwater Level and Soil Moisture Monitoring (March 2017 to February 2019)

Overall, HEC concluded that the baseline monitoring data within Areas 5 and 6 exhibits a direct response to rainfall events in the swamp soil moisture profile, however this is not always evidenced by an associated rise in water level within a swamp. The results of baseline monitoring also demonstrate that perched groundwater levels within Upland Swamps naturally recede during extended dry periods, and recover when rainfall events are sufficient to saturate the soil profile.

Avoidance Measures

It is not considered reasonable to avoid undermining all swamps within Areas 5 and 6.

The Swamp Offset Policy provides the framework for offsetting potential impacts to Upland Swamps from longwall mining and requires that offsets should only be used to compensate for impacts of longwall mining where it can be demonstrated that all feasible measures to avoid and minimise impacts have been taken.

The Project has considered measures to avoid potential impacts to Upland Swamps through:

- The selection of proposed mining in Areas 5 and 6 as opposed to Area 4, in consideration of potential environmental, mining and infrastructure constraints (particularly the number of Upland Swamps within Area 4).
- Siting surface infrastructure to avoid direct impacts to Upland Swamps, other than minor disturbance associated with the installation of monitoring equipment.
- Alternative longwall geometry/methods within Areas 5 and 6 have been considered (e.g. narrower longwall widths), however, no material difference in the potential for impacts to Upland Swamps associated with alternative longwall layouts is expected.
- The implementation of the mine constraints and setbacks for the Project (i.e. from Dam walls, FSLs, named watercourses and key stream features) would result in avoidance of directly undermining a number of Upland Swamps including Den124, Den115, Den131, Den132, Den119 and Den134.
- The Project relinquishes the existing authority to impact certain Upland Swamp vegetation areas within Area 3, for which offsets have previously been secured.

Residual predicted impacts to Upland Swamps due to the Project are proposed to be offset consistent with the Swamp Offset Policy. This includes offsets for potential subsidence impact to Upland Swamps as well as offsets for threatened fauna species for which the Upland Swamps provide habitat.

The Biodiversity Offset Strategy relevant to Upland Swamps is discussed in detail in Section 6.10.3.

Application of the Swamp Offset Policy

The Swamp Offset Policy requires (emphasis added):

> *For each extraction plan, a **maximum predicted offset liability** must be calculated for the total area of Upland Swamps predicted to be subject to greater than **negligible environmental consequences**.*

Greater than 'negligible environmental consequences' are defined as including one or more of the following:

- a shallow groundwater level within swamp sediments lower than the baseline level at any monitoring site within a swamp (in comparison to control swamps); and/or
- a rate of shallow groundwater level reduction post-mining that exceeds the rate of shallow groundwater level reduction during the baseline period at any monitoring site (measured as average millimetres per day during the recession curve).

The Swamp Offset Policy also states:

> *Where it is predicted that a partial impact to an Upland Swamp is likely, then only the portion of the swamp likely to experience greater than negligible environmental consequences should be included in the offset calculation.*

Watershed HydroGeo (2019a) completed a detailed analysis of Upland Swamp shallow piezometer data for Dendrobium Mine Areas 2, 3A and 3B (Appendix 12 of the Appendix D of the EIS). The analysis was specifically focused on assessing the measured change in groundwater against the 'negligible environmental consequences' criteria provided in the Swamp Offset Policy.

The analysis of groundwater data found that almost all Upland Swamps directly above or within 60 m of previously-mined longwall panels exhibited a response (either as a reduction in the water level in the swamp and/or change in recession rate) greater than the 'negligible environmental consequences' criteria.

However, greater than 'negligible environmental consequences' were not observed at distances greater than 60 m from undermined longwall panels (Watershed HydroGeo, 2019a). On this basis, the offset liability for Upland Swamp TECs was calculated using the total area of Upland Swamps partially or entirely within 60 m of the proposed longwalls.

The Swamp Offset Policy also provides:

> *It is recognised that the impact of altering the hydrological regime within Coastal Upland Swamps is not equivalent to removing all vegetation …*

South32 acknowledges that changes to the hydrological regime of Upland Swamp sediments may be experienced in Upland Swamps within 60 m of the proposed longwalls. However, a review undertaken by Niche (2019a) of the monitoring data collected during the previous 11.5 years in Area 2, 7.5 years in Area 3A and 4.5 years in Area 3B did not conclude there is a strong link between subsidence effects to hydrological regime and Upland Swamp vegetation response.

It is noted that, while no strong links between subsidence effects and vegetation response have been identified, the time between the impact and vegetative response may not be immediate and, therefore, not yet detected.

Monitoring at the Wollongong Coal and Metropolitan Coal Mines also reported a lack of evidence linking subsidence effects to vegetative response, consistent with monitoring results at the Dendrobium Mine (Biosis, 2015; 2017; Peabody, 2013; 2014; 2015; Trevor Brown and Associates, 2016).

Vegetation monitoring of Swamp 15b, for example, which was undermined in 2010, confirms Upland Swamp vegetation persists following subsidence-related impacts (Plates 6-9A and 6-9B).

These photos show various perspectives of Swamp Den15b, 9 years after it was undermined and hydrological change occurred.

No strong links between vegetation change and undermining have been observed to date.

Plates 6-9A and 6-9B – Swamp Den 15b - Nine Years after Undermining
Source: Niche (2019a).

This outcome of monitoring has been applied to the calculation of the Project Upland Swamp maximum offset liability by amending the vegetation site value scores to reflect a transition vegetation type (i.e. partial loss scenario), rather than total impact.

This is consistent with the Swamp Offset Policy which states:

> *Any application for a reduction in the maximum predicted offset liability must be supported by monitoring data …*

Potential Subsidence Impacts to Upland Swamps

Based on observed effects of longwall mining to Upland Swamps, the Project may result in the following subsidence-related impacts to Upland Swamps within 60 m of the proposed longwalls:

- A change to the hydrological regime of swamp sediments as a result of:
  - fracturing of downstream rockbars;
  - fracture networks forming in the bedrock below the swamp; and/or
  - upsidence and dilation of bedrock below the swamp.
- Alteration of surface drainage patterns due to subsidence-induced tilting, resulting in localised erosion or scour or alteration of water distribution.
- Consequential impacts to vegetation composition (i.e. transition to a drier community) due to changes in the soil moisture regime.

Accordingly, predicted impacts to Upland Swamps due to the Project would be offset consistent with the Swamp Offset Policy. The Biodiversity Offset Strategy relevant to Upland Swamps is discussed in detail in Section 6.10.3.

4. Clarification of NSW and Commonwealth Offset Liability.

In consideration of the additional justification of habitat assessment and species polygons provided above, the Project Offset Liability, for both the NSW and Commonwealth offset requirements, remains unchanged from that presented in the BARBOS (Appendix D of the EIS).

Table 6-9B provides a summary of the offset requirements for the Project.

Table 6-9B
Total NSW and Commonwealth Offset Liability for the Project – Incorporating Fixed Disturbance, Disturbance which is Not Fixed and Subsidence

Threatened Entity		Area (ha)	Credits Required
Vegetation Communities (Ecosystem credits)			
HN560	Needlebush - banksia wet heath on sandstone plateaus of the Sydney Basin Bioregion (Upland Swamp)	16.3	227
HN662	Needlebush - banksia wet heath swamps on coastal sandstone plateaus of the Sydney Basin (Upland Swamp)	4.6	78
HN566	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaus, Sydney Basin	25.8	1,022
HN556	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	1.5	120
HN651	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest	1.0	80
ME044	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	0.2	6
Threatened Fauna Species (Species credits)			
Broad-headed Snake		0.3	9
Littlejohn's Tree Frog		32.7	851
Giant Burrowing Frog		32.7	426
Red-crowned Toadlet		7.2	94
Giant Dragonfly		13.9	1,073
Koala		1.5	39

Source: Niche (2019a)

5. Proposed monitoring, management and mitigation measures.

a. Biodiversity.

In addition to the avoidance measures relevant to biodiversity described above, South32 would continue to implement biodiversity management and mitigation measures currently employed at the Dendrobium Mine for the Project, including:

- bushfire risk management;
- erosion and sediment control;
- measures to prevent vehicle fauna strikes; and
- landscape management, including vegetation clearance protocols, weed control and pest management.

Noise, air quality and lighting management and mitigation measures relevant to reducing potential indirect impacts to biodiversity values within the Project area would also continue to be implemented by South32 for the Project, consistent with existing Dendrobium Mine management plans.

All areas of native vegetation subject to direct disturbance would be progressively rehabilitated following decommissioning of surface infrastructure, such that only a practical minimum area is disturbed at any one time.

Specific mitigation and management measures to reduce bushfire risk are detailed in the existing Dendrobium Mine Bushfire Management Plan and include:

- fire awareness and fire safety training for South32 staff and contractors;
- reduction of bushfire hazards (principally fuel levels);
- minimisation and control of ignition sources (e.g. by appropriate engineering design, where relevant);
- development of appropriate emergency responses (e.g. fire management plans) and evacuation strategies/procedures;
- establishing suitable firebreaks and/or radiation zones;
- availability of extensive firefighting water pipelines and booster pump facilities; and
- regular inspection of bushfire management controls on South32 properties.

South32 would continue to consult with WaterNSW with respect to management of bushfire risk activities within the Special Areas.

As described above, a KPoM has been prepared for the Project in accordance with SEPP 44 (Appendix 11 of Appendix D of the EIS). The KPoM describes management measures proposed for potential impacts to core Koala habitat.

b. Upland Swamps.

Baseline surface water and groundwater monitoring (including shallow piezometers and soil moisture probes) of Upland Swamps within 400 m of the proposed longwalls would be undertaken to refine the predicted offset liability. Should monitoring indicate impacts greater or less than those predicted, the ultimate offset liability would be increased or decreased accordingly, consistent with the process in the Swamp Offset Policy.

Upland Swamp monitoring would be detailed in the Extraction Plans for the Project, and would include subsidence, surface water, groundwater and vegetation composition.

c. Remediation of streams and Upland Swamps.

Mitigation and remediation of named watercourses and key stream features, where monitoring indicates that subsidence-related impacts have occurred as a result of the Project, are detailed in Section 6.5.3.

South32 is also conducting research into methods for swamp rehabilitation as described in the *Dendrobium Area 3B Swamp Impact, Monitoring, Management and Contingency Plan* (South32, 2019c) and *Dendrobium Area 3B Swamp Rehabilitation Research Program* (South32, 2016).

Subject to confirmation from key stakeholders that swamps undermined in Area 3 have been successfully remediated, swamp remediation measures could be implemented for the Project.

6.10 BIODIVERSITY OFFSET STRATEGY

6.10.1 Submissions

Public and Organisations Submissions

Relevant comments made in public and organisation submissions queried the adequacy of the proposed Biodiversity Offset Strategy for the Project.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to the Biodiversity Offset Strategy included DPIE-BCD, DRG, and Wollondilly Shire Council. These comments included:

- Justification of use of the Maddens Plains Offset Site to generate species credits.
- Adequacy of the proposed Upland Swamp offsets in consideration of the Swamp Offset Policy and development of performance measures.
- Further detail of Upland Swamps proposed to be used as offsets, including how they compare to those potentially impacted by the Project.
- Consideration of resource sterilisation in potential offset areas.

6.10.2 Key Aspects

In consideration of the submissions described above, detailed responses to the following key aspects are provided below:

1. Establishment of a Stewardship site on a recently purchased South32 landholding.
2. Other direct offset measures.
3. Supplementary offset measures.
4. Maddens Plains Strategic Offset.
5. Biodiversity Offset Strategy reconciliation.

6.10.3 Responses

1. Establishment of a Stewardship site on a recently purchased South32 landholding.

Since lodgement of the Project EIS, South32 has secured an additional landholding (the Offset Property), which would be established as a Stewardship site to address biodiversity offset requirements for the Project.

The Offset Property is located north-east of the Project underground mining area and is bordered by the Dharawal Reserves, which include the Dharawal Nature Reserve and Dharawal National Park (Figure 6-10A). Preliminary habitat assessment has determined that the Offset Property is comprised of a majority of Upland Swamp TEC (totalling 51.3 ha) (Figures 6-10B and 6-10C).

South32 will prepare a Biodiversity Stewardship Site Management Plan specific to the Offset Property. The Biodiversity Stewardship Site Management Plan would detail a number of management and remediation measures that would be implemented to improve the quality of vegetation and species habitat that the Offset Property provides.

South32 would continue to consult with DPIE-BCD and the DoEE as available credits at the Offset Property are refined, to confirm how the Offset Property contributes to addressing both the NSW and Commonwealth offset liabilities. A summary of the initial credit calculations is provided below.

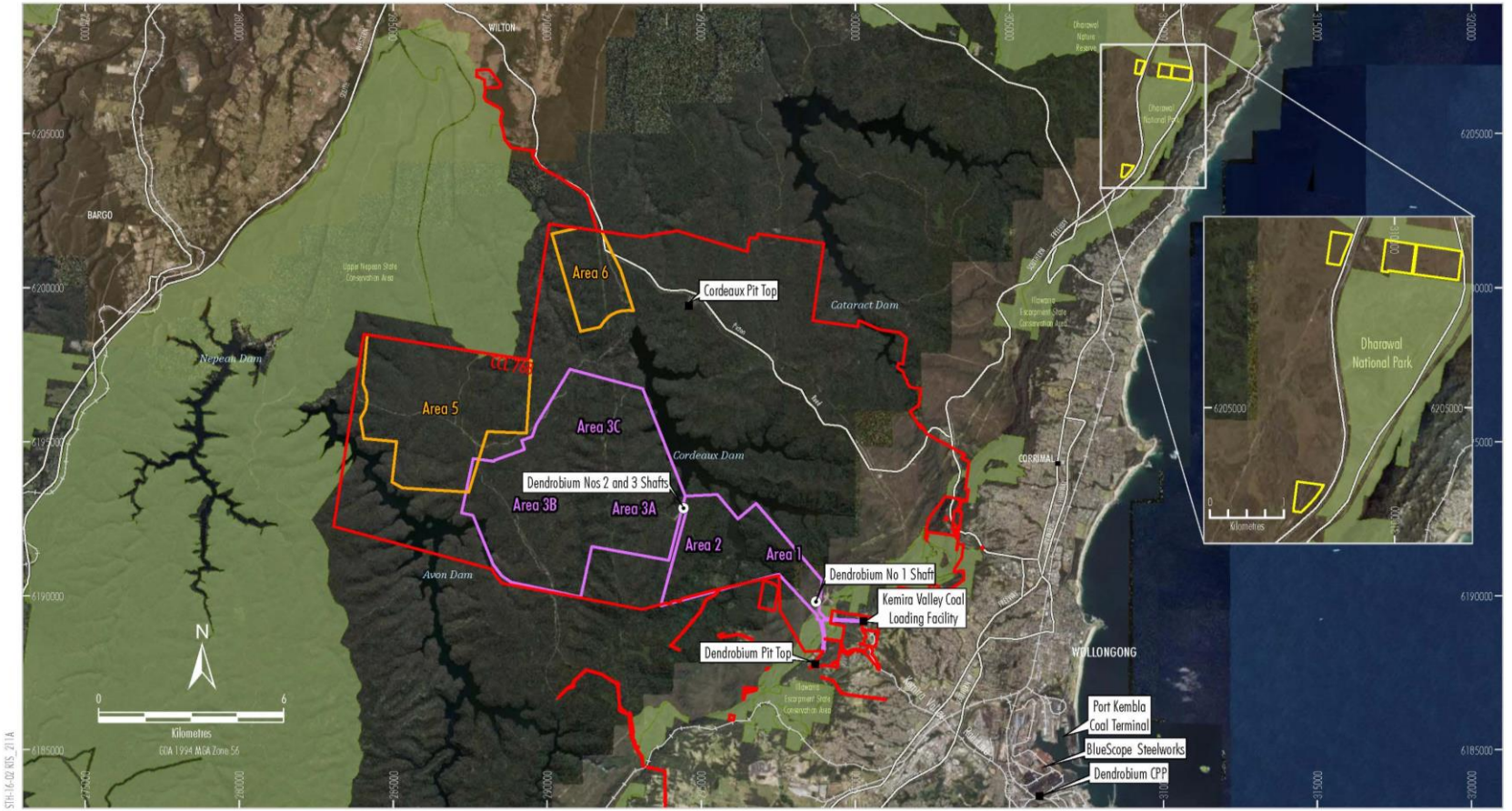

WILTON
BARGO
Area 6
Cordeaux Pit Top
Cataract Dam
Nepean Dam
Area 5
Area 3C
Cordeaux Dam
Dendrobium Nos 2 and 3 Shafts
Area 3B
Area 3A
Area 2
Area 1
Avon Dam
Dendrobium No 1 Shaft
Kemira Valley Coal Loading Facility
Dendrobium Pit Top
CORRIMAL
WOLLONGONG
Port Kembla Coal Terminal
BlueScope Steelworks
Dendrobium CPP
Dharawal National Park
N
0
6
Kilometres
GDA 1994 MGA Zone 56
0
1
Kilometres
LEGEND
Dendrobium Mining Lease
Road
Railway
National Park, Nature Reserve and State Conservation Area
Dendrobium Underground Mining Area - Existing Mine (DA 60-03-2001)
Dendrobium Underground Mining Area - Proposed Project
Offset Property
Source: Geoscience Australia (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018);
DENDROBIUM MINE
Location of Offset Property

Figure 6-10A


SOUTHERN FREEWAY
SOUTHERN FREEWAY
N
0
500
Metres
LEGEND
Threatened Species Records
Littlejohn's Tree Frog
Validated Vegetation Mapping
Coastal Upland Swamps TEC
Eucalypt Fringing Woodland
Non-native
Source: Geoscience Australia (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018); Niche (2019)
SOUTH32
Illawarra Coal
DENDROBIUM MINE
Offset Property -
Validated Vegetation Mapping

Figure 6-10B

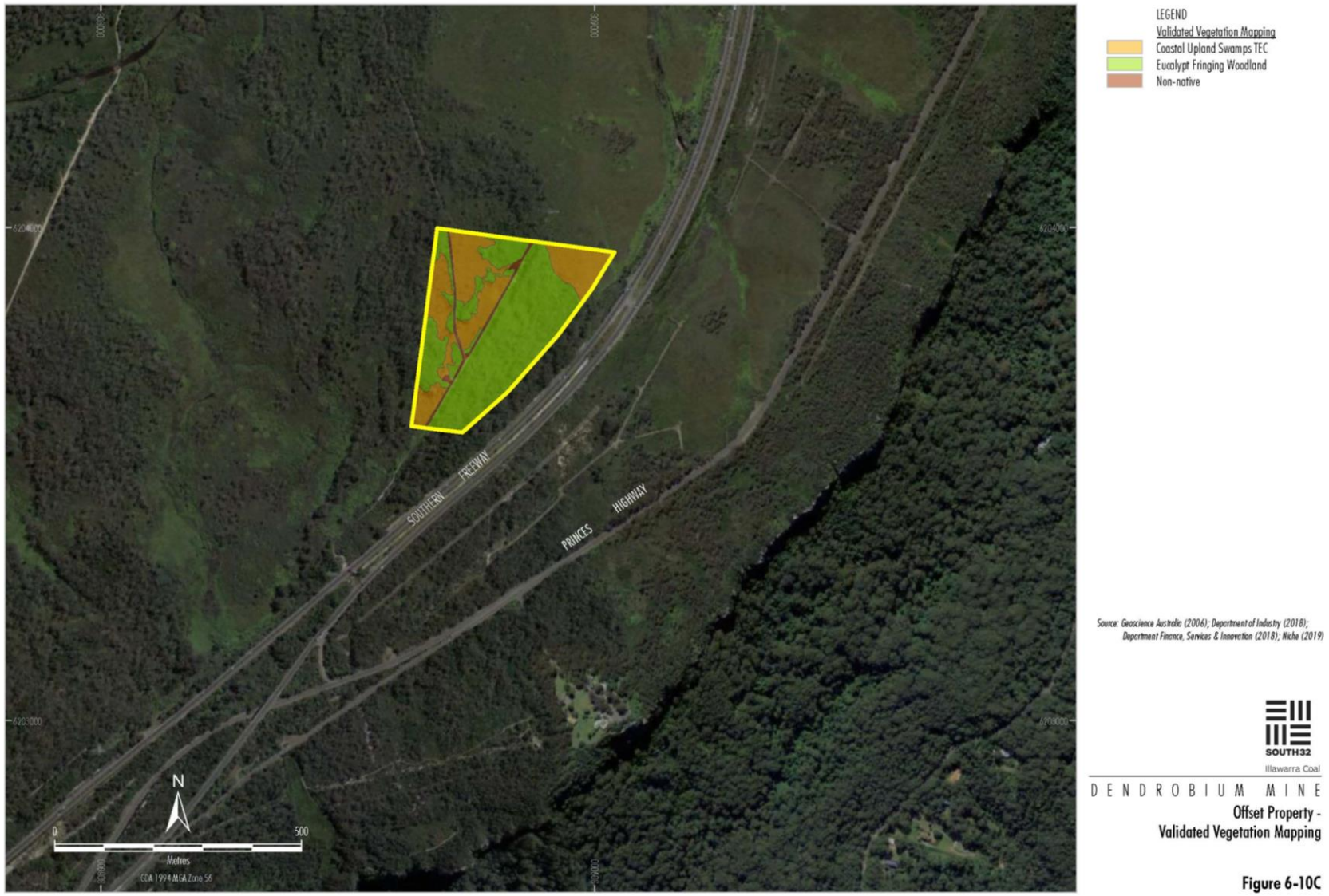

LEGEND
Validated Vegetation Mapping
Coastal Upland Swamps TEC
Eucalypt Fringing Woodland
Non-native
SOUTHERN FREEWAY
PRINCES HIGHWAY
N
0
500
Metres
GDA 1994 MGA Zone 56
Source: Geoscience Australia (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018); Niche (2019)
SOUTH32
Illawarra Coal
DENDROBIUM MINE
Offset Property -
Validated Vegetation Mapping

Figure 6-10C

NSW Offset Liability

Initial calculations undertaken for the Offset Property using the NSW BioBanking calculator have determined approximate credits available to address the Project offset liability.

The Offset Property addresses:

- more than 90% of the NSW Offset Liability for Upland Swamp TECs (i.e. 289 credits of 305 credits required); and
- a portion of the required credits for amphibian species:
  - Giant Burrowing Frog – 364 credits (426 credits required).
  - Littlejohn's Tree Frog – 364 credits (851 credits required).

Commonwealth Offset Liability

The Project is assessed under a Bilateral Agreement and biodiversity offset requirements for Matters of National Environmental Significance were determined using the NSW Offsetting Policy and associated FBA. Notwithstanding, approval of the Project Biodiversity Offset Strategy will be required under both the EP&A Act and the EPBC Act.

Key considerations of the Commonwealth *Environment Protection and Biodiversity Conservation Act Environmental Offsets Policy* (DSEWPAC, 2012) (Commonwealth Offsetting Policy) have been addressed in the Project Biodiversity Offset Strategy including the requirement for 90% direct offset and 10% indirect offset through compensatory methods.

The EPBC Calculator was applied to quantify the contribution of the Offset Property to the Commonwealth Offset Liability for Upland Swamps. Assuming a swamp impact quality of 10 (which is the maximum input available) and a conservative total loss scenario, the Offset Property addresses approximately 89.6% of the direct offset requirement for Upland Swamps.

As demonstrated by monitoring, Upland Swamp vegetation transitions to a drier vegetation type following undermining (Section 6.9.3). Therefore, a partial impact scenario is considered to be more likely to occur for Upland Swamps within Areas 5 and 6. Under a partial impact scenario, the Offset Property would provide direct offsets for Upland Swamps in excess of those required (i.e. greater than 89.6%).

On this basis the DoEE can be confident that the Offset Property provides more than 90% of the Commonwealth direct offset required for Upland Swamp TECs.

Since lodgement of the EIS, South32 has finalised purchase of freehold land ('the Offset Property') which predominately comprises mapped upland swamp vegetation communities.

It is expected the Offset Property will provide greater than 90% of the State and Federal offset liability for upland swamps.

2. Other direct offset measures.

South32 is investigating additional direct offset measures to compensate for any potential shortfall of the NSW and Commonwealth offset liability for Upland Swamps and threatened amphibian species.

South32 has discussed potential management actions with the NSW National Parks and Wildlife Service (NPWS), who identified a number of potential rehabilitation and remediation projects that could be implemented within the Dharawal Reserves to improve biodiversity outcomes, including:

- rehabilitation of previously cleared/degraded portions of Upland Swamps;
- closure of existing tracks that dissect Upland Swamps;

- upgrade/installation of gates and fencing to prevent unlawful access; and
- weed and pest management programs.

These potential projects are discussed in further detail in Table 6-10A. Identification of potential rehabilitation and remediation measures considered actions to address the "Priority Conservation Actions" listed in the *Conservation Advice (including listing advice) for Coastal Upland Swamps in the Sydney Basin Bioregion* (Commonwealth Department of the Environment [DoE], 2014).

The identification of potential rehabilitation and remediation projects also considered relevant Key Threatening Processes identified for the Giant Burrowing Frog and Littlejohn's Tree Frog within *The Vertebrate Fauna of Dharawal State Conservation Area, Dharawal Nature Reserve and Adjacent Lands* (Department of Environment and Climate Change, 2007), including:

- infection of frogs by amphibian Chytrid Fungus causing the disease chytridomycosis;
- herbivory and environmental degradation caused by Feral Deer;
- predation by Plague Minnow (*Gambusia holbrooki*); and
- alteration of the natural flow regimes of rivers, streams, floodplains and wetlands.

The Blue Mountains City Council, Lithgow City Council, Gosford City Council and Wingecarribee Shire Council have instigated a coordinated effort to develop locally responsive soft engineering swamp rehabilitation and rehydration techniques to restore natural swamp hydrology within their respective LGAs (referred to as the 'Save Our Swamps' [SOS] program).

The outcome of the SOS program was the development of a *Soft engineering solutions for swamp remediation – A "how-to" guide* (NSW Environmental Trust, 2010) which considered successful rehabilitation and remediation works implemented in swamps in the Blue Mountains and Lithgow LGAs. Plates 6-10A to 6-10F show the outcomes of remediation works implemented at two of these swamps.

The case studies that informed the NSW Environmental Trust (2010) swamp remediation guide demonstrate that implementation of suitable remediation and rehabilitation measures in Upland Swamps within the Dharawal Reserves, in coordination with NPWS, would provide a material increase in quality of the swamps and contribute to the direct offset requirement for the Project.

South32 would continue to consult with NPWS throughout the Project assessment and determination process. If residual Upland Swamp and threatened amphibian species offsets are required, rehabilitation and remediation projects within the Dharawal Reserves would be incorporated in the Project Biodiversity Offset Strategy.

Note that funding and/or implementation of management actions identified by NPWS would be in addition to any existing management and remediation activities within the Dharawal Reserves.

Table 6-10A
Potential Direct Offset Measures – Dharawal Reserves

Proposed Management Action	Impact Mechanism	Outcome of Proposed Management Action	
		Coastal Upland Swamps	Giant Burrowing Frog and Littlejohn's Tree Frog
1. Rehabilitation of previously cleared/degraded portions of Upland Swamps	A number of areas within or adjacent to Upland Swamps in the Dharawal Reserves have existing damage from bike tracks, vehicle access, trails and infrastructure. Rehabilitation of these areas is not proposed by NPWS due to limited availability of funding.	• Prevent further degradation and potential development of edge effects, 'knick points' and associated scouring and erosion. • Increase the total area of Upland Swamps. • Restore natural hydrology within and also downstream of Upland Swamps. • Increase native flora diversity and cover within Upland Swamps.	• Increase total area and enhance quality of habitat within Upland Swamps. • Increased connectivity of habitat.
2. Closure of existing tracks that dissect Upland Swamps	A number of existing tracks within the Dharawal Reserves dissect Upland Swamps. Some of these tracks have previously been unsuccessfully rehabilitated due to ongoing access. Closure and rehabilitation of these tracks is not proposed by NPWS due to limited availability of funding.	• Prevent further degradation and potential development of edge effects, 'knick points' and associated scouring and erosion. • Increase the total area of Upland Swamps. • Restore natural hydrology within and also downstream of Upland Swamps. • Increase native flora diversity and cover within Upland Swamps. Prevent further spread of weed species, including *Phytophthora cinnamomi*.	• Increase total area and enhance quality of habitat within Upland Swamps. • Increased connectivity of habitat. • Reduce risk of unlawful access and further degradation of habitat. • Track closure would assist in preventing further spread of Chytrid Fungus throughout the Dharawal Reserves. Infection of frog species resulting from Chytrid Fungus is a Key Threatening Process for threatened amphibian species, particularly the Giant Burrowing Frog and Littlejohn's Tree Frog.
3. Upgrades/installation of gates and fencing to prevent unlawful access into the Dharawal Reserves	Existing gates and fencing within the Dharawal Reserves are not adequate to prevent unlawful access by dirt bikes and vehicles. This access has resulted in use of closed tracks and disturbance of rehabilitation areas. Update of existing gates and fencing, as well as repair of any damage, is not proposed by NPWS due to limited availability of funding.	• Prevent further unlawful access and associated Upland Swamp degradation. • Prevent spread of *Phytophora cinnamomi* to uninfected Upland Swamps.	• Prevent further unlawful access and associated habitat degradation and loss. • Track closure would assist in preventing further spread of Chytrid Fungus throughout the Dharawal Reserves.

Table 6-10A (continued)
Potential Direct Offset Measures – Dharawal Reserves

Proposed Management Action	Impact Mechanism	Outcome of Proposed Management Action	
		Coastal Upland Swamps	Giant Burrowing Frog and Littlejohn's Tree Frog
4. Funding and implementation of a pest management control program	Key pests within the Dharawal Reserves include feral deer, goats, rabbits and foxes. Without effective control, pests would continue to degrade Upland Swamps and associated threatened species habitat. Currently, effective pest control is not undertaken due to limited availability of funding.	• Prevent further degradation and potential development of edge effects, 'knick points' and associated scouring and erosion. • Prevent spread of *Phytophora cinnamomi* to uninfected Upland Swamps.	• Reduce risk of further degradation of habitat. • Increase total area and enhance quality of habitat within Upland Swamps.
5. Weed management control within Upland Swamps and adjacent vegetation	Weed control measures implemented in the Dharawal Reserves are limited due to NPWS funding. No widespread or large-scale weed control has taken place to date. Weeds occurring within Upland Swamps and adjacent areas include: Whisky Grass (*Andropogon virginicus*), Pampas Grass (*Cortaderia selloana*) and African Love Grass (*Eragrostis curvula*).	• Increase native flora diversity and cover. • Prevent change in soil dynamics, unnatural moisture and nutrient competition. • Prevent further degradation and reduce risk of edge effects due to increase in weed cover.	• Reduce risk of further degradation of habitat. • Prevents the loss of necessary native flora assemblages for the species to persist. • Enhances potential habitat for the species. • Reduces competition from amphibian populations which can withstand weed dominated areas.

Plate 6-10A – Braeside Swamp (Blue Mountains LGA) – during installation of rehabilitation.
Source: NSW Environmental Trust (2010).

Plate 6-10B – Braeside Swamp (Blue Mountains LGA) – 6 months after installation of rehabilitation.
Source: NSW Environmental Trust (2010)

Plate 6-10C – Braeside Swamp (Blue Mountains LGA) – 12 months after installation of rehabilitation.
Source: NSW Environmental Trust (2010)

These photos show examples of successful swamp remediation projects in the Blue Mountains and Lithgow LGAs.

South32 is investigating options to implement similar projects in the Dharawal Reserves to improve biodiversity outcomes for upland swamps and associated threatened amphibian habitat.

Plate 6-10D – Happy Valley Swamp (Lithgow LGA) – before installation of rehabilitation.
Source: NSW Environmental Trust (2010)

Plate 6-10E – Happy Valley Swamp (Lithgow LGA) – during installation of rehabilitation.
Source: NSW Environmental Trust (2010)

Plate 6-10F – Happy Valley Swamp (Lithgow LGA) – following installation of rehabilitation.
Source: NSW Environmental Trust (2010)

3. Supplementary offset measures.

South32 is also investigating indirect offset measures to compensate for any potential shortfall of the NSW and Commonwealth offset liability for Upland Swamps and threatened amphibian species.

South32 has discussed potential management actions with the NPWS, who identified a number of potential research projects that could be implemented within the Dharawal Reserves, including investigation of Chytrid Fungus, the Plague Minnow (*Gambusia holbrooki*) and *Phytophthora cinnamomi*.

Chytrid Fungus

Chytrid Fungus is known to occur within the Dharawal Reserves, however the full extent of the distribution of the species and severity of its presence on the longevity of threatened amphibian populations is not well understood due to limited survey and recording to date.

NPWS identified that an investigation could be undertaken to identify impacted Upland Swamps, clarify the extent of the species in the Reserves generally and inform the development of appropriate management actions for Upland Swamps (e.g. closure of tracks and access restrictions) to minimise the impact to threatened amphibian populations.

Plague Minnow

The Plague Minnow and its effects on threatened amphibian populations within the Dharawal Reserves, including the Giant Burrowing Frog and Littlejohn's Tree Frog, are well documented.

NPWS identified that a research investigation could be undertaken to understand the distribution of the species and severity of its presence on the longevity of threatened amphibian populations. This investigation would inform reporting of the extent of the spread of the species within the Reserves and inform development of appropriate management actions specific to Giant Burrowing Frog and Littlejohn's Tree Frog populations (e.g. Plague Minnow-free habitat, removal of Plague Minnow in key amphibian habitats).

Phytophthora cinnamomi

Phytophthora cinnamomi has contributed to Upland Swamp vegetation die-back and associated reduction of threatened amphibian habitat within the Dharawal Reserves.

NPWS identified that a research investigation could be undertaken to further understand the potential interactions of the species with threatened amphibians and development of effective mitigation and management actions to prevent further spread of the species. The outcomes of this investigation would inform the implementation of rehabilitation and remediation measures for Upland Swamps outlined above (e.g. closure of trails, access restrictions to infected areas) to address the "Objectives" of the *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (DoEE, 2018).

4. Maddens Plains Strategic Offset.

To account for predicted offset requirements for Upland Swamps within Dendrobium Mine Areas 3A and 3B and at the Bulli Seam Operations, South32 established a Strategic Biodiversity Offset at Maddens Plains.

The Strategic Biodiversity Offset at Maddens Plains contains biodiversity values in excess of the offset requirements of Areas 3A and 3B and at the Bulli Seams Operations. As permitted by the Strategic Biodiversity Offset, the excess biodiversity values are available for future South32 projects.

DPIE-BCD, in their submission on the Project, identified that there are no remaining credits available to offset impacts to Upland Swamps at the Strategic Biodiversity Offset Site at Maddens Plains. Satisfying the Project Upland Swamp offset liability via generation of Upland Swamp credits using the Maddens Plains Offset Site is not proposed in the Project Biodiversity Offset Strategy, with the exception of the relinquishment of areas of Upland Swamp approved to be impacted (and already offset by Maddens Plains) in Area 3 and associated reduction in Project offset liability.

Biodiversity offsets for the Giant Burrowing Frog and Littlejohn's Tree Frog were not required under the Dendrobium Mine Areas 3A and 3B and Bulli Seam Operations Approvals, however they are required for the Project.

South32 will continue to discuss the contribution of the Maddens Plains Offset Site to the Project Biodiversity Offset Strategy with DPIE-BCD and the DoEE for threatened amphibian species credits.

5. Biodiversity Offset Strategy reconciliation.

The proposed Biodiversity Offset Strategy for the Project has been prepared in consideration of the Project SEARs, the NSW Offset Policy (and supporting FBA), the Swamp Offset Policy and the Commonwealth Offset Policy.

The following options are available to South32 to address the NSW and Commonwealth offset liability:

1. Retirement of FBA credits through existing South32 BioBank sites, including Appin West, Douglas Park and Cataract River BioBank Sites.
2. Establishment of Stewardship sites on the recently purchased Offset Property.
3. Establishment of Stewardship sites on other South32 landholdings.
4. Use of residual offset values at Maddens Plains Offset Site.
5. Other direct offset options, such as implementation of Upland Swamp rehabilitation and remediation measures within the Dharawal Reserves.
6. Payment into the Biodiversity Conservation Trust (BCT) Payment Fund (specific to the NSW offset liability).
7. Other supplementary measures, including research programs for the Dharawal Reserves.

Table 6-10B provides a summary of the credit requirements and proposed offset strategies. The offset strategies are described in detail in Section 6.9.6 of the Project EIS and also above where strategies have been augmented since submission of the EIS.

Given the options presented, it is expected South32 will be able to satisfy the Project's offset liability.

Table 6-10B
Offset Requirements and Strategy Options

Threatened Entity	Area (ha)	Credits Required	Offsetting Options							NSW Offset Liability Met?	Commonwealth Offset Liability Met?
			Retirement of FBA Credits from Existing BioBank Sites	Establishment of Stewardship Site – Recently Purchased Offset Property	Establishment of Stewardship Site – Other South32 Landholding	Maddens Plains	Other Direct Measures – Swamp Rehabilitation and Remediation Projects	Other Supplementary Measures – Research Projects	Payment into the BCT Fund		
Ecosystem Credits											
HN556	25.8	1,022	✓	-	-	-	-	-	✓	**Yes**	**N/A**
HN566	1.5	120	-	-	✓	-	-	-	✓	**Yes**	**N/A**
HN651	1.0	80	-	-	✓	-	-	-	✓	**Yes**	**N/A**
ME044	0.2	6	-	-	✓	-	-	-	✓	**Yes**	**N/A**
HN560 / HN662 (Coastal Upland Swamp TECs)	20.9	305	-	✓	-	-	✓	✓	✓ NSW only	**Yes**	**Yes**
Species Credits											
Koala	1.50	39	✓	-	-	-	-	-	✓	**Yes**	**N/A**
Littlejohn's Tree Frog	32.7	851	-	✓	✓	✓	✓	✓	✓ NSW only	**Yes**	**Yes**
Broad-headed Snake	0.3	9	-	-	✓	-	-	-	✓	**Yes**	**N/A**
Giant Burrowing Frog	32.7	426	-	✓	✓	✓	✓	✓	✓ NSW only	**Yes**	**Yes**
Red-crowned Toadlet	7.2	94	-	-	✓	✓	-	-	✓	**Yes**	**N/A**
Giant Dragonfly	13.9	1,073	-	-	-	-	-	-	✓	**Yes**	**N/A**

6.11 ABORIGINAL HERITAGE

6.11.1 Submissions

Public and Organisation Submissions

Comments made in public and organisation submissions relevant to Aboriginal cultural heritage included:

- Adequacy of Aboriginal cultural heritage survey extent.
- Adequacy of significance assessment.
- Consideration of cumulative impacts in regard to previous subsidence impacts to Aboriginal heritage sites at the Dendrobium Mine and the wider region.
- Potential impacts on Aboriginal cultural values, identity and connection to land.
- Consideration of the Burra Charter and United Nations Declaration of Rights of Indigenous Peoples.
- Implementation of avoidance measures or consideration of alternative mine designs.
- Proposed compensation for impacts to Aboriginal cultural heritage sites and values.
- Proposed Aboriginal cultural heritage monitoring and management measures.
- Ongoing engagement with the Aboriginal community and access to Aboriginal heritage sites.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to Aboriginal cultural heritage included DPIE-BCD and the Wollongong City Council. These comments included:

- Justification of significance assessment methodology.
- Further analysis of cumulative impacts to Aboriginal heritage sites.
- Justification of proposed impacts to Aboriginal heritage sites of moderate to high significance.
- Clarification of proposed monitoring of Aboriginal heritage sites and request for preparation of an Aboriginal Heritage Management Plan (AHMP).
- Clarification of ongoing Aboriginal community consultation and access arrangements to the Project area.

6.11.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Aboriginal Cultural Heritage Assessment – clarification of:
    a. Survey extent.
    b. Assessment of cultural values.
    c. Significance assessment.
2. Potential impacts to Aboriginal cultural heritage sites.
    a. Surface infrastructure.
    b. Underground mining area.
    c. Cumulative impact assessment.
3. Proposed Aboriginal cultural heritage monitoring and management measures, including ongoing engagement.

6.11.3 Responses

1. Aboriginal Cultural Heritage Assessment – clarification of:

a. Survey extent.

Figure 11 of the Project Aboriginal Cultural Heritage Assessment (ACHA) (reproduced below in Figure 6-11A) depicts the survey coverage across the investigation areas.

For the purposes of the field surveys and impact assessment undertaken for the Project ACHA, the Project area was divided as follows:

- Underground Investigation Area - Area 5 and Area 6 underground mining areas (encompassing the 600 m boundary from proposed longwalls).
- Surface Infrastructure Investigation Area - proposed Ventilation Shaft Site Nos 5A, 5B, 6A and 6B, and the Dendrobium Pit Top Carpark Extension.

Surveys undertaken within the investigation areas were informed by the predictive model and designed in consultation with the Registered Aboriginal Parties (RAPs) as part of the Proposed Methodology, consistent with relevant guidelines. A search of the Aboriginal Heritage Information Management System (AHIMS) was also undertaken to identify known Aboriginal heritage records.

The predictive model developed for the Project area included consideration of the following:

- previous archaeological surveys and assessments in the local area and wider surrounds;
- the distribution and patterning of known sites within the Project area and surrounds;
- the landform units and landscape context of the Project area; and
- the previous known land uses in the area.

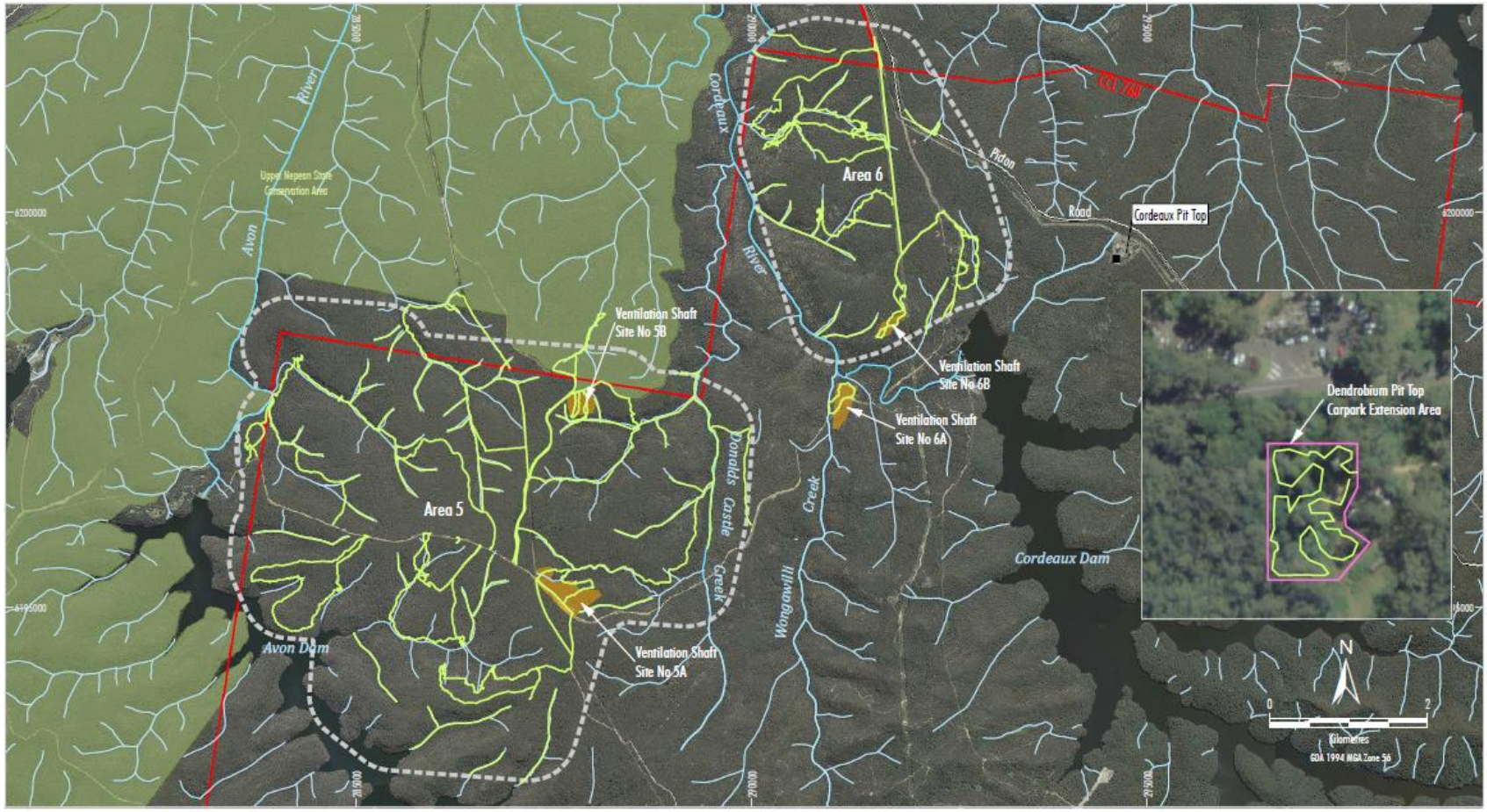
The entire surface infrastructure investigation area was subject to systematic survey (Figure 6-11A). Given the size of the underground investigation area, surveys focused on those areas which would likely be more susceptible to subsidence-related effects, such as creek lines and steep slopes, as well as areas that were predicted to contain obtrusive site types which are more likely to be susceptible to subsidence impacts (e.g. grinding grooves and sandstone shelters). Surveys also targeted known Aboriginal heritage sites within the investigation areas.

The survey coverage achieved in the investigation areas reflect the focused survey intensity outlined above. It was considered that the survey coverage was adequate for the purposes of the Project ACHA and nature of predicted impacts.

b. Assessment of cultural values.

Consultation for the Project ACHA (Appendix F of the EIS) was undertaken in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (Department of Environment, Climate Change and Water, 2010) and Clause 80C of the NSW *National Parks and Wildlife Regulation, 2009* (now superseded by Clause 60 of the NSW *National Parks and Wildlife Regulation, 2019*), and involved a notification and registration process to identify RAPs.

Consultation with RAPs regarding the Dendrobium Mine and the Project has been extensive and involved various methods including public notices, on-site meetings, written and verbal correspondence, archaeological survey attendance and on-site inspections.


Upper Nepean State Conservation Area
Avon River
Cordeaux River
Area 6
Area 5
Piton Road
Cordeaux Pit Top
Ventilation Shaft Site No 5B
Ventilation Shaft Site No 6B
Ventilation Shaft Site No 6A
Ventilation Shaft Site No 5A
Donalds Castle Creek
Wongawilli Creek
Avon Dam
Cordeaux Dam
Dendrobium Pit Top Carpark Extension Area
N
0
2
Kilometres
GDA 1994 MGA Zone 56
LEGEND
Dendrobium Mining Lease
Road
National Park, Nature Reserve and State Conservation Area
Proposed Ventilation Shaft Site
Survey Effort
Streams
Study Area Based on 600 m Boundary
Source: Geoscience Australia (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018);
DENDROBIUM MINE
Survey Extent of Aboriginal Cultural Heritage Assessment
Figure 6-11A

During the surveys and site inspections, the RAPs (and their representatives) were asked to identify any areas of cultural significance within the Project area and surrounds, or any cultural values relevant to the area. All cultural comments relating to the Project area and/or the wider region were recorded and also included in the Project ACHA (Appendix F of the EIS).

A number of Aboriginal heritage assessments have been undertaken in the Project area over the past 29 years, including assessment undertaken at the Dendrobium Mine. Outcomes of cultural value assessments from these previous assessments have been considered in the Project ACHA.

c. Significance assessment.

The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS, 2013) (The Burra Charter) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (Office of Environment and Heritage, 2011) provide definitions of Aboriginal heritage significance which were applied to the significance assessment undertaken for the Aboriginal cultural heritage sites identified within the Project area (Section 11 of Appendix F of the EIS).

The archaeological significance of the 58 known Aboriginal heritage sites identified during surveys for the Project ACHA is summarised as follows:

- 49 were assessed as being low scientific significance;
- 3 were assessed as being of moderate scientific significance; and
- 6 were assessed as being of high scientific significance.

A statement of significance was prepared for each Aboriginal cultural heritage site identified within the Project Area (Table 16 of Appendix F of the EIS), as well as for the Project area as a whole, which described the application of the definitions of Aboriginal cultural heritage significance.

Assessment of the cultural heritage significance of the Aboriginal cultural heritage sites considered comments received from the RAPs throughout the consultation process (Appendix F of the EIS). It is noted that the RAPs identified that all Aboriginal heritage sites have cultural significance.

2. Potential impacts to Aboriginal cultural heritage sites.

The potential impacts of the Project have been assessed in consideration of comments made by RAPs throughout the consultation process completed as part of the Project ACHA.

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) requires that both direct (i.e. an activity physically impacts an object or place) and indirect (i.e. secondary consequences to an object or place, stemming from an activity) harm to Aboriginal objects and places be assessed for potential impacts.

a. Surface infrastructure.

The proposed surface infrastructure for the Project has been designed to avoid identified sandstone shelters, axe grinding grooves and other natural landscape features (Table 6-15 of Section 6 of the EIS).

Of the 58 Aboriginal cultural heritage sites identified within the study area (52 of which were previously recorded, and six of which were newly recorded), only one site (newly recorded site Dendrobium AGG-1 [AHIMS ID #52-2-4468]) was located in close proximity to Ventilation Shaft Site No 5B. Despite the close proximity of the site to proposed surface infrastructure, this site would not be directly disturbed.

The location and design of ancillary infrastructure (e.g. access tracks, Project power and/or water supply infrastructure) required progressively over the life of the Project is flexible and would be located to avoid Aboriginal cultural heritage sites as far as practicable.

b. Underground mining area.

Table 22 of the ACHA (Appendix F of the EIS) provides a summary of the potential subsidence impacts of the Project on Aboriginal cultural heritage sites based on the maximum predicted subsidence movement determined by MSEC (2019).

DPIE-BCD, in their submission on the Project EIS, requested that South32 considers alternative mine designs to avoid or limit harm to specific Aboriginal heritage sites, namely AHIMS ID #52-2-1752, 52-2-1782, 52-2-1779, 52-2-1780, 52-2-1456 and 52-2-1466 (note that a figure has not been provided on the basis of comments received from RAPs during the ACHA consultation period requesting the location of Aboriginal heritage sites are not provided to the public).

It is not considered reasonable to avoid undermining all Aboriginal heritage sites within Area 5 and Area 6.

Previous experience of underground mining in the Southern Coalfields and associated monitoring has shown that approximately 11% of 206 rock-based sites predicted to experience subsidence-induced ground movements have shown structural changes that can be attributed to subsidence (e.g. block fall, exfoliation, cracking) (Regal and Reeves, 2017). Note that a structural change due to subsidence does not necessarily contribute to an adverse consequence to the heritage values of the site.

Sixty-one of the 206 sites monitored within the Southern Coalfield are within the existing Dendrobium Mine areas and were predicted to experience subsidence-induced ground movements of the same or greater magnitude than currently predicted for sites within Area 5 and Area 6.

To date, only three of the 61 undermined sites, all sandstone shelters with art, have been impacted as a result of subsidence movements within the Dendrobium Mine areas:

- Dendrobium 4 (AHIMS ID #52-2-2252).
- Browns Road Site 11 (AHIMS #52-2-1626).
- Site 1 – DB1 (AHIMS #52-2-2229).

These impacts are not classified as an ‘adverse consequence to heritage values’ (as defined by the relevant TARP) as the subsidence movements did not affect the art located within the shelters.

Notwithstanding the above, the ACHA described that all of the 58 recorded Aboriginal cultural heritage sites have some potential to be impacted by predicted subsidence movements due to their location on the surface relative to the proposed underground mining area. The draft ACHA, which outlined the predicted impacts to Aboriginal cultural heritage and recommended management measures, was provided to RAPs for consultation.

c. Cumulative impact assessment.

Consideration of potential cumulative impacts on Aboriginal cultural heritage in the wider region (i.e. Southern Coalfield) and local area associated with the Project was undertaken and is presented in Section 12.5 of the ACHA (Appendix F of the EIS).

The Project would result in a minor increase to cumulative potential impacts to Aboriginal cultural heritage of the region, noting that Aboriginal heritage items in the area have had a limited impact due to restrictions to access associated with the Metropolitan Special Area.

As described above, of the 61 rock-based Aboriginal cultural heritage sites that have been subject to subsidence-related movements due to the Dendrobium Mine, only three have been impacted. However, these impacts are not classified as an ‘adverse consequence to heritage values’ (as defined by the relevant TARP).

The Aboriginal cultural heritage sites identified for the Project would be monitored as part of the Project and Dendrobium Mine operations, and become part of the wider list of sites monitored within the Southern Coalfield.

3. Proposed Aboriginal cultural heritage monitoring and management measures, including ongoing engagement.

Aboriginal cultural heritage sites identified in the Project area would be managed in accordance with the recommendations of the ACHA (Appendix F of the EIS), which were prepared in consultation with the RAPs.

South32 will prepare an AHMP for the Project, incorporating the recommended management measures in Section 13 of the ACHA (Appendix F of the EIS). The AHMP would be developed prior to any Project-related works that would potentially harm Aboriginal cultural heritage sites.

Monitoring of potential impacts to Aboriginal cultural heritage sites would be conducted prior to and following subsidence from longwall mining. The details of the subsidence monitoring program would be outlined in the AHMP and detailed in Extraction Plans for the Project, including site specific TARPs.

Consistent with the recommendations of the Project ACHA, the subsidence monitoring program would include 43 grinding groove and sandstone shelter site types identified within the 35º angle of draw for the Project. Grinding groove and sandstone shelter sites located outside the 35º angle of draw and other Aboriginal heritage site types such as isolated artefacts (which includes the remaining 15 of 58 sites identified in the Project area) are unlikely to experience direct or indirect impacts as a result of longwall mining (Niche, 2019b; MSEC, 2019) and therefore would not be monitored.

Ongoing consultation would be undertaken with the RAPs over the life of the Project, including Aboriginal representation during archaeological fieldwork (e.g. assessment of proposed ancillary infrastructure). The AHMP would include a protocol to allow for Aboriginal community access to Aboriginal cultural heritage sites (e.g. for cultural reasons, or, as part of scheduled field activities), noting that access to the Project area is also subject to the requirements of WaterNSW as it is located within the Metropolitan Special Area.

The RAPs and DPIE-BCD would be given the opportunity to provide comments on the draft AHMP prior to submission to DPIE for approval.

6.12 GEOLOGY

6.12.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to geology included:

- Clarification of the assessment of risks associated with geological features.
- Potential increased impacts to the Avon and Cordeaux dam walls due to geological features.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to geology included WaterNSW, DSC and Wollondilly Shire Council. These comments included:

- Clarification of the extent of geological structures.
- Further description of how geological features have been considered in the Subsidence Assessment with respect to potential impacts to the Avon and Cordeaux dam walls.

6.12.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Consideration of geological features in the EIS.
2. Consideration of geological features on subsidence predictions at the Avon and Cordeaux dam walls.
3. Ongoing monitoring and investigation of geological features.

6.12.3 Responses

1. Consideration of geological features in the EIS.

Geological structures have been considered during various stages of the preparation of the Project EIS, including:

- Environmental Risk Assessment;
- Subsidence Assessment (MSEC, 2019); and
- Geological Structures Review (PSM, 2019).

Surface and underground geological structures were initially considered in the Environmental Risk Assessment conducted as part of the Project (Appendix M of the EIS), which identified the requirement for ongoing monitoring and mapping of geological structures throughout the Project area as mining progresses.

Details of the identification and inspection of surface and underground geological features within the vicinity of Area 5 and Area 6 of the Project are described in the Geological Structures Review prepared by PSM (Appendix P of the EIS).

The Geological Structures Review for the Project was informed by analysis of previous borehole investigations conducted by South32, as well as additional borehole investigations conducted by PSM for the Project, to identify and infer underground geological structures within Area 5 and Area 6 of the Project (Figure 6-12A).

The Subsidence Assessment (Appendix A of the EIS) includes a description of geological features (including faults, lineaments, joints and igneous intrusions) within the vicinity of Area 5 and Area 6 relevant to the assessment of potential subsidence effects and the effect of geological features, and commentary on how these have been considered in the assessment of subsidence impacts.

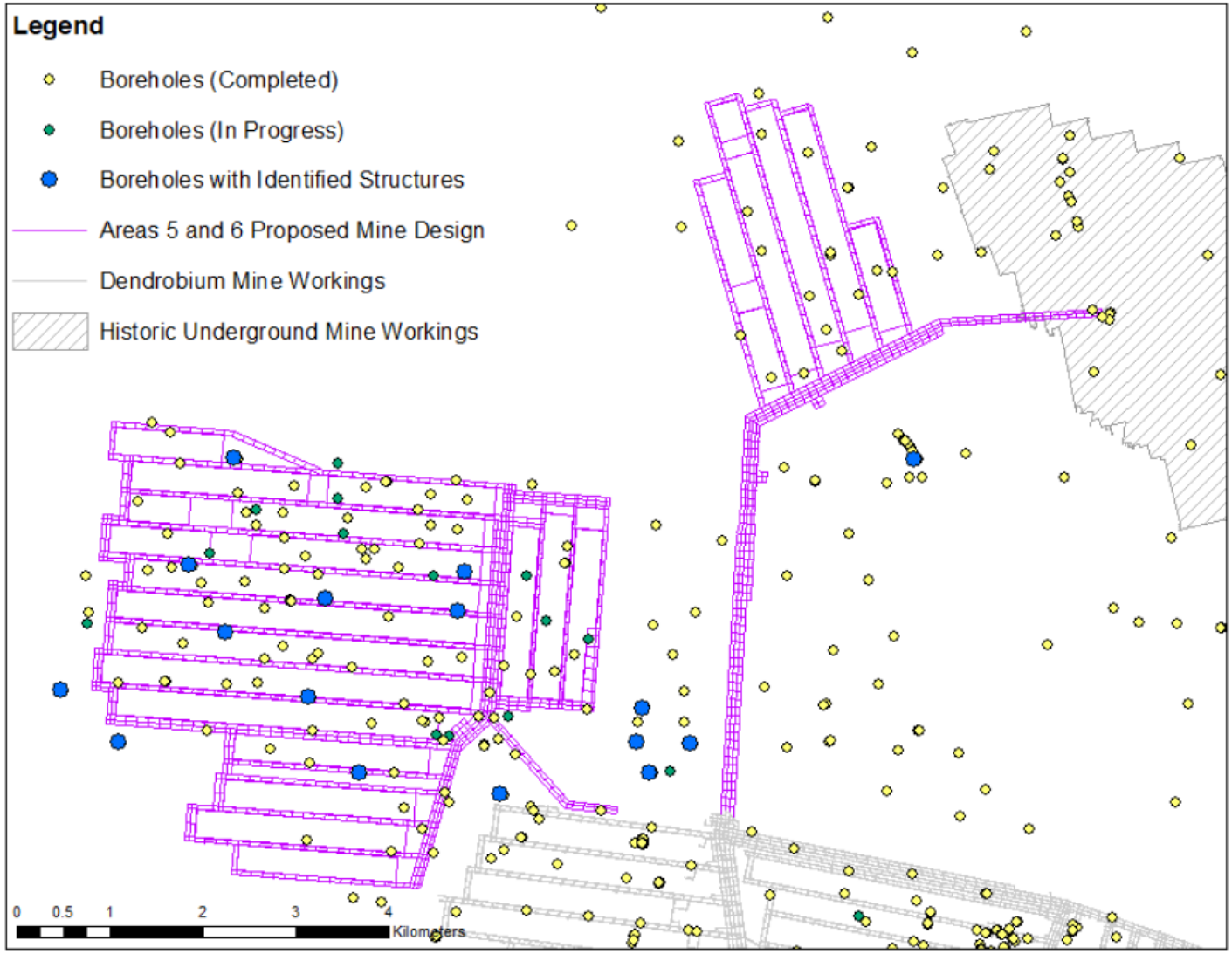


Figure 6-12A: Investigation Boreholes and Mapping Boreholes that Identify a Geological Structure

2. Consideration of geological features on Avon and Cordeaux dam walls.

The Geological Structures Review (Appendix P of the EIS) concluded that there is no strong evidence suggesting there are geological structures persistent from seam to surface which would be affected by underground mining in Area 5 and Area 6 of the Project.

The Subsidence Assessment (Appendix A of the EIS) describes the potential subsidence impacts to the Avon and Cordeaux dam walls. South32 has incorporated setbacks to the Project mine design to minimise potential subsidence-related impacts to Avon and Cordeaux dam walls, where Project longwalls are setback from the Avon and Cordeaux dam walls by a minimum distance of 1,000 m. As a result of these setbacks, the potential subsidence effects on the dam walls due to geological structures is also reduced.

Geological structures identified in Area 5 and Area 6 are unlikely to affect subsidence predictions for these mining areas (MSEC, 2019).

This is supported by evidence from Dendrobium Mine Area 3B, where the effects of lineaments and geological structures on the measured subsidence effects were reviewed based on the ground monitoring data from Area 3B (MSEC, 2019).

It was identified that there was no apparent increase in subsidence and closure movements measured at the locations where mapped lineaments and geological structures were present, when compared with the predictions and measurements at locations where these mapped features were not present (MSEC, 2019).

The geological structures mapped above Area 5 and Area 6 are of a similar nature to those mapped in Area 3B, and therefore, it is unlikely that these structures would affect the subsidence predictions for the Project (MSEC, 2019).

South32 would continue to refine the identification of geological structures based on the ongoing investigations at the Dendrobium Mine and during the development of first workings for the Project. The Project longwall layout would be reviewed based on the progressive update to the geological information available and, if required, will be modified to avoid the major geological features during the preparation of the Extraction Plans for the Project.

As described in Section 6.6, South32 would develop a monitoring and adaptive management approach for the management of potential subsidence movements at the Avon and Cordeaux dam walls, which would involve the monitoring of potential subsidence movements as the longwalls are extracted.

3. Ongoing monitoring and investigation of geological features.

Geological assessment within Area 5 and Area 6 and their surrounds will continue to be undertaken for the Dendrobium Mine as part of the Extraction Plan process.

In particular, exploratory surface to in-seam drilling is used to collect information on the character of geological features. In-seam drilling is undertaken as part of the development of roadways, and therefore, approval of the Project is a prerequisite for the collection of this data for Area 5 and Area 6.

6.13 GROUNDWATER

6.13.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to groundwater included:

- Accuracy of groundwater modelling and assumptions.
- Groundwater drawdown at privately-owned bores.
- Potential impacts to groundwater quality.
- Potential impacts to Groundwater Dependent Ecosystems (GDEs).
- Loss of groundwater to mine workings (including cumulative impact considerations) and groundwater recharge.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to groundwater included DSC, Wollondilly Shire Council, DPIE – Land & Water and Department of Primary Industries. These comments included:

- Accuracy of groundwater modelling and predictions (including confidence in parameter selection and sensitivity).
- Justification of groundwater model scale and resolution to adequately predict potential impacts on large features (particularly dams and streams).
- Groundwater model calibration to mine inflows.
- Justification of additional losses from Avon Reservoir.
- Consideration of potential impacts of surface cracking and near-surface ground movement in the groundwater model.
- Consideration of potential impacts to GDEs.
- Consideration of predicted drawdown and long-term recovery of groundwater levels.
- Clarification of the locations of all monitoring bores that contributed to the groundwater model.
- Consideration of changes in the hydraulic properties due to mining-induced ground movements in the groundwater model.
- Clarification of inconsistencies between the stratigraphic and modelled typical thickness of strata, notably for the Bulgo Sandstone and the Wongawilli Seam in the groundwater model.
- Clarification of groundwater entitlements for the Project.
- Consideration of groundwater and interconnected surface water in the groundwater model.

6.13.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Groundwater model development.
    a. Consideration of changes in hydraulic properties due to mining effects.
    b. Clarification of monitoring bore network.
    c. Clarification of stratigraphic and modelled thickness of strata.
2. Potential groundwater impacts.
    a. Clarification of impacts to privately-owned bores.
    b. Groundwater drawdown.
    c. Groundwater quality.
    d. Clarification of potential impacts to GDEs.

A number of aspects in relation to groundwater have been discussed in other sections of the Submissions Report.

In particular, responses related to surface water losses (including details of beneficial mine water use) and groundwater modelling methodology, surface and groundwater licencing, physical impacts to streams (including remediation) and ecology (non-GDEs) are provided in Sections 6.3, 6.4, 6.5 and 6.10, respectively.

6.13.3 Responses

1. Groundwater model development.

This section provides responses to the following:

a. Consideration of changes in hydraulic properties due to mining effects.
b. Clarification of monitoring bore network.
c. Clarification of stratigraphic and modelled thicknesses of strata.

Further detail regarding the development of the groundwater model and model calibration is provided in Section 6.3.

a. Consideration of changes in hydraulic properties due to mining effects.

Hydrogeological parameters incorporated into the groundwater model for the Project have been well informed by extensive site-specific data (e.g. the results of hundreds of packer tests, pumping tests and core sample measurements). This includes the incorporation of data to constrain parameters such as vertical and horizontal permeability.

The model also has the benefit of more than a decade of data measuring the effect of historical mining operations to the groundwater system. The dataset of pre- and post-mining permeability is larger than is available at most mining projects in NSW.

As such, the adopted horizontal and vertical hydraulic conductivities for the groundwater model have been derived from these extensive monitoring datasets, and are, therefore, within the range of data obtained from the Dendrobium Mine, Bulli Seam Operations and the Tahmoor Mine.

Simulation of changes in hydraulic properties as a result of sub-surface fracturing has been conducted for the Project groundwater modelling using the ‘stacked drain’ method.

HydroSimulations (2019) identified that sub-surface fracturing of overburden above the longwall panels can cause significant changes in hydraulic properties, and potentially provide pathways for vertical and horizontal groundwater movement. In addition, there is the potential for increased horizontal and vertical hydraulic conductivities associated with subsidence-related surface cracking.

However, as described in Section 6.3, the groundwater model has adopted a number of conservative assumptions for those parameters that cannot be directly measured or are variable, in consideration of expert reviews of groundwater modelling in the Southern Coalfield and the recommendations of the IEP (2019a, 2019b), including:

- the height of sub-surface connective fracturing;
- depth of surface cracking; and
- surface water loss from ephemeral streams.

The overall effect of these conservative assumptions is that the groundwater model has accounted for changes in hydraulic properties due to mining-induced impacts (i.e. in particular through the conservative sub-surface fracturing height and depths of surface cracking adopted).

In addition, while the most significant effects of longwall mining to hydraulic properties occur in the strata overlying the longwalls (i.e. as a result of sub-surface and surface cracking), potential changes in hydraulic properties beyond the longwall footprint have also been investigated.

However, there is no definitive relationship between horizontal hydraulic conductivity and lateral distance from the goaf. Therefore, these effects were considered in the Groundwater Assessment (Appendix B of the EIS) through model sensitivity and uncertainty analysis. Simulation of changes in hydraulic properties as a result of sub-surface fracturing has been conducted for the Project groundwater modelling using the 'stacked drain' method for areas directly above extracted longwall panels. For areas outside of the footprint of extracted panels, changes to hydraulic conductivity has been simulated as an enhancement of horizontal hydraulic conductivity, and the adopted parameters are based on the investigation and analysis of pre- and post-mining hydraulic conductivity conducted for South32 at bores around Area 3B.

Considering the above, the pre- and post-mining hydraulic properties adopted in the groundwater model are considered to be reasonable and have considered changes in hydraulic properties due to mining effects. The simulation of changes to strata permeability in the Dendrobium groundwater model, including surface cracking and off-goaf effects, is more detailed and more conservative than the approach taken at most coal mines in NSW.

In addition, the conservativeness of the groundwater model is supported by Dr Frans Kalf in the peer review of the Groundwater Assessment for the Project (emphasis added):

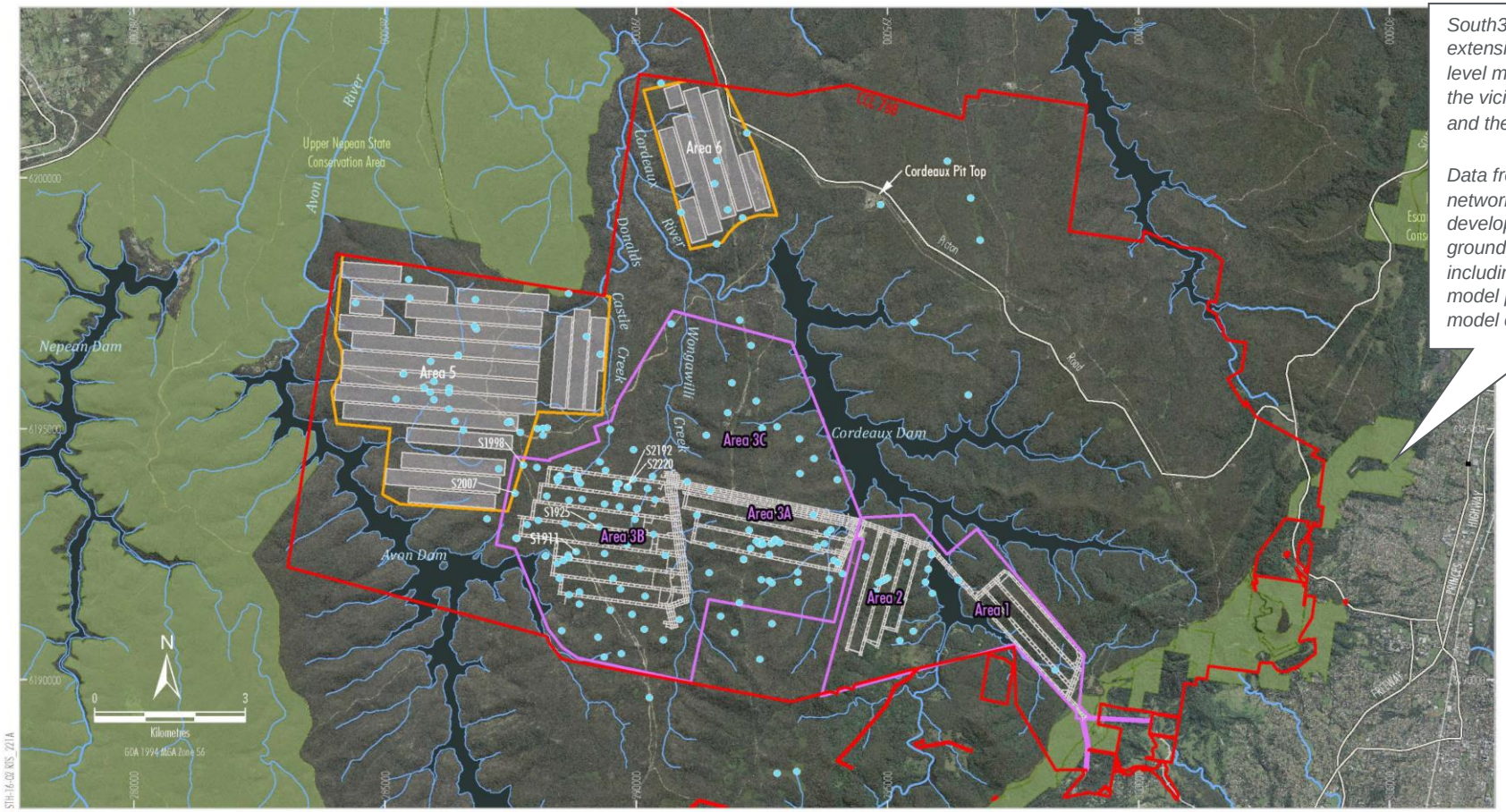
> *KA has no objection to the use of this 'Stacked Drain' method as it has been used by MER* [Mackie Environmental Research Pty Ltd] *for a number of years and has proved to be suitable. In addition it has been found on some projects by MER to* ***overestimate the mining effects such as drawdown and overall inflow*** *and therefore can be considered to be a* ***conservative overall methodology*** *for determining fracture propagation and associated draining in the geological profile.*

b. Clarification of monitoring bore network.

South32 maintains an extensive groundwater level monitoring network in the vicinity of the Project and the Dendrobium Mine. The location of boreholes and piezometers used for groundwater level calibration are depicted on Figure 6-13A.

The network includes monitoring of groundwater levels in the Hawkesbury Sandstone, Bulgo Sandstone, Scarborough Sandstone, Coal Cliff Sandstone, Bulli Seam and Wongawilli Seam.

The groundwater model has incorporated all available groundwater level data in the development of the groundwater model, which included data from 698 groundwater bores and piezometers to assess the calibration of observed and modelled groundwater levels. This is more extensive than many (or all) similar coal mining projects in NSW.



LEGEND
- Dendrobium Mining Lease
- Road
- National Park, Nature Reserve and State Conservation Area
- Dendrobium Underground Mining Area - Proposed Project
- EIS Base Plan Longwalls
- Groundwater Monitoring Locations

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

DENDROBIUM MINE
Groundwater Level Monitoring Locations

Figure 6-13A

South32 maintains an extensive groundwater level monitoring network in the vicinity of the Project and the Dendrobium Mine.

Data from the monitoring network has informed development of the groundwater model, including selection of model parameters and model calibration.

Illawarra Metallurgical Coal also operates a number of bores equipped with multi-level piezometers proximal to Dendrobium Mine longwalls. There are a limited number of monitoring bores located directly above the longwall panels (for safety reasons during mining operations). South32 has, however recently installed additional monitoring bores above Dendrobium Mine longwalls, which would measure effects before and post-mining (i.e. would be decommissioned during mining operations for safety reasons but re-installed post-mining). Data from these new centre-line boreholes will be incorporated into future modelling.

c. Clarification of stratigraphic and modelled thicknesses of strata.

The IESC notes in their submission on the Project that there appear to be a number of inconsistencies between the stratigraphic and modelled thicknesses of strata in the Project area.

Table 3-1 of the Groundwater Assessment (Appendix B of the EIS) provides a general summary of the typical thickness of the strata of the Southern Coalfield. Figures 3-4 to 3-6 of the Groundwater Assessment (Appendix B of the EIS) present detailed stratigraphic cross-sections showing the variable thickness of the stratigraphic units, based on the Illawarra Coal geological model.

Further, Table 6-1 of the Groundwater Assessment summarises the *typical* thicknesses adopted in the groundwater model layers.

These model layers incorporate site-specific data from the Illawarra Coal geological model (as per Figures 3-4 to 3-6 of the Groundwater Assessment [Appendix B of the EIS]), which is defined by hundreds of data points from exploration drill logs as well as data from other mining operations in the Southern Coalfield (e.g. Tahmoor Mine).

Therefore, the model layers include a range of thicknesses (rather than a specific value as per Table 3-1) to reflect the Project underground mining areas as well as the site-specific data used in the model.

As such, there are inherent differences between the stratigraphic thicknesses outlined in Table 3-1 (which represent a summary of the Southern Coalfield stratigraphy) to those outlined in Table 6-1 of the Groundwater Assessment (Appendix B of the EIS), which have been refined to incorporate site-specific data, and also with some splitting or lumping of stratigraphic units into groundwater model layers (e.g. three layers for the Hawkesbury Sandstone) to allow more appropriate simulation of mining effects and environmental features.

2. Potential groundwater impacts.

a. Clarification of impacts to privately-owned bores.

Due to its location within the Metropolitan Special Area, there is limited groundwater use in the vicinity of the Project underground mining areas.

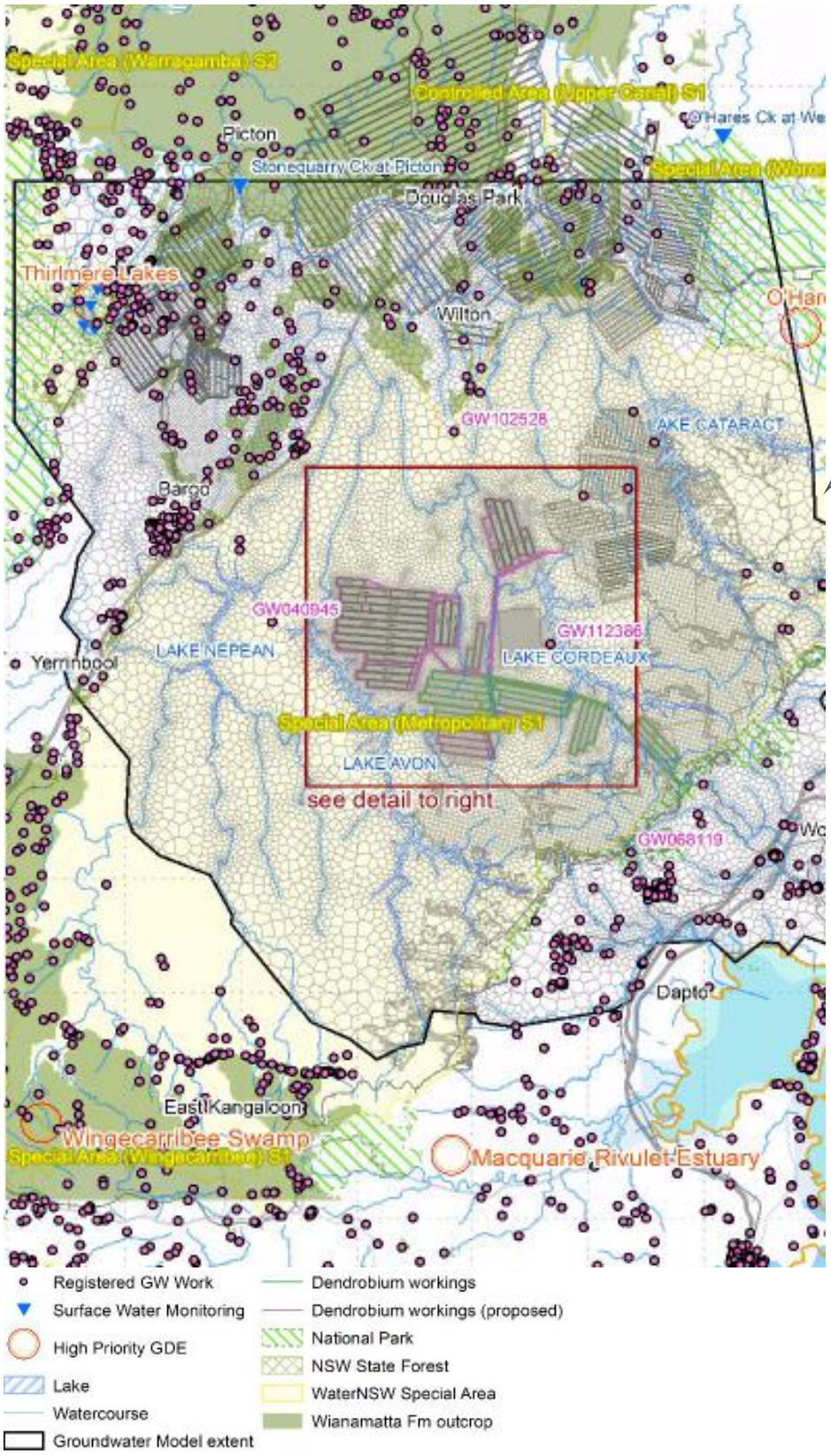
Groundwater bores located proximal to the Project (within a 40 by 40 km area of the Project underground mining areas) are predominantly located to the north-west of the Metropolitan Special Area around Tahmoor, Picton and Bargo, and to the east of the Metropolitan Special Area along the coastal plains (Figure 6-13B).

There are over 700 bores located within the Project region, 309 of which are classified as water supply works as per the definition in the AIP. All of these water supply bores are located at least 4-5 km from the Project. The bores located proximal to the Dendrobium Mine are all exploration and monitoring bores associated with mining.

The AIP defines a threshold for ‘minimal harm’ for ‘highly productive’ and ‘less productive’ groundwater sources. The Sydney Basin Porous Rock in the vicinity of the Project is classified as ‘highly productive’ in accordance with the AIP. This threshold for a water supply is defined as cumulative impacts no greater than 2 m drawdown due to a proposed activity.

There are no water supply works predicted to experience greater than 2 m drawdown due to the Project.

Deterministic scenarios undertaken as part of the Groundwater Assessment (Appendix B of the EIS) also suggest that the number of ‘water supply’ works to be affected by operations at the Dendrobium Mine (and the Project) is likely to be zero.



There is limited groundwater use in the vicinity of the Project underground mining areas due to its location within the Metropolitan Special Area.

There are no water supply works predicted to experience greater than 2 m drawdown due to the Project.

Figure 6-13B: Groundwater Model Extent and Location of Groundwater Bores

The greatest predicted drawdown due to the Project at any of the identified water supply works is 1.5 m in the Hawkesbury Sandstone aquifer.

b. Groundwater drawdown.

Historical mining effects on groundwater drawdown.

Groundwater levels near to active mining have historically shown different extents of drawdown, depending on the proximity to mining, the type of mining employed and the vertical height above the mined seam.

This is demonstrated by monitoring at groundwater bores located at the Dendrobium Mine and proximal to the Project underground mining areas, including:

- groundwater bores which have shown a response to Area 3B mining, with drawdown in the coal seams of approximately 20 m (i.e. at S1998 and S2007 between Area 3B and Area 5 for the Project) (Figure 6-13A); and
- groundwater, bores which have shown limited discernible signs of historic mining (at monitoring bores located further west and north of Area 5).

The Dendrobium Mine has also undermined or passed a number of monitoring bores in Area 3B (including S1911, S1925, S2192 and S2220) (Figure 6-13A).

Monitoring results from these bores show that in the deeper formations (such as the Illawarra Coal Measures and Bulgo Sandstone) significant drawdown was observed, as is typical given complete depressurisation can occur due to fracturing in the strata above mining.

However, in strata nearer the surface, such as the shallowest horizons of the Hawkesbury Sandstone, little or no discernible drawdown was observed.

Project-related drawdown and recovery of groundwater levels.

The numerical groundwater modelling for the Project predicts the most significant drawdown would occur in the coal seams (i.e. approximately 300 m due to extraction of the Bulli Seam in Area 5 and 320 to 350 m due to extraction of the Wongawilli Seam in Area 6).

Recovery of the water table and pressures within the groundwater system is predicted to occur over many decades following the cessation of mining, with the recovery of water levels predicted to be variable (partial [in many cases], relatively quick in the upper layers but slower in the lower units) (Appendix B of the EIS).

As described previously, there are no water supply works predicted to experience greater than 2 m drawdown due to the Project. Therefore, the Project is predicted to have a ‘Level 1’ (i.e. minimal impact) on these water supply works in accordance with the AIP.

Potential impacts to water supply from groundwater drawdown.

South32 has considered the potential impact of the Project on the water supply of the Sydney Drinking Water Catchment (see Section 6.3).

The Groundwater Assessment (Appendix B of the EIS) conservatively predicted groundwater inflows to Area 5 due to the Project would peak at approximately 18 ML/day in 2033 and 2037, averaging approximately 12 ML/day. Inflows to Area 6 are conservatively predicted to peak at approximately 4 ML/day in 2047, averaging approximately 3 ML/day due to the Project.

Cumulatively, the total inflow for the Project and Dendrobium Mine is predicted to peak at approximately 26 ML/day in 2032 and 2036, averaging approximately 22 ML/day for the period 2023 to 2049 (of which approximately 10 ML/day is due to inflows from Areas 1 to 3).

Notwithstanding, the potential loss of surface water from the catchment is the key water loss component when considering potential impacts to the water supply of the Metropolitan Special Area.

As described in Section 6.3, the groundwater model conservatively predicts the maximum loss of surface water to the mine workings of 1,935 ML/annum as a result of the Project (3,330 ML/annum for the Dendrobium Mine cumulatively with the Project), which is equivalent to approximately 5.2 ML/day and 9.1 ML/day for the Project-only and cumulative scenarios, respectively.

As described in Section 6.3, South32 proposes to implement a beneficial mine water use scheme for excess mine water (i.e. comprising surface water and groundwater) for industrial and/or other users, such that the mine water use volume matches or exceeds maximum predicted Project surface water take from the Metropolitan Special Area storages, therefore, achieving no net reduction (or a net gain) in the total drinking water supply system.

c. Groundwater quality.

South32 maintains an extensive groundwater quality monitoring network, with more than 3,280 groundwater samples collected and analysed at the Dendrobium Mine since 2004.

Results of analysis indicates that groundwater quality over the Dendrobium Mine area is highly variable, and changes depending on the geological unit and depth of the groundwater sample taken. In general, the salinity of groundwater increases with depth as a result of the longer groundwater residence times in the deeper units.

In the Project area, the electrical conductivity of groundwater throughout the stratigraphic sequence is typically less than 2,500 µs/cm (indicative of a salinity or total dissolved solids [TDS] of ~1,500 mg/L). As a result, the groundwater quality within the Project area meets the criteria for 'highly-productive' groundwater in accordance with the AIP.

Although mining-induced changes to the hydraulic properties and depressurisation of the strata in the Dendrobium Mine area may result in mixing of potentially chemically different groundwater between overlying and underlying units, it is considered unlikely that the Project would result in changes to the existing beneficial use category of groundwater as a result of impacts to groundwater quality (Appendix B of the EIS).

South32 would conduct groundwater sampling for the Project to confirm beneficial use categories of the groundwater.

Post-mining, there is potential for groundwater that has been in contact with the coal seams to recover to levels within the shallow strata (i.e. via the goaf and sub-surface fracture network) such as the Bulgo Sandstone and potentially to within the Hawkesbury Sandstone in some areas. However, there would be significant dilution of groundwater recharge from the surrounding shallow strata, and rainfall. In addition, any relatively high salinity groundwater would be expected to remain at depth (rather than move vertically upwards, as it would have greater density than the relatively fresher water recharged from the shallow strata and from rainfall).

d. Clarification of potential impacts to GDEs.

The *Groundwater Dependent Ecosystems Atlas* (Bureau of Meteorology, 2019) indicates that there is a low potential for groundwater interaction across the majority of the Project underground mining areas, primarily due to the elevated topography.

Mapping of moderate to high priority GDEs in the vicinity of the Project is provided in Figure 6-13B, consistent with the *Groundwater Dependent Ecosystems Atlas* (Bureau of Meteorology, 2019).

There is moderate potential for groundwater interaction in lower-lying areas within the Project underground mining areas, including along the Avon and Cordeaux Rivers downstream of the Avon and Cordeaux Dams, respectively.

However, there are no 'high-priority' GDEs located within the Project underground mining areas. The nearest 'high-priority' GDE is the O'Hares Creek catchment which is located 13 to 18 km to the north-east of Area 6.

Although there are a number of Upland Swamps located within the Project underground mining areas, they are not defined as high-priority GDEs and in general the swamp water levels are higher than the underlying groundwater table. Responses in relation to Upland Swamps are described in Section 6.10.

The Groundwater Assessment (Appendix B of the EIS) assessed potential impacts of the Project on GDEs, and concluded that no drawdown effects are predicted at the nearest 'high-priority' GDEs, therefore, the Project would have a 'Level 1' (i.e. minimal impact) in accordance with the AIP.

6.14 IMPACTS TO BUILT INFRASTRUCTURE

6.14.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to impacts to built infrastructure, other than WaterNSW assets (Section 6.6), pertained to the proposed management and monitoring of potential subsidence impacts to existing built infrastructure (including electricity, rail, gas and road infrastructure).

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to impacts to built features included Subsidence Advisory NSW, Wollongong City Council, Roads and Maritime Services (RMS), Jemena, TransGrid and Endeavour Energy. These comments pertained to proposed management and monitoring of potential subsidence impacts to existing built infrastructure (including electricity, rail, gas and road infrastructure).

6.14.2 Key Aspects

In consideration of the submissions described above, responses to the following key issue is provided below:

1. Proposed built feature monitoring and management measures.

The responses in this section are in relation to potential impacts to built features other than WaterNSW assets (which are provided in Section 6.6).

6.14.3 Responses

1. Proposed built feature monitoring and management measures.

Existing measures to manage potential impacts of subsidence on key built features would be reviewed, and additional measures developed as a component of future Extraction Plans for the Project.

South32 would consult with a range of government agencies and infrastructure owners during the preparation of future Extraction Plans, where relevant, including:

- Subsidence Advisory NSW;
- Australian Rail Track Corporation (ARTC);
- RMS;
- WaterNSW;
- DSC;
- TransGrid;
- Endeavour Energy;
- Jemena Gas Networks; and
- Telstra.

Where relevant for each infrastructure item, Extraction Plans for the Project would include the following:

- a summary of relevant background or baseline data;
- a review of predictions of the potential subsidence effects, subsidence impacts and environmental consequences, incorporating any relevant information obtained since the Project EIS (such as monitoring results obtained during mining);
- a monitoring program to provide data to assist with the management between subsidence effects, impacts and any ensuing environmental consequences;
- a plan to manage and remediate subsidence impacts and/or environmental consequences (e.g. remediation of observed cracking);
- TARPs to identify and outline specific follow-up actions to avoid exceedances of agreed performance measures;
- contingency plans that provide for adaptive management where monitoring indicates that there has been an exceedance of agreed performance measures; and
- reporting and review mechanisms.

Consultation with ARTC would be subject to the status of the disused Maldon-Dombarton Rail Corridor, with construction of this corridor suspended in 1988. If the corridor were to be completed prior to the active subsidence at the Project, a management plan would be developed to manage subsidence impacts on the Maldon-Dombarton Rail Corridor, in consultation with ARTC.

6.15 GREENHOUSE GAS EMISSIONS

6.15.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to greenhouse gas emissions included:

- The Project's contribution to state, national and global greenhouse gas emissions over the life of the Project, with particular reference to relevant government policies and to Australia's commitments in accordance with the *Paris Agreement*.
- Clarification of assessment methodology to estimate Scope 3 emissions and other indirect greenhouse gas emissions (e.g. clearing, loss of ecosystem carbon sequestration capacity).
- Consideration of potential for use of alternative energies, including renewable energy.

Agency, Local Council and Service Provider Submissions

The Wollongong City Council provided comments on greenhouse gas emissions associated with the Project.

6.15.2 Key Aspects

In consideration of the submissions described above, detailed responses to the following key aspects are provided below:

1. Project contribution to greenhouse gas emissions in consideration of relevant policy frameworks.
    a. Predicted Project greenhouse gas emissions.
    b. Project link to BlueScope Steelworks and associated downstream emissions.
    c. Consideration of greenhouse gas emissions policy.
    d. Economic valuation of emissions in consideration of Ecologically Sustainable Development (ESD).
2. Mitigation and management measures, and energy saving opportunities.
3. Clarification of assessment methodology for greenhouse gas emissions.

6.15.3 Responses

1. Project contribution to greenhouse gas emissions in consideration of relevant policy frameworks.

a. Predicted Project greenhouse gas emissions.

The Project is a continuation of mining at the Dendrobium Mine (approved to operate until 2030). In comparison to the approved Dendrobium Mine, there would be no increase in maximum annual ROM coal production for the Project.

It is acknowledged that (subject to the efficacy of national and international greenhouse gas abatement measures) all sources of greenhouse gas emissions will contribute in some way towards the potential global, national, state and regional effects of climate change.

The Project's contribution to global climate change effects would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the Project (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of fuel and electricity (i.e. Scope 2 emissions) are estimated to be between 0.7 to 0.9 million tonnes of carbon dioxide equivalent per year (Mt CO_2-e per year) (estimated annual average Scope 1 and 2 emissions from the Project represent approximately 0.5% of NSW's and 0.1% of Australia's annual greenhouse gas emissions from 2016, respectively).

The total Scope 3 (indirect) emissions were estimated by Ramboll (2019) to be 8.2 Mt CO_2-e per year. These Scope 3 emissions would be associated with the end use of coal by third parties.

The primary end use of Project coal would be for use as a reducing agent in the steelmaking process. A portion of these Scope 3 emissions at customer's facilities would occur in Australia, for example when the coking coal is used at the BlueScope Steelworks or Whyalla Steelworks.

b. Project link to BlueScope Steelworks and associated downstream emissions.

The Project involves the continued extraction of ROM coal from the Dendrobium Mine to primarily produce metallurgical coal products for use in steelmaking. This would provide an ongoing, local supply of metallurgical coal to the BlueScope Steelworks at Port Kembla.

There is currently no economically viable alternative to the use of metallurgical coal as a reducing agent in the blast furnace method (i.e. a method employed at the BlueScope Steelworks) at a commercial scale.

Coking coal is used as a reducing agent in the steelmaking process, where the carbon in the coal is used to convert iron ore to molten iron in a blast furnace.

The majority of greenhouse gas emissions produced from the blast furnace method of steel manufacture, as is employed at the BlueScope Steelworks, are a direct result of the chemical process that uses carbon (from coal) to extract iron from iron ore (BlueScope Steel Limited, 2008).

While the BlueScope Steelworks produces a portion of its steel using recycled scrap steel as a feed stock, there is not sufficient supply of scrap steel to meet demands, and therefore the steelmaking process continues to require the use of metallurgical coal and iron ore.

Research into the use of alternative reducing agents in the blast furnace method, such as hydrogen, is being undertaken. However, there is currently no economically viable alternative to the use of metallurgical coal as a reducing agent in the blast furnace method (i.e. a method employed at the BlueScope Steelworks) at a commercial scale (BlueScope Steel Limited, 2019).

Assuming BlueScope Steelworks continues to require metallurgical coal in its blast furnace, then if the Project was not approved there would be:

- no net change in Australia's greenhouse gas emissions due to the end use of coal, assuming BlueScope Steelworks sourced coal from alternative sources; or
- a decrease in Australia's greenhouse gas emissions if steelmaking is reduced as a result of not sourcing an alternative coal supply.

As noted by the ACCC (2017), the Illawarra region is not expected to have producers capable of supplying volumes of technically substitutable metallurgical coals (to those produced by South32 and the Metropolitan Mine) in the medium to long term, and if coal was sourced from the Bowen Basin this would come at a cost of an additional $US10-15 per tonne of coal to BlueScope, as well as generating additional greenhouse gas emissions associated with the transportation of the coal to BlueScope Steelworks facilities.

If no alternative coal supply were sourced by BlueScope, this would result in associated reductions in the safety and socio-economic benefits of local steelmaking recognised by the Senate Economics Reference Committee (Commonwealth of Australia, 2017), and unless there was a corresponding reduction in the demand and use of steel from 'virgin' iron, no net reduction in global greenhouse gas emissions (as other steelmakers using coking coal would supply steel to meet demand).

The steelmaking industry is highly trade exposed, with Australian steelmakers competing against suppliers across the globe. Accordingly, maintaining low production costs are critical to the competitiveness and viability of the Australian steelmaking industry.

The proximity of the existing Southern Coalfield mines, including Dendrobium Mine, to BlueScope Steelworks facilities at Port Kembla is a factor in BlueScope Steelworks ability to make economically competitive steel.

BlueScope has previously noted that without local metallurgical coal suppliers, it may struggle to remain economically viable at Port Kembla (BlueScope Steel Limited, 2019).

The continued supply of coal from the Dendrobium Mine to the BlueScope Steelworks, which would be facilitated by approval of the Project, would contribute to its ongoing economic viability and associated socio-economic benefits. BlueScope states in its submission on the Project:

> *The purpose of BlueScope's submission is to emphasise to the NSW Minister for Planning and the Independent Planning Commission for the Project the critical importance of a continuation of mining at the Dendrobium Mine situated in the Southern Coalfield of NSW. This continuation is vital for the continuing protection of the economic health of the Illawarra region and NSW at large, including the 3,500 direct jobs and 5,400 indirect jobs that rely on Port Kembla Steelworks, the largest steel production facility in Australia…*
>
> *…*
>
> *… The Dendrobium Mine Project produces metallurgical coal for steelmaking. Currently, there is no economically viable, commercial-scale alternative to the use of metallurgical coal in the blast furnace method of steelmaking, which is employed at Port Kembla Steelworks. The Project would provide a local and continued supply of metallurgical coal to the Steelworks, allowing BlueScope to continue to generate at least $6.5 billion in regional economic output for the Illawarra region*

Furthermore, the existing emissions associated with the end-of-use coal from the Dendrobium Mine at Australian facilities are already reflected in Australia's greenhouse gas accounting. The Project would, however, facilitate continuation of the existing emissions from these Australian facilities.

c. Consideration of greenhouse gas emissions policy.

Where coal from the Project is used overseas, emissions associated with the end use of this coal would be managed by any nationally determined contributions (NDCs) of these countries.

It is noted that the NSW Government has announced it will introduce legislation to prevent the regulation of Scope 3 emissions in NSW mining approvals (NSW Government, 2019).

At the Conference of Parties 21 (in 2015), parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached an agreement to combat climate change at a global level (the *Paris Agreement*). The goal of the *Paris Agreement* is to limit global temperature increases to well below 2°C (UNFCCC, 2019).

This is to be achieved by reaching peak global emissions as soon as possible, so as to achieve a "balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of the century" (UNFCCC, 2019).

The *Paris Agreement* does not specify how global emission reductions are to be achieved. It requires countries that are parties to the *Paris Agreement* to prepare, communicate and maintain NDCs and to pursue domestic measures to achieve them (UNFCCC, 2019). The NDCs are to be communicated every 5 years, with each successive NDC to represent a progression beyond the previous NDC.

Australia's existing NDC under the *Paris Agreement* is a greenhouse gas emission reduction target of 26 to 28% of 2005 levels by 2030 (Commonwealth of Australia, 2015). This would include addressing, where relevant, the emissions of use of Project product coal in Australia.

South32 would continue to manage its contribution to Australian greenhouse gas emissions inventories (i.e. Scope 1 and 2 emissions) through participation in the National Greenhouse and Energy Reporting Scheme (NGERS), as well as other applicable government initiatives and policies implemented to manage emissions at the national level under Australia's progressive NDCs.

Scope 3 emissions would be managed by the facility that generates the emissions, either in Australia (i.e. where these emissions would be part of Australia's *Paris Agreement* obligations) or overseas (where they would be managed by the emissions reduction targets of the relevant country).

d. Economic valuation of emissions in consideration of ESD.

One of the common broad underlying goals or concepts of sustainability is economic efficiency, including improved valuation of the environment. Resources should be carefully managed to maximise the welfare of society, both now and for future generations.

In the past, some natural resources have been misconstrued as being free or underpriced, leading to their wasteful use and consequent degradation. Consideration of economic efficiency, with improved valuation of the environment, aims to overcome the underpricing of natural resources and has the effect of integrating economic and environmental considerations in decision making, as required by ESD.

While environmental costs have been considered to be external to Project development costs historically, improved valuation and pricing methods attempt to internalise environmental costs and include them within Project costing.

The Economic Assessment for the EIS (Cadence, 2019) incorporated environmental values via direct valuation where practicable (e.g. greenhouse gas emissions of the Project). Furthermore, wherever possible, direct environmental impacts of the Project would be internalised through the adoption and funding of mitigation measures by South32 to mitigate potential environmental impacts (e.g. biodiversity offset costs, infrastructure management costs, decarbonisation plans).

The Economic Assessment indicated a net benefit (i.e. net of the value of externalities including Scope 1 and 2 greenhouse gas emissions) of $1,073 million in NPV terms to the State of NSW and $431 million in NPV terms to the greater Wollongong Region would be forgone if the Project is not implemented. This includes an estimated $272.1 million in royalties, payroll tax and council values in NPV terms.

While the value of externalities from indirect (Scope 3) greenhouse gas emissions are not considered in the net benefit to NSW, neither are the economic benefits associated with the ongoing use of this coal for steelmaking and other uses, which have been recognised as significant to the Illawarra region and Australia (Commonwealth of Australia, 2017).

Notwithstanding, the quantity of Scope 3 greenhouse gas emissions that may be emitted by other parties, namely from the use of the product coal produced by the Project have been estimated (approximately 8 Mt CO_2-e per year, with a proportion of these global Scope 3 emissions occurring directly in NSW [e.g. BlueScope Steelworks] and elsewhere in Australia [e.g. Liberty Primary Steel Whyalla Steelworks]).

These (typically manufacturing related) greenhouse gas emissions are currently occurring at facilities such as the BlueScope Steelworks and are, therefore, already accounted for in NSW and Australia's current greenhouse gas emission estimates.

These emissions, therefore, form part of the existing Australian greenhouse gas emission estimates that are being considered by State and Federal Governments when developing greenhouse gas abatement mechanisms to meet Australia's international greenhouse gas abatement obligations (e.g. under the *Paris Agreement*).

2. Mitigation and management measures, and energy saving opportunities.

South32 would operate the Project to minimise direct (Scope 1) greenhouse gas emissions as far as possible, in particular through maximising gas flaring to convert methane to carbon dioxide.

Gas liberated during mining of Area 5 and Area 6 is expected to be highly variable in content and composition. On this basis, South32 determined that utilisation of the fugitive methane (i.e. for electricity generation) would not be feasible for the Project.

South32 regularly review energy supply options to identify sustainable supplies and methods to reduce greenhouse gas emissions, as well as investing in energy efficiency initiatives to continue to support viable renewable energy schemes. The Project would allow South32 to continue their support for these initiatives.

Notwithstanding, South32 would implement greenhouse gas minimisation measures (i.e. flaring) to convert the methane to carbon dioxide, as methane gas has 21 times the Global Warming Potential of carbon dioxide. Project-specific greenhouse gas minimisation measures would be described in a Greenhouse Gas & Energy Efficiency Management Plan for the Project.

Furthermore, South32's Company-wide Climate Change Strategy reflects key strategies of the *Paris Agreement*, as it includes:

- The target of staying below a baseline Scope 1 greenhouse gas emissions level (established based on financial year 2015) until 2021 (i.e. company-wide peak emissions would be reached between 2015 and 2021).
- Consideration of decarbonisation opportunities such as gas drainage, ventilation air methane utilisation and/or destruction.
- Reviewing greenhouse gas emissions every five years from 2021 to achieve a goal of net zero Scope 1 greenhouse gas emissions by 2050 (including carbon offsetting for any residual emissions).

3. Clarification of assessment methodology for greenhouse gas emissions.

The Air Quality and Greenhouse Gas Assessment prepared by Ramboll (2019) considers Scope 1, 2 and 3 greenhouse gas emission sources associated with the Project.

The direct and indirect greenhouse gas emissions for the Project have been estimated by Ramboll (2019) using the published emission factors from the *National Greenhouse Accounts Factors* (NGAF) (DoE, 2016). Fugitive emissions have been calculated using site-specific emission data.

The estimated emissions from flaring of gas were incorporated as part of the Scope 1 emissions of the Project. For flaring, the total estimated CO_2-e emissions were separated into mine ventilation air and drainage, based on an assumption that 67% of the total estimated CO_2-e emissions are emitted via mine ventilation air and 33% via pre- and post-drainage.

Furthermore, of the 33% released via pre- and post-drainage, 32% of the total estimated CO_2-e emissions are assumed to be methane (CH_4) and 1% assumed to be carbon dioxide. The assumed percentage splits are derived from a ventilation study conducted by PALGAS for Area 5.

The loss of the carbon sequestration capacity from the minor surface disturbance of vegetation (e.g. clearance) would be very small. The rehabilitation of surface disturbance for the Project, would offset this temporary loss in the long-term.

6.16 AIR QUALITY

6.16.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to air quality included:

- Clarification of modelling of potential air quality emissions during the construction of surface facilities.
- Proposed air quality management and monitoring measures, specifically with regard to the Dendrobium Pit Top.

Agency, Local Council and Service Provider Submissions

The EPA provided comments on the Project relating to air quality. These comments included:

- Potential Project-only (incremental) impacts, in particular at receivers D0007 and D0117, proximal to the KVCLF.
- Clarification of the emissions inventory and consideration of a worst-case scenario.
- Consideration of best practice emission control strategies.
- Consideration of wind erosion from stockpiles.

6.16.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Consideration of air quality emissions during construction activities.
2. Details of incremental increases in air quality emissions proximal to the KVCLF.
    a. Predicted increments at receivers D0007 and D0117.
    b. Proposed air quality monitoring and management measures.
3. Justification of modelling of 'worst-case' emissions scenario.

6.16.3 Responses

1. Consideration of air quality emissions during construction activities.

The construction activities associated with the Project surface activities are anticipated to be minor and short-term in nature, and include the following:

- minor upgrades to and augmentation of infrastructure at existing surface facilities;
- decommissioning and removal of redundant infrastructure; and
- development of new surface infrastructure (e.g. at the Cordeaux Pit Top and Ventilation Shaft Sites).

All construction activities would be short-term and potential emissions would be controlled using standard mitigation and management practices as outlined in the existing Air Quality Management Plan, which would be updated for the Project.

2. Details of incremental increases in air quality emissions proximal to the KVCLF.

a. Predicted increments at receivers D0007 and D0117.

The Air Quality and Greenhouse Gas Assessment (Appendix I of the EIS) presents a quantitative assessment of potential air quality impacts, using a Level 2 assessment approach in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods) (EPA, 2016).

Predicted cumulative annual average PM_{10}, $PM_{2.5}$ and TSP concentrations and dust deposition levels indicated that no sensitive receptor would experience exceedances of the EPA's impact assessment criteria.

The predicted cumulative 24-hour average PM_{10} and $PM_{2.5}$ concentrations demonstrated that no additional exceedances of the impact assessment criteria are expected at sensitive receptors.

As requested by the EPA, additional analysis has been undertaken to determine the largest source contributions of the predicted Project-only average 24-hour PM_{10} and $PM_{2.5}$ concentrations at two sensitive receptors (i.e. D0007 and D0117).

The three sources contributing the majority of the Project-only emissions were (Table 6-16A):

- dozers operating on the ROM stockpile at the KVCLF;
- diesel consumption at the KVCLF and Dendrobium Pit Top; and
- operation of the coal sizer and crusher unit at the KVCLF.

It should be noted that the activities described above are currently occurring for the approved Dendrobium Mine and would be unchanged for the Project.

Table 6-16A
Largest Project-only Source Contributions at D0007 and D0117

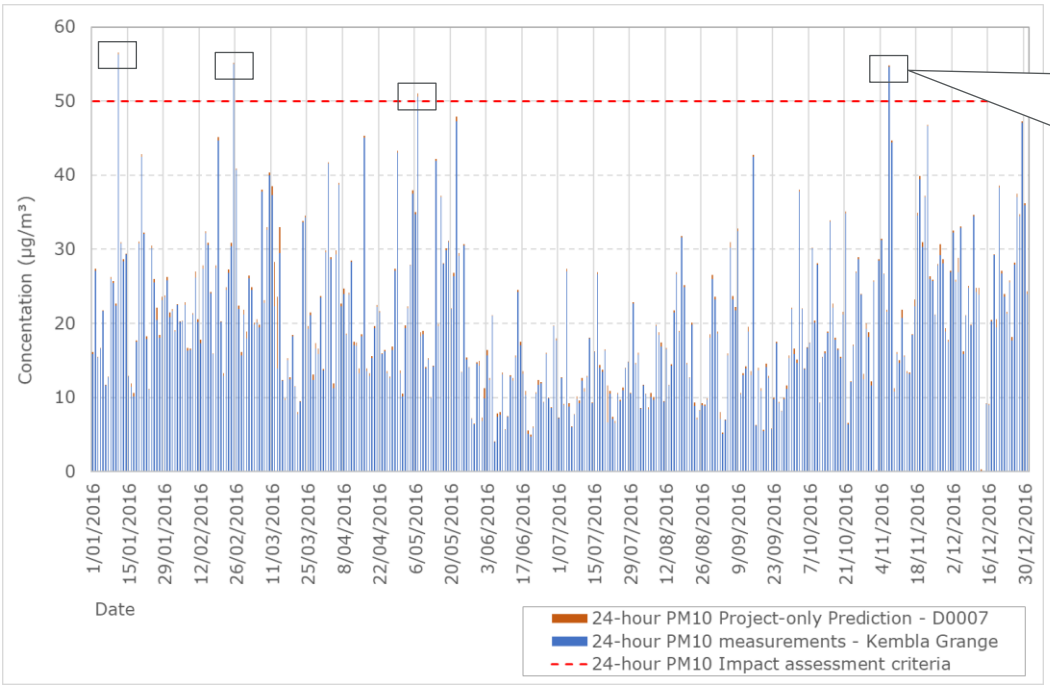
Source	Location	Project-only average 24-hour PM_{10}		Project-only average 24-hour $PM_{2.5}$	
		D0007	D0117	D0007	D0117
Dozer on ROM Stockpile	KVCLF	64%	66%	27%	28%
Diesel Consumption	Dendrobium Pit Top and KVCLF	12%	13%	57%	58%
Coal Sizer and Crusher	KVCLF	12%	11%	4%	4%
Total Contribution		**88%**	**90%**	**88%**	**90%**

The model results indicated that the highest contributor of average 24-hour PM_{10} emissions at both locations was the dozer operating on the ROM stockpile at the KVCLF, while diesel consumption was the highest contributor to average 24-hour $PM_{2.5}$ emissions.

The EPA also requested that bar charts be prepared with contemporaneous predictions and background concentrations for D0007 and D0117 (Charts 6-16A to 6-16D). Consistent with the Air Quality and Greenhouse Gas Assessment (Ramboll, 2019), the background monitoring data used in the analysis was collected by DPIE at Kembla Grange, which measure PM_{10} and $PM_{2.5}$ on a continuous basis.

There were no additional exceedances of the average 24-hour PM_{10} or $PM_{2.5}$ criteria at D0007 or D0117 when the predicted incremental increase of the Project was added to the measured background data at these receptors for the year analysed.

Chart 6-16A
Contemporaneous Background and Predicted 24-hour PM_{10} Concentrations at D0007



These graphs show that exceedances of criteria have been recorded in the background data (unrelated to the Project).

When the minor increment from the Project is added (see red bars) there are no additional days where the criteria is exceeded.

Chart 6-16B
Contemporaneous Background and Predicted 24-hour $PM_{2.5}$ Concentrations at D0007

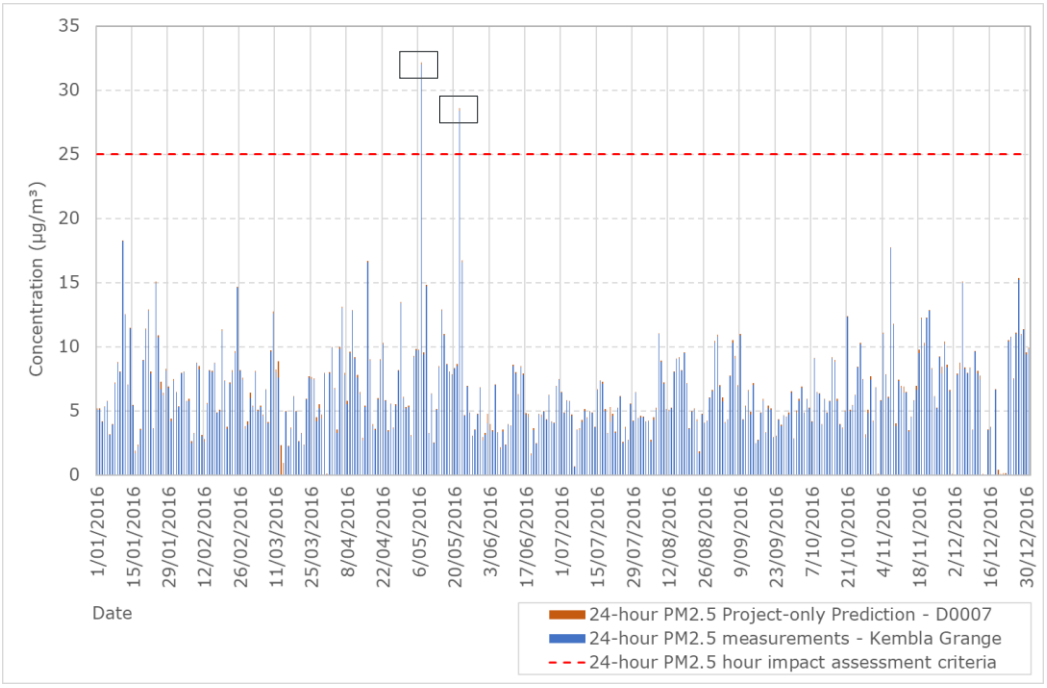


Chart 6-16C
Contemporaneous Background and Predicted 24-hour PM_{10} Concentrations at D0117

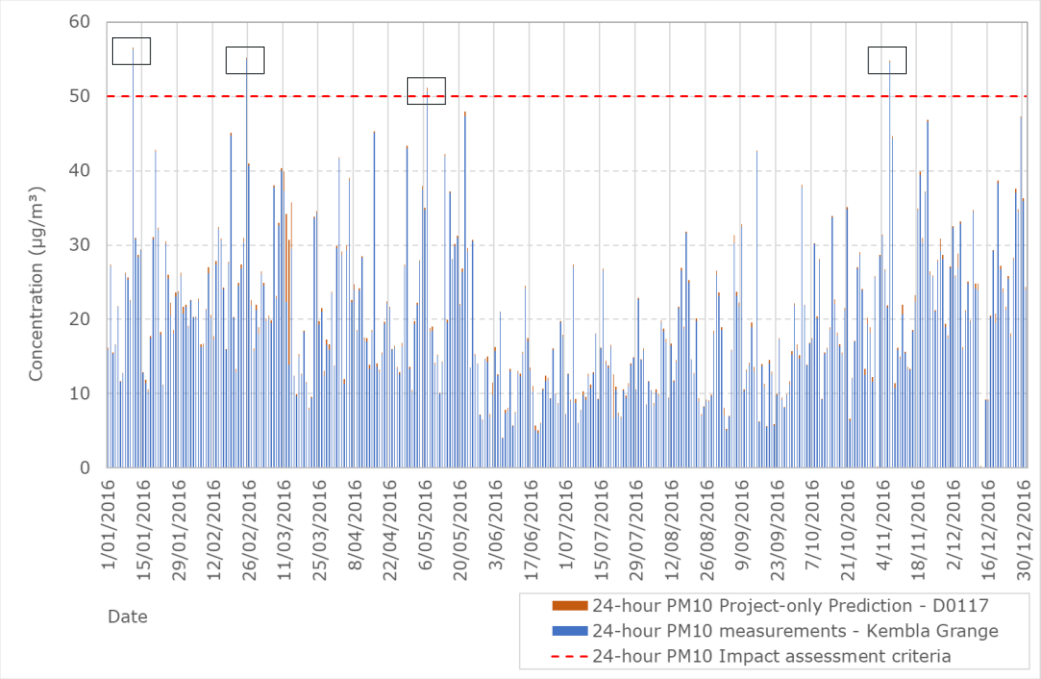
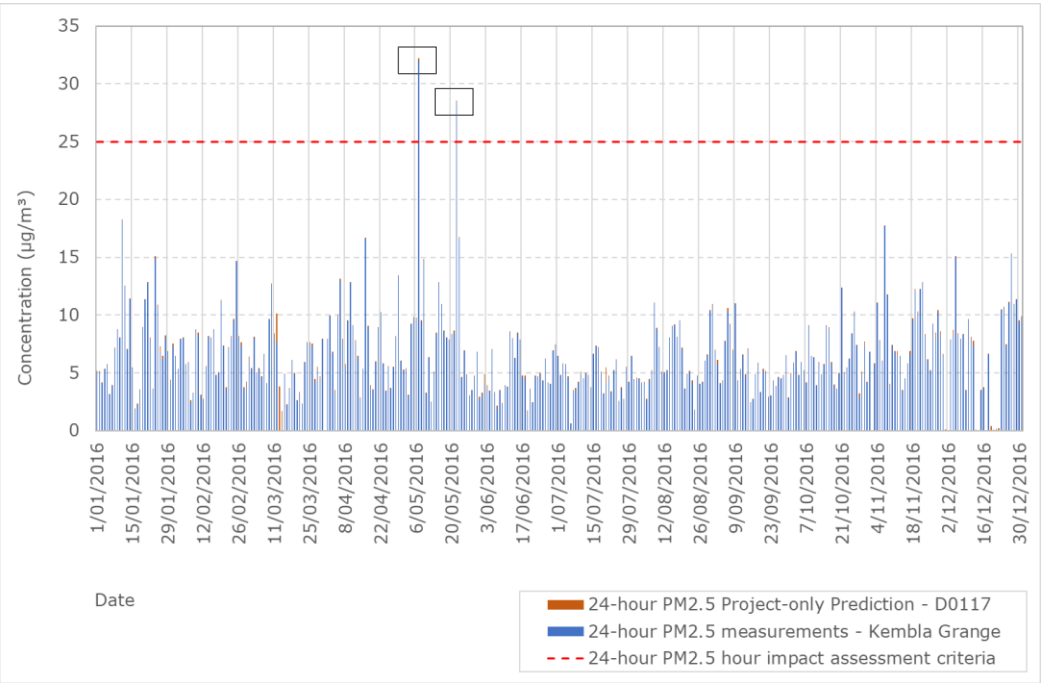


Chart 6-16D
Contemporaneous Background and Predicted 24-hour $PM_{2.5}$ Concentrations at D0117



b. Proposed air quality monitoring and management measures.

South32 would continue to conduct air quality monitoring in accordance with the existing Air Quality Management Plan, which would be updated for the Project.

South32 would also install additional real-time PM_{10} and $PM_{2.5}$ monitoring equipment for the Project.

Although the modelling indicated the Project would result in only minor incremental impacts, if air quality monitoring was to identify potential exceedances of criteria as a result of the Project, additional control strategies and mitigation measures that could be implemented include:

1. Implementation of wind breaks and enclosures.
2. Adjustment to stockpile proportions (e.g. minimise the height of stockpiles).
3. Wetting of material and associated unsealed surfaces.
4. Avoidance (e.g. minimise vehicle and equipment movement on stockpiles, as this causes mechanical disturbances and reduces stabilisation of the surface).

These measures would be documented in the Air Quality Management Plan for the Project.

Project air quality adaptive management measures would also include responses to any community issues or complaints.

As a component of the Project, South32 would install additional PM_{10} and $PM_{2.5}$ real-time monitoring equipment to evaluate the emissions of the Project against contemporary particulate matter criteria.

3. Justification of modelling of 'worst-case' emissions scenario.

The Air Quality and Greenhouse Gas Assessment (Ramboll, 2019) was prepared in accordance with the Approved Methods (EPA, 2016) and the Secretary's Environmental Assessment Requirements (SEARs) for the Project, with dispersion modelling and emissions inventories conducted as per best practice.

The daily throughput in the dispersion model for the Project was based on the proposed peak production rate for the operation (i.e. 5.2 Mtpa).

Hourly varying emissions were modelled for the peak production scenario, with resultant concentrations at sensitive receivers varied according to changes in meteorology, including wind speed. As such, 'worst-case' meteorological conditions for sensitive receivers are accounted for in modelling.

In addition, as the Project is an underground mine, fixed infrastructure sources of emissions do not vary in comparison with those modelled and as such, the modelling has considered 'worst-case' proximities of emissions sources to sensitive receivers.

Given the above, it is considered that the scenarios modelled provide an estimation of potential 'worst-case impacts' for the Project.

6.17 NOISE

6.17.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to noise included:

- Potential amenity impacts at sensitive receivers and for wildlife.
- Accuracy of noise modelling predictions.
- Proposed noise management and monitoring measures.
- Clarification of consultation with affected landowners regarding existing Dendrobium Mine operations.

Agency, Local Council and Service Provider Submissions

The EPA provided comments on the Project relevant to noise. These comments included:

- The benefits of South32's noise reduction programs implemented on the Kemira Valley Rail Line.
- Accuracy of noise assessment methodology, derivation of noise criteria and predictions.
- Justification that the Noise Assessment has adequately considered the provisions of the Noise Policy for Industry (NPfI).
- Clarification of the adopted sound power levels (SWLs).
- Comparison of predicted noise levels and existing Dendrobium Mine noise limits.
- Accuracy of construction noise assessment and predictions.
- Justification of proposed construction hours.
- Existing noise mitigation measures currently implemented at Dendrobium Mine.
- Proposed mitigation measures for the Project (particularly for receiver R6a).
- Clarification of the road noise assessment.

6.17.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Noise modelling methodology and predictions.
    a. Application of the NPfI and development of noise model.
    b. Predicted operational noise levels.
    c. Clarification of adopted equipment SWLs.
    d. Justification of proposed construction hours.
    e. Clarification of road transport noise impacts.
2. Noise mitigation and management measures.
3. Noise exceedances at privately-owned residences.

The responses in this section are related to potential noise impacts of the Project. Responses specifically related to biodiversity, air quality and visual amenity are provided in Sections 6.10, 6.16 and 6.21, respectively.

6.17.3 Responses

1. Noise modelling methodology and predictions.

a. Application of the NPfI and development of noise model.

EPA has stated on their submission on the Project EIS:

> *The EPA expects a strong justification be provided for varying (and indeed predicting noise levels above) the existing Project Approval noise limits. The proponent appears to have provided insufficient information to explain why essentially existing operations are resulting in predicted noise levels above the existing Project Approval limits.*

The Dendrobium Mine surface facilities are significant industrial facilities that have been operating in the local area for an extended period. As such, suburban and rural receivers have historically co-existed with, and are in some cases located in close proximity to infrastructure associated with these existing industrial facilities. The Project would not involve significant changes to the operation of these facilities.

Prior to the Project, the existing operational noise criteria for the Dendrobium Mine, as specified in Development Consent DA 60-03-2001, were derived in accordance with the methodology provided in the *Industrial Noise Policy* (INP), which was superseded by the NPfI in October 2017.

The Project SEARs were revised on 18 September 2018, and specifically included the requirement to assess potential noise impacts of the Project in accordance with this new policy.

Noise predictions and NPfI meteorological conditions

The NPfI adopts a revised methodology which differs to the INP, notably in that it considers noise assessment to now apply under all weather conditions, rather than the more limited conditions previously specified under the INP (EPA, 2017).

Consistent with the NPfI, the acoustic model (SoundPLAN) developed by Renzo Tonin has considered these revised meteorological effects. This includes adverse weather conditions, for example temperature inversions, which apply under more adverse meteorological conditions.

The predicted noise levels are the maximum under adverse weather conditions, as required by the NPfI (Table 6-17A). By comparison, under calm meteorological conditions, compliance with the existing Dendrobium Mine DA 60-03-2001 noise limits is generally predicted.

NPfI noise limits

The operational noise criteria for the Project (i.e. the Project Specific Trigger Levels [PSTLs]) have been derived in accordance with the NPfI to provide contemporary noise criteria for the Project.

As a consequence of the adoption of this new policy, the existing Dendrobium Mine noise limits and NPfI derived criteria for potential receivers proximal to the Project also differ.

The overall effect of the application of the NPfI for the Project is the contemporary criteria are in many cases either higher or lower (i.e. more or less stringent) than existing noise limits. Table 6-17B demonstrates this, whereby noise limits for receivers R2, R3a, R5a, R6a and R6b are generally more stringent than the existing Dendrobium Mine noise limits. Conversely, NPfI derived criteria for receiver R39a are less stringent.

As such, a comparison of the Project noise predictions to existing and NPfI derived noise limits is not equivalent. Notwithstanding, the Noise and Blasting Assessment has assessed potential noise impacts in accordance with the NPfI (and the NPfI derived noise criteria).

Table 6-17A
Predicted Operational Noise Levels at Potentially Affected Privately-owned Receivers Proximal to Dendrobium Pit Top and KVCLF

Receiver[1]	Project NPfI PSTLs ($L_{Aeq[15min]}$)			Predicted Operational Noise Levels ($L_{Aeq[15min]}$), dB(A)			
	Day	Evening	Night	Day (max)	Evening (max)	Night (Scenario 1) (max)	Night (Scenario 2) (max)
R6a	40	37	37	41	40	40	27
R39a	40	40	39	39	40	40	40
D0065	40	37	37	40	39	39	25
D0066	40	37	37	41	39	38	28
D0071	40	37	37	41	39	38	38

Source: Appendix J

[1] Receivers listed are those predicted to experience potential exceedances of the PSTLs under adverse conditions.

Green denotes a negligible exceedance of 0-2 dB(A) above the PSTL.

Orange denotes a marginal exceedance of 3-5 dB(A) above the PSTL, but the total cumulative industrial noise is less than recommended amenity noise level.

Table 6-17B
Comparison of Dendrobium Mine DA 60-03-2001 Noise Limits and Project PSTLs

Receiver	Dendrobium Mine DA 60-03-2001 Noise Limits ($L_{Aeq[15min]}$)			Project NPfI PSTLs ($L_{Aeq[15min]}$)		
	Day	Evening	Night	Day	Evening	Night
R2	42	42	38	40	40	39
R3a, R5a, R6a and R6b	40	40	37	40	37	37
R39a	37	35	35	40	40	39

Green denotes a Project PSTLs are less stringent (i.e. higher than existing Dendrobium Mine noise limits).

Red denoted a Project PSTLs are more stringent (i.e. less than existing Dendrobium Mine noise limits).

Consequence for the Project

The Project has remodelled the existing operations of the Dendrobium Mine in accordance with the NPfI.

The adoption of the NPfI means predictions under adverse meteorological conditions are now required, which would have been excluded under the INP as well as under the conditions of existing Dendrobium Mine DA 60-03-2001.

The overall effect of this is that the noise modelling for the Project predicts higher noise levels under these adverse conditions.

Compliance monitoring (for the existing operations) suggests that compliance with existing noise limits has generally been achieved for those receivers predicted to experience potential exceedances of the NPfI noise limits. Hence, this suggests that noise modelling for the Project under the NPfI is conservatively high.

In addition, for a number of receivers the NPfI results in more stringent (i.e. lower) noise limits than those derived under the INP (and specified in Dendrobium Mine DA 60-03-2001).

b. Predicted operational noise levels.

The operational noise levels for the Project have been predicted in accordance with the methodology provided in the NPfI.

As stated previously, the NPfI differs to the INP in that it considers noise assessment to now apply under all weather conditions. Therefore, predictions made using the NPfI methodology are likely to be different to those that would be predicted under the INP.

Under the NPfI, the Project EIS has predicted a limited number of negligible noise exceedances of the contemporary PSTLs at privately-owned residences. Only one receiver (R6a) is predicted to experience noise levels with more than a negligible exceedance.

In comparison to the existing Dendrobium Mine noise limits, a number of those predicted exceedances would comply with the existing criteria.

In their submission on the Project, the EPA identified receiver R39a (proximal to the KVCLF) as a receiver with notable differences between the predicted noise levels for the Project (in accordance with the NPfI PSTLs), existing Dendrobium Mine noise limits (derived in accordance with the INP) and the results of compliance monitoring to date.

The predicted noise levels for receiver R39a would generally be in compliance with the Project PSTLs derived under the NPfI (i.e. the Project PSTLs derived under the NPfI are less stringent than the existing noise limits). Notwithstanding the contemporary predictions, compliance has been demonstrated with the existing Dendrobium Mine noise limits at this receiver (South32, 2019).

A similar comparison can be made with receiver R6a, whereby the NPfI criteria are generally more stringent than existing noise limits (for the evening period).

As a result, receiver R6a is predicted to experience a marginal exceedance under both sets of criteria. Under the more stringent Project PSTLs, R6a would experience marginal exceedances during the evening and night periods, however, under the existing Dendrobium Mine noise limits would only experience marginal noise exceedance during the night period (i.e. the existing Dendrobium Mine noise limits are less stringent than the PSTLs for R6a).

The Project noise predictions are therefore, generally consistent with compliance monitoring results to date for this receiver. Consultation with this receiver as well as proposed mitigation measures by South32 are discussed in the sections below.

c. Clarification of adopted equipment SWLs.

The majority of SWLs of equipment used during the operation of the Project have been determined based on noise measurement undertaken on-site, as the majority of the items of plant and equipment are currently operating at the Dendrobium Mine surface facilities.

Recent equipment noise monitoring was undertaken by Renzo Tonin for the Noise and Blasting Assessment (Appendix J of the EIS) at the Dendrobium Pit Top and KVCLF in August 2018.

Those equipment items not captured in the monitoring undertaken have been determined based on manufacturer's specifications or other available information, including Renzo Tonin's database of noise levels and previous studies.

Ongoing maintenance of equipment would be conducted over the life of the Project along with SWL monitoring to confirm the ongoing acoustic performance of mining equipment.

d. Justification of proposed construction hours.

South32 would limit construction of the Dendrobium Pit Top Carpark Extension to between 7:00 am and 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturday (no works are proposed on Sunday), consistent with the *Interim Construction Noise Guideline* (ICNG) recommended standard hours.

The Noise and Blasting Assessment (Appendix J of the EIS) identified the construction of the Dendrobium Pit Top Carpark Extension as the major construction noise source for the Project. However, with the construction period restricted to ICNG recommended standard hours for the Dendrobium Pit Top Carpark Extension, the potential number of exceedances predicted for proximal privately-owned residences would be significantly reduced during the short time the Carpark Extension construction works would be undertaken.

Construction activities outside of standard hours (e.g. Saturday afternoon and Sunday) are considered justified at other surface facilities as construction works are:

- generally, minor upgrades and augmentations of existing infrastructure;
- localised and temporary in nature; and
- generally located remote from potential receptors (e.g. construction of the Ventilation Shaft Sites is located remotely from privately-owned receivers as they are located in the Metropolitan Special Area).

In addition, construction activities outside standard hours are considered justified as it would allow continuity of work for construction crews, reducing the length of the construction period and, therefore, the overall duration of potential impacts from construction noise at receivers.

For all construction activities, South32 commits to maintaining construction noise levels below the highly affected noise level in accordance with the ICNG.

South32 would consult with nearby landowners in regard to construction activities and associated noise management measures.

e. Clarification of road transport noise impacts.

The assessment of potential road transport noise impacts associated with the Project was undertaken in accordance with the NSW *Road Noise Policy* (RNP).

The Project is located in the greater Wollongong area, which has a significant regional population and an extensive and highly trafficked road network.

As such, the Road Transport Assessment (Appendix H of the EIS) identified Cordeaux Road east of Mount Kembla as the road segment most likely to be affected by noise generated by road movements associated with the Project.

The road noise assessment considered road noise associated with the following Project years:

- Year 2020 – peak construction workforce for the Project including the operational workforce;
- Year 2027 – maximum operational workforce of the Project; and
- Year 2035 – operational movements following primary mine access relocating to Cordeaux Pit Top.

The Project traffic noise levels at the closest affected receiver location were predicted by Renzo Tonin in accordance with the RNP and based on traffic projections developed by GTA Consultants for each of the Project years (Appendix H of the EIS).

The Noise and Blasting Assessment predicted that incremental traffic noise for the Project is within the 2 dB relative increase criteria for the nearest privately-owned receivers for all Project years and, therefore, any change as a result of the Project is considered to be barely perceptible.

Regardless of the Project, cumulative noise levels along Cordeaux Road, East of Mount Kembla, for all modelled Project years are predicted to exceed the relevant RNP criteria during the daytime period. Cumulative noise levels would comply with the relevant RNP criteria during the night-time period.

However, increases in predicted cumulative noise levels are small, and are well below the relative increase criteria.

2. Noise mitigation and management measures.

The Noise and Blasting Assessment (Appendix J of the EIS) was prepared in accordance with the NPfI, which requires an assessment of potential noise impacts following the implementation of all reasonable and feasible mitigation measures.

In addition, the Noise and Blasting Assessment adopted indicative SWLs based on noise measurements of equipment undertaken for the Project or based on current best practice mining equipment SWLs.

South32 has previously committed to maintaining operational noise levels at relevant receivers to the Project at the current Dendrobium Mine noise compliance levels through the implementation of the Noise Management Plan (NMP), which includes a range of existing noise management and mitigation measures.

Renzo Tonin (2019) conducted an assessment of reasonable and feasible noise mitigation measures for the Project, particularly in relation to reducing potential noise impacts at the receivers which are located in close proximity to the Dendrobium Pit Top.

Reasonable and feasible mitigation measures that were considered for the Project and incorporated in the modelling at the Dendrobium Pit Top include:

- restriction of surface vehicle movements (e.g. limiting the number and type of operating forklifts) from 10:00 pm to 6:15 am;
- vehicle access restrictions (other than personnel passenger vehicles) controlled through the allowable travel times specified in the Dendrobium Mine Drivers' Code of Conduct; and
- closure of the main workshop door during the evening and night-time periods.

The adopted mitigation measures result in a significant reduction in the number of potential noise exceedances initially identified at the Dendrobium Pit Top.

The existing Dendrobium Mine NMP would also be reviewed and updated to address the Project where appropriate.

The NMP describes a number of noise management and mitigation measures which South32 has implemented to reduce potential noise at the KVCLF, including:

- the replacement of steel rollers with lower noise polyurethane coated rollers of the Kemira Valley conveyor; and
- extensive modifications to the rill tower at the KVCLF to modify the impact plates on the coal delivery chute and the exit doors to reduce noise emissions.

In addition to the measures already incorporated at the Dendrobium Mine, South32 would, if necessary (i.e. as informed by operational noise monitoring results), implement noise management and mitigation measures to reduce operational noise.

3. Noise exceedances at privately-owned residences.

The Noise and Blasting Assessment also gave consideration to the *Voluntary Land Acquisition and Mitigation Policy*. The *Voluntary Land Acquisition and Mitigation Policy* provides that in those cases where the NPfI Project-specific noise criteria are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable.

As described previously, one receiver, R6a, is predicted to experience noise levels with a 'marginal' exceedance of the PSTLs (i.e. 3 dBA above the PSTL) in the evening period and night periods under noise enhancing meteorological conditions, which would occur infrequently (Figure 6-17A).

The predicted noise level at R6a during the evening would comply with the existing evening noise criteria under Development Consent DA 60-03-2001 (40 dBA).

As such, R6a would have the right to mitigation upon request in accordance with the Voluntary Land Acquisition and Mitigation Policy, subject to the conditions of any development consent for the Project. The noise predictions for this receiver are below the existing noise acquisition criteria outlined in Development Consent DA 60-03-2001.

There are only a small number of other predicted noise level exceedances under noise enhancing meteorological conditions at other affected privately-owned receivers (receivers R39a, D0065, D0066 and D0071). These exceedances are 'negligible' (i.e. exceedance is within 0-2 dBA of the PSTLs).

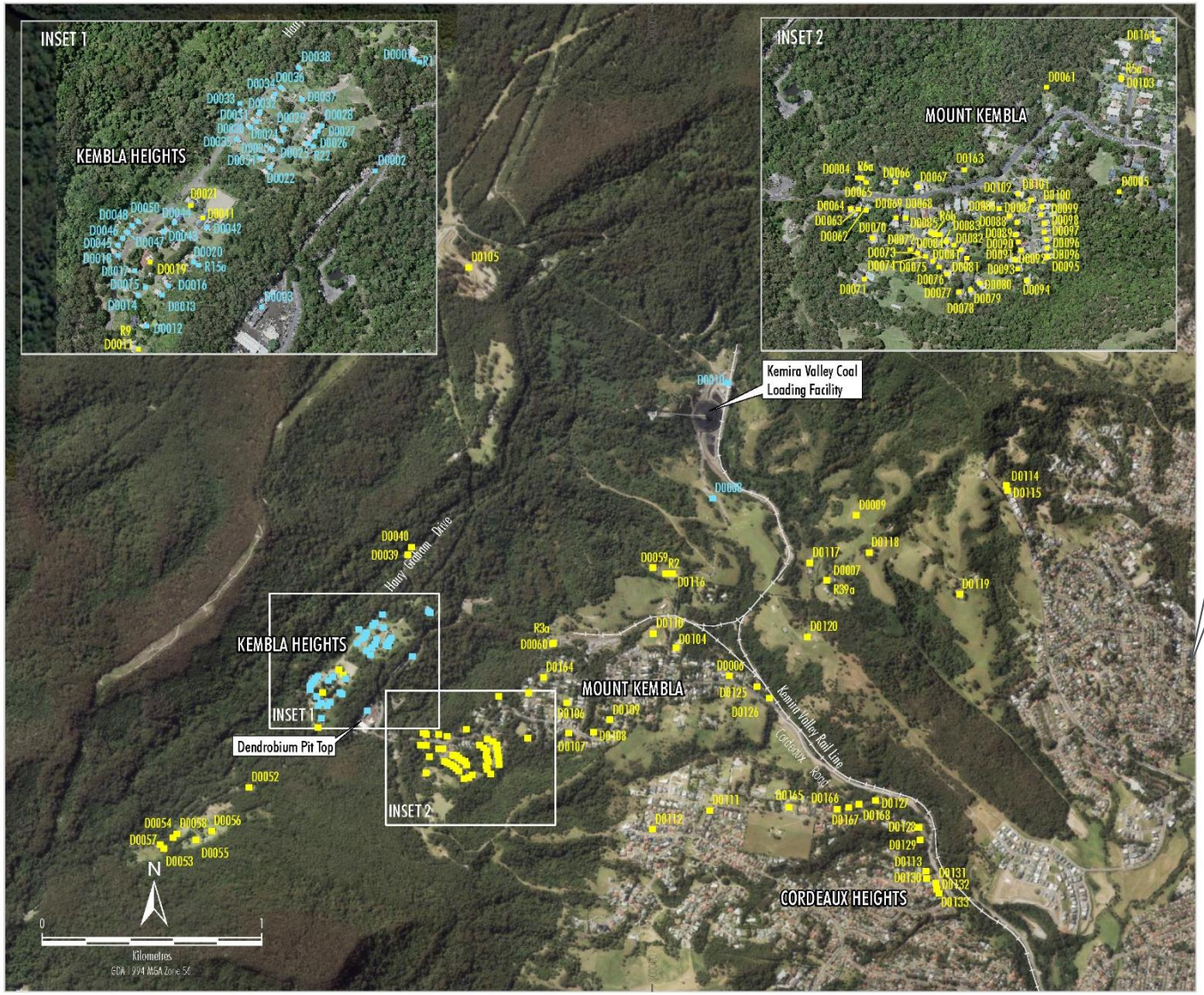
The Project noise predictions are generally consistent with the compliance monitoring to date for receiver R6a (noting the Project predictions represent adverse meteorological conditions which are not assessable under the existing consent). Compliance monitoring generally shows compliance with the existing Dendrobium Mine noise limits, with a marginal (day) and negligible (night-time) exceedance of the noise limits recorded recently during the September 2019 and June 2019 monitoring periods, respectively.

South32 is currently consulting with receiver R6a regarding potential mitigation measures to manage existing noise impacts from the Dendrobium Mine. South32 would continue to consult with this receiver regarding potential mitigation and management measures to manage potential noise impacts of the Project.

The existing Dendrobium Mine NMP would also be reviewed and updated to address the Project where appropriate, including the locations of noise monitoring.

In addition to the measures already incorporated at the Dendrobium Mine, South32 would, if necessary (i.e. as informed by operational noise monitoring results), implement reasonable and feasible mitigation at relevant privately-owned receivers to reduce noise levels.

There are only a small number of other predicted noise level exceedances under noise enhancing meteorological conditions at other affected privately-owned receivers (receivers R39a, D0065, D0066 and D0071). These exceedances are considered negligible (i.e. exceedance is within 0-2 dBA of the PSTLs). The impact of a potential exceedance of 0-2 dBA above the PSTL is negligible and not discernible by the average listener.



LEGEND
- Mine Owned Dwelling
- Privately Owned Dwelling

The Dendrobium Mine surface facilities are existing industrial facilities that have been operating in the local area for an extended period. The Project would not involve significant changes to the operation of these facilities.

One receiver (R6a) is predicted to experience a 'marginal' exceedance of the Project Specific Trigger Levels (PSTLs). There are a small number of additional exceedances predicted, however, these are 'negligible' exceedances of the PSTLs.

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

Illawarra Coal

DENDROBIUM MINE

Receivers Proximal to Dendrobium Pit Top and Kemira Valley Coal Loading Facility

Figure 6-17A

6.18 BLASTING

6.18.1 Submissions

Public and Organisations Submissions

No comments from public and organisation submissions were relevant to blasting.

Agency, Local Council and Service Provider Submissions

The EPA provided comments on the Project relevant to blasting. These comments included:

- Clarification of criteria used in the blasting assessment.
- Clarification of infrastructure considered in the blasting assessment (particularly the dam walls).

6.18.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Clarification of blasting assessment criteria.
2. Consideration of potential blasting impacts to built infrastructure.

6.18.3 Responses

1. Clarification of blasting assessment criteria.

The *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (Australia and New Zealand Environment Council [ANZEC], 1990) has been adopted by the EPA to establish ground vibration and airblast overpressure criteria.

South32 would undertake all blasting activities such that ground vibration and airblast overpressure would comply with the criteria outlined in the *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZEC, 1990), which are repeated in Table 6-18A.

Table 6-18A
Blasting Assessment Criteria

Day	Time of Blasting	Blast Overpressure Level (dB[L_{in}])	Ground Vibration Level (mm/s)
Monday to Saturday	9.00 am – 3.00 pm	115	5
Monday to Saturday	6.00 am – 9.00 am 3.00 pm – 8.00 pm	105	2
Sunday and Public Holidays	6.00 am – 8.00 pm	95	1
Any day	8.00 pm – 6.00 am	95	1

2. Consideration of potential blasting impacts to built infrastructure.

Underground blasting is undertaken infrequently at the Dendrobium Mine.

The maximum predicted ground vibration due to underground blasting activities at any location in the Project underground mining area is predicted to comply with the criteria outlined in Table 6-18A at any point on the surface (i.e. when considering the vertical distance to the surface of between 250 m [Area 5] and 375 m [Area 6]).

Therefore, any underground blasting would comply with criteria regardless of blast location, for all infrastructure and sensitive receivers at the surface.

In regard to the Avon and Cordeaux dam walls, no adverse impacts from blasting are predicted as the dam walls are located more than 1,000 m from the Project underground mining areas.

Potential minor blasts for surface construction activities, if required (i.e. for proposed Ventilation Shaft Sites) would also be designed to comply with relevant blast limits.

South32 commits to complying with the ANZEC blasting criteria at sensitive locations for any blasting required for the Project.

6.19 TRAFFIC

6.19.1 Submissions

Public and Organisations Submissions

Comments made in public and organisation submissions relevant to traffic included:

- Safety and efficiency of the road network as a result of additional Project-related traffic.
- Uncovered heavy vehicles leaving the Dendrobium Pit Top.

Agency, Local Government and Service Provider Submissions

RMS provided comments on the Project relevant to traffic in relation to the Project-only contribution at intersections proximal to the Cordeaux and Dendrobium pit tops.

6.19.2 Key Aspects

In consideration of the submissions described above, detailed responses to the following key aspects are provided below:

1. Clarification of potential impacts to intersection performance due to Project traffic.
    a. SIDRA analysis of intersection performance.
    b. Potential impacts of Project traffic on intersection performance.
2. Safety and efficiency of the road network.

The responses in this section are in relation to potential Project-related traffic movements on the road network. Responses related to traffic noise are provided in Section 6.17.

6.19.3 Responses

1. Clarification of Project impacts to intersection performance due to Project traffic.

a. SIDRA analysis of intersection performance.

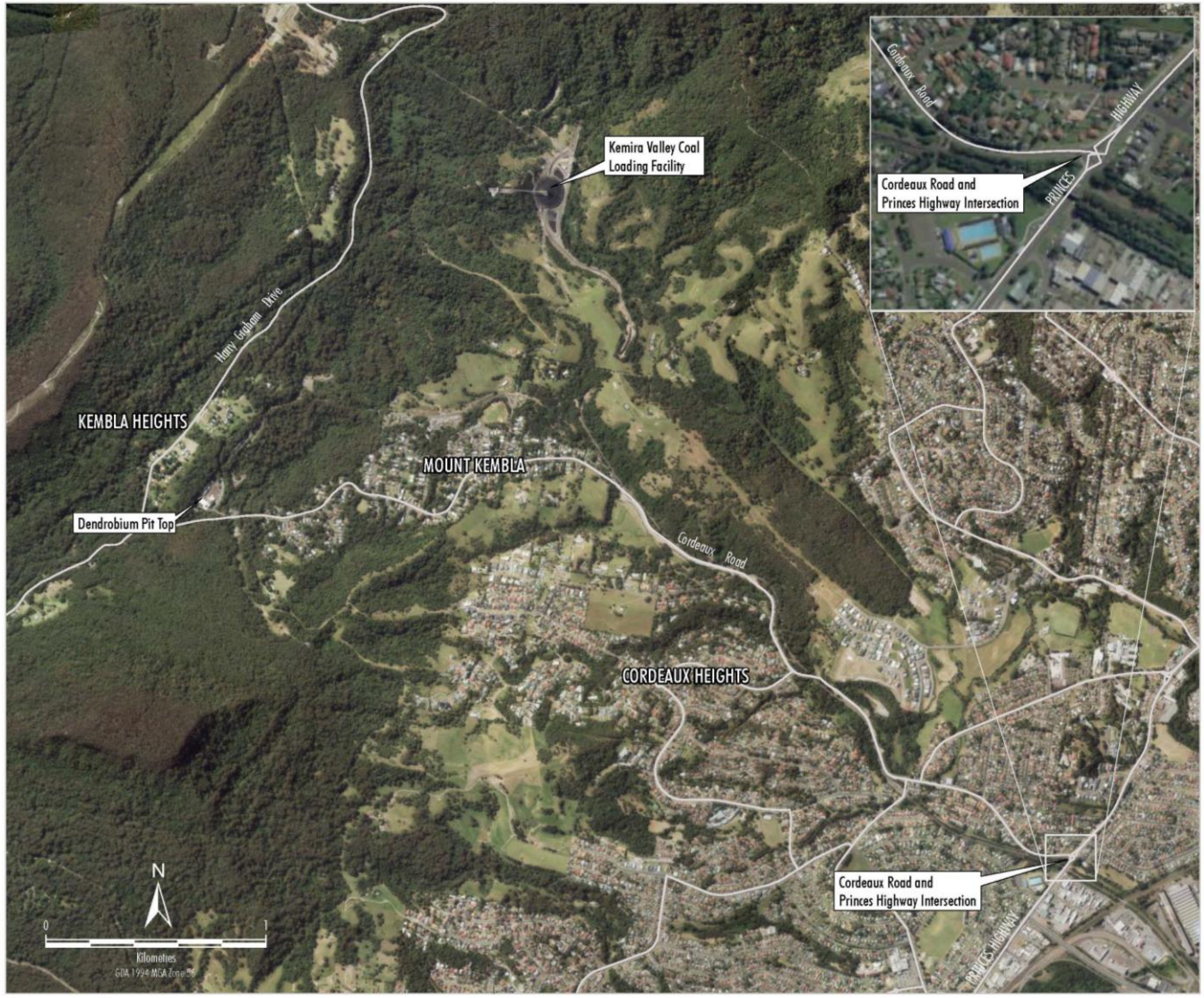
The Project is located in the greater Wollongong area, which has a significant regional population and an extensive and highly trafficked road network.

The Road Transport Assessment prepared for the Project (Appendix H of the EIS) (GTA Consultants, 2019) included a SIDRA analysis of the expected intersection performance with background growth.

The Road Transport Assessment for the EIS concluded that the majority of key intersections utilised by Project traffic would continue to operate at good levels of service in the future during peak hours, in consideration of potential Project traffic on the road network and the contribution of background growth.

Subsequently, RMS requested as part of their submission on the Project that the SIDRA analysis be undertaken for a number of intersections without background growth assumptions to assess intersection performance as a result of Project-only impacts (Table 6-19A and Figures 6-19A and 6-19B).

Table 6-19A lists intersections, and relevant traffic usage associated with construction and operational activities for the Project.



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

SOUTH32

Illawarra Coal

DENDROBIUM MINE

Local Road Network - Dendrobium Pit Top and Kemira Valley Coal Loading Facility

Figure 6-19A

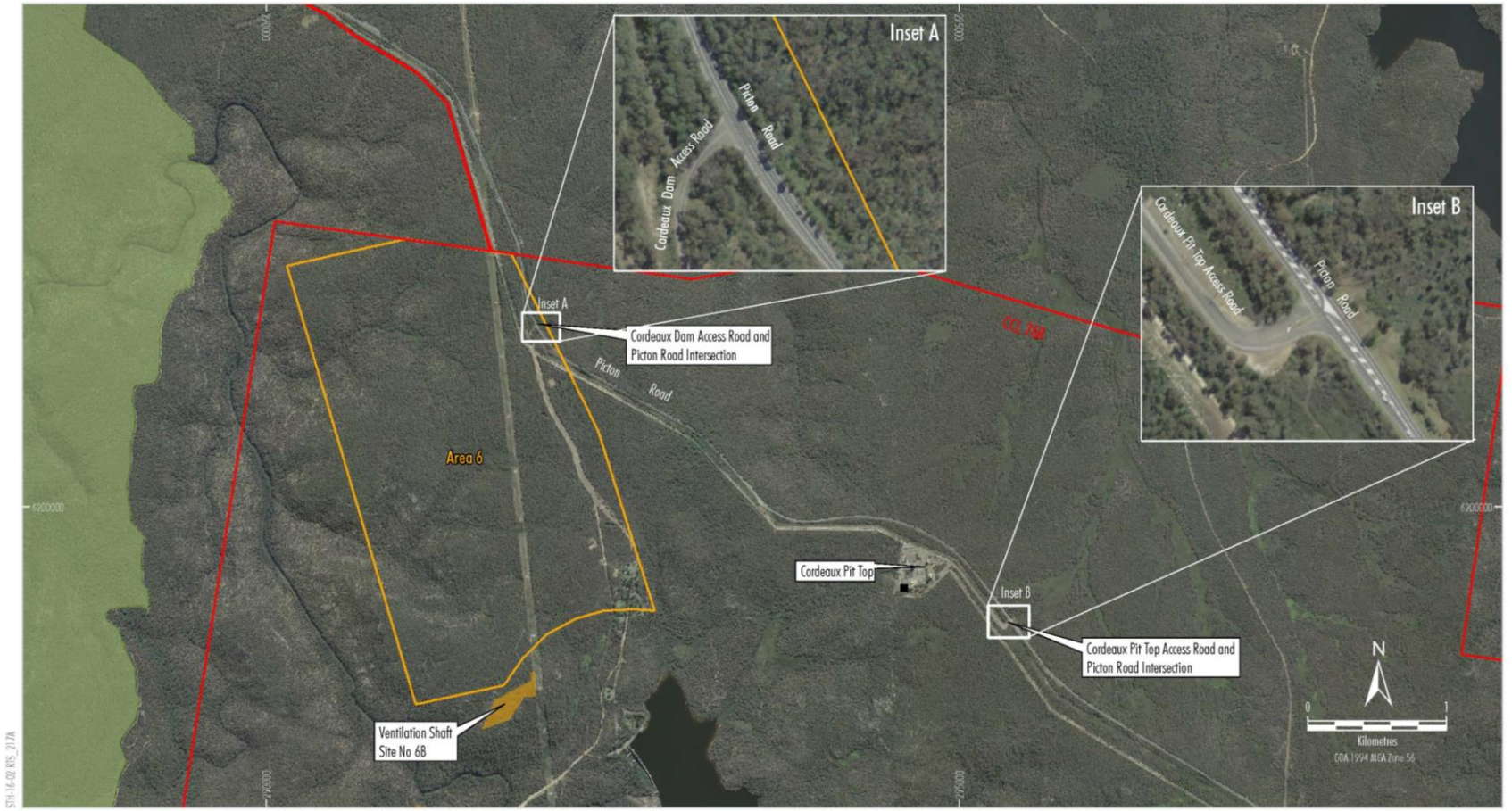

Inset A
Cordeaux Dam Access Road
Picton Road
Inset B
Cordeaux Pit Top Access Road
Picton Road
Inset A
Cordeaux Dam Access Road and Picton Road Intersection
Picton Road
Area 6
Cordeaux Pit Top
Inset B
Cordeaux Pit Top Access Road and Picton Road Intersection
Ventilation Shaft Site No 6B
N
0
1
Kilometres
GDA 1994 MGA Zone 56
LEGEND
Dendrobium Mining Lease
National Park, Nature Reserve and State Conservation Area
Dendrobium Underground Mining Area - Proposed Project
Source: Geoscience Australia (2006); Department of Industry (2018); Department Finance, Services & Innovation (2018);
SOUTH32
Illawarra Coal
DENDROBIUM MINE
Local Road Network - Cordeaux Pit Top

Figure 6-19B

Table 6-19A
Intersections Considered for SIDRA Analysis

Intersection		Project-related Traffic Use
1	Cordeaux Pit Top Access Road and Picton Road	Operational employees accessing/leaving the Cordeaux Pit Top (assuming use of the Cordeaux Pit Top for Area 6 which is not proposed to occur until 2035).
2	Cordeaux Dam Access Road and Picton Road	Construction vehicle accessing/leaving proposed Ventilation Shaft Sites (peak Year 2020).
3	Cordeaux Road and Princes Highway	Operational employees accessing/leaving the Dendrobium Pit Top (peak Year 2027).

GTA Consultants prepared the revised SIDRA analysis for the intersections requested by RMS without the background growth for the peak construction and operational scenarios for the Project. Tables 6-19B to 6-19D provide summaries of the conditions and performance for existing, peak construction and operational scenarios at each intersection.

Table 6-19E presents a summary of the predicted Project-related traffic impacts to intersection performance (without background growth) in comparison to existing conditions.

Table 6-19B
Existing Scenario Intersection Performance

Intersection		Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (m)	Level of Service
1	Cordeaux Pit Top Access Road and Picton Road	AM	Picton Road (South)	0.519	0.1	0	A
			Picton Road (North)	0.509	0.1	0	A
			Cordeaux Pit Top Access Road (West)	0.022	23.8	0.1	B
		PM	Picton Road (South)	0.507	0.1	0	A
			Picton Road (North)	0.591	0.3	1	A
			Cordeaux Pit Top Access Road (West)	0.112	27.1	2.4	B
2	Cordeaux Dam Access Road and Picton Road	AM	Picton Road (South)	0.515	0.1	0.1	A
			Picton Road (North)	0.539	0.2	0.3	A
			Cordeaux Dam Access Road (West)	0.11	30.2	2.3	C
		PM	Picton Road (South)	0.548	0.1	0	A
			Picton Road (North)	0.65	0.2	0	A
			Cordeaux Dam Access Road (West)	0.239	59.5	0.6	E
3	Princes Highway and Cordeaux Road	AM	Princes Highway (South)	0.35	6	18	A
			Princes Highway (North)	0.35	7	20	A
			Cordeaux Road (West)	1.03	58	251	E
		PM	Princes Highway (South)	0.49	6	28	A
			Princes Highway (North)	0.51	7	32	A
			Cordeaux Road (West)	0.59	11	29	A

A = good operation; B = acceptable delays and spare capacity; C = satisfactory; D = near capacity; E = at capacity; F = extreme delay

Table 6-19C
Peak Project Construction Scenario Intersection Performance without Background Growth

Intersection		Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (m)	Level of Service
1	Cordeaux Pit Top Access Road and Picton Road	AM	Picton Road (South)	0.53	1	1	A
			Picton Road (North)	0.51	1	1	A
			Cordeaux Pit Top Access Road (West)	0.02	24	1	B
		PM	Picton Road (South)	0.51	1	1	A
			Picton Road (North)	0.59	1	1	A
			Cordeaux Pit Top Access Road (West)	0.11	28	3	B
2	Cordeaux Dam Access Road and Picton Road	AM	Picton Road (South)	0.52	1	1	A
			Picton Road (North)	0.54	1	1	A
			Cordeaux Dam Access Road (West)	0.17	33	4	C
		PM	Picton Road (South)	0.55	1	1	A
			Picton Road (North)	0.65	1	1	A
			Cordeaux Dam Access Road (West)	0.4	75	8	F
3	Princes Highway and Cordeaux Road	AM	Princes Highway (South)	0.38	6	17	A
			Princes Highway (North)	0.38	7	18	A
			Cordeaux Road (West)	1.06	82	338	F
		PM	Princes Highway (South)	0.51	7	26	A
			Princes Highway (North)	0.54	7	31	A
			Cordeaux Road (West)	0.64	12	36	A

A = good operation; B = acceptable delays and spare capacity; C = satisfactory; D = near capacity; E = at capacity; F = extreme delay

Table 6-19D
Peak Project Operational Scenario Intersection Performance without Background Growth

Intersection		Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (m)	Level of Service
1	Cordeaux Pit Top Access Road and Picton Road	AM	Picton Road (South)	0.52	1	1	A
			Picton Road (North)	0.51	1	1	A
			Cordeaux Pit Top Access Road (West)	0.3	37	8	C
		PM	Picton Road (South)	0.51	1	1	A
			Picton Road (North)	0.59	1	1	A
			Cordeaux Pit Top Access Road (West)	0.63	44	3	D
2	Cordeaux Dam Access Road and Picton Road	AM	Picton Road (South)	0.52	1	1	A
			Picton Road (North)	0.55	1	1	A
			Cordeaux Dam Access Road (West)	0.11	31	2	C
		PM	Picton Road (South)	0.55	1	1	A
			Picton Road (North)	0.65	1	1	A
			Cordeaux Dam Access Road (West)	0.24	61	5	E

Table 6-19D (Continued)
Peak Project Operational Scenario Intersection Performance without Background Growth

Intersection		Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (m)	Level of Service
3	Princes Highway and Cordeaux Road	AM	Princes Highway (South)	0.38	6	17	A
			Princes Highway (North)	0.38	7	18	A
			Cordeaux Road (West)	1.06	77	321	F
		PM	Princes Highway (South)	0.51	7	26	A
			Princes Highway (North)	0.54	7	39	A
			Cordeaux Road (West)	0.29	8	11	A

A = good operation; B = acceptable delays and spare capacity; C = satisfactory; D = near capacity; E = at capacity; F = extreme delay

Table 6-19E
Comparison of Existing Scenario and Project-related Traffic Impacts at Intersections

Intersection		Peak	Leg	Level of Service		
				Existing Scenario	Peak Project Construction Scenario[1]	Peak Project Operational Scenario[1]
1	Cordeaux Pit Top Access Road and Picton Road	AM	Picton Road (South)	A	A	A
			Picton Road (North)	A	A	A
			Cordeaux Pit Top Access Road (West)	B	B	C
		PM	Picton Road (South)	A	A	A
			Picton Road (North)	A	A	A
			Cordeaux Pit Top Access Road (West)	B	B	D
2	Cordeaux Dam Access Road and Picton Road	AM	Picton Road (South)	A	A	A
			Picton Road (North)	A	A	A
			Cordeaux Dam Access Road (West)	C	C	C
		PM	Picton Road (South)	A	A	A
			Picton Road (North)	A	A	A
			Cordeaux Dam Access Road (West)	E	F	E
3	Princes Highway and Cordeaux Road	AM	Princes Highway (South)	A	A	A
			Princes Highway (North)	A	A	A
			Cordeaux Road (West)	E	F	F
		PM	Princes Highway (South)	A	A	A
			Princes Highway (North)	A	A	A
			Cordeaux Road (West)	A	A	A

[1] Note: without background growth.

A = good operation; B = acceptable delays and spare capacity; C = satisfactory; D = near capacity; E = at capacity; F = extreme delay

Grey = change to existing intersection performance as a result of Project-related traffic.

b. Potential impacts of Project traffic on intersection performance.

The results of the SIDRA modelling (without the consideration of background growth) show that the Project would not change the existing performance of the majority of intersections during the peak construction and operational phases (and during the morning and afternoon peak periods) (Table 6-19E).

The predicted intersection performance for the three intersections modelled in the updated SIDRA analysis are described below.

The performance of each intersection is assessed using the SIDRA level of service criteria, where:

- A indicates good operation, and the average delay per vehicle is less than 14 seconds;
- B indicates acceptable delays and spare capacity, and the average delay per vehicle is 15 to 28 seconds;
- C indicates the level of service is satisfactory, and the average delay per vehicle is 29 to 42 seconds;
- D indicates the level of service is near capacity, and the average delay per vehicle is 43 to 56 seconds;
- E indicates the level of service is at capacity, and the average delay per vehicle is 57 to 70 seconds; and
- F indicates extreme delay, and the average delay per vehicle is greater than 70 seconds.

Cordeaux Pit Top Access Road and Picton Road

The Cordeaux Pit Top Access Road and Picton Road intersection would be used primarily for operational activities, assuming the transfer of the primary underground mine access from the Dendrobium Pit Top to the Cordeaux Pit Top when mining operations occur in Area 6. This activity is not proposed to occur until 2035.

The SIDRA model shows that the Cordeaux Pit Top Access Road and Picton Road intersection currently operate at a satisfactory level (SIDRA criteria B) or better, for both morning and afternoon periods.

Generally, modelling for the Project peak construction and peak operational traffic scenarios indicates that the Cordeaux Pit Top Access Road and Picton Road intersection would continue to operate at a similar level of service to existing conditions, with the exception of Cordeaux Pit Top Access Road (West).

Cordeaux Pit Top Access Road (West) will experience a change in service level for peak operational traffic scenario, where morning traffic will operate at a satisfactory (SIDRA criteria C) level, and afternoon traffic will operate at near capacity (SIDRA criteria D).

This change in traffic activity is not proposed to occur until 2035, where operational activities are proposed to relocate to the Cordeaux Pit Top. As described in the EIS, this intersection would require improvements to accommodate for this changed activity.

South32 would review operational shift arrangements in order to provide suitable performance during peak periods (closer to the time of relocation and subject to future traffic conditions at this intersection).

Cordeaux Dam Access Road and Picton Road

The Cordeaux Dam Access Road and Picton Road intersection would be used for construction and operational activities at the proposed Ventilation Shaft Sites.

Construction is proposed to occur from 2020 to 2024 for Shaft Site Nos 5A and 5B, and from 2035 to 2039 for Shaft Site Nos 6A and 6B.

The SIDRA model shows that the Cordeaux Dam Access Road and Picton Road intersection generally has good operation (SIDRA criteria A). However, at Cordeaux Dam Access Road (West), existing peak traffic operates at satisfactory (SIDRA criteria C) levels in the morning, and at capacity (SIDRA criteria E) in the evening.

Modelling for Project peak construction and peak operational traffic scenarios indicates that the Cordeaux Dam Access Road and Picton Road intersection would continue to operate at a similar level of service to existing conditions.

Cordeaux Pit Top Access Road (West) will operate with extreme delay (SIDRA criteria F) in the afternoon period for peak construction for the Project (2020 to 2024 for Shaft Site Nos 5A and 5B, and 2035 to 2039 for Shaft Site Nos 6A and 6B).

Notwithstanding, modelling indicates delays on Cordeaux Dam Access Road and Picton Road intersection under existing traffic conditions, regardless of predicted Project traffic.

Cordeaux Road and Princes Highway Intersection

The Cordeaux Road and Princes Highway intersection would be used primarily by operational employees accessing and leaving the Dendrobium Pit Top.

This peak operational activity for the Project is proposed to occur from 2027.

The SIDRA model shows that the Cordeaux Road and Princes Highway intersection generally has good operation (SIDRA criteria A). However, during the morning traffic period, Cordeaux Road (West) operates at capacity (SIDRA criteria E).

Generally, modelling for the Project peak construction and peak operational traffic scenarios indicates that the Cordeaux Road and Princes Highway intersection would continue to operate at a similar level of service to existing conditions, with the exception of Cordeaux Road (West) during the morning period.

Cordeaux Road (West) will operate with extreme delay (SIDRA criteria F) during the morning period for both peak operation and construction traffic scenarios.

Notwithstanding, it is noted that Cordeaux Road provides access from Kembla Heights to the Princess Highway at Figtree, via the Cordeaux Heights and Mount Kembla residential areas to the east of the Dendrobium Pit Top access road. Cordeaux Road (West) experiences delays regardless of predicted Project traffic.

Overall, modelling shows delays are experienced under existing road conditions regardless of the Project (GTA Consultants, 2019). Therefore, all intersections would continue to operate similar to the existing conditions under both peak construction and operational phases for the Project.

2. Safety and efficiency of the road network.

The Road Transport Assessment (Appendix H of the EIS) concluded that with the additional Project traffic, there is not anticipated to be any material change in the condition of the roads in the region.

A review of the crash data of the surrounding road network identified no specific concerns with the safety of the key routes and accesses used by mine-related traffic. As the Project is not expected to significantly alter traffic flows, the Project is considered unlikely to exacerbate any existing safety issues with the operation of the road network (Appendix H of the EIS).

The transportation, handling and storage of all dangerous goods for the Project would be conducted in accordance with the requirements of the *Storage and Handling of Dangerous Goods – Code of Practice 2005* (WorkCover, 2005) and *NSW Work Health and Safety Regulation, 2017* (or its latest equivalent) (Appendix H of the EIS).

6.20 NON-ABORIGINAL HERITAGE

6.20.1 Submissions

Public and Organisations Submissions

No comments in public and organisation submissions were relevant to non-Aboriginal heritage.

Agency, Local Council and Service Provider Submissions

Agencies, local government and service providers that provided comments on the Project relevant to non-Aboriginal heritage included Wollongong City Council and NSW Heritage Council. These comments included:

- Detail of proposed construction works at Dendrobium Pit Top.
- Preparation of a Conservation Management Plan prior to determination of the Project.
- Management of subsidence impacts on Avon and Cordeaux dam walls.
- Mine plan design to avoid heritage curtilage areas of the dams.
- Potential visual impacts of the Project from historic vantage points.

6.20.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Potential impacts, management and monitoring for listed historic heritage items.
    a. Avon and Cordeaux dam walls.
    b. Dendrobium Pit Top (Nebo Colliery) buildings.
2. Potential visual amenity impacts of the Project on historic heritage.

6.20.3 Responses

1. Potential impacts, management and monitoring for listed historic heritage items.

a. Avon and Cordeaux dam walls.

The Avon Dam wall (State Heritage Register [SHR] ID: 01360) and Cordeaux Dam wall (SHR ID: 01358) were identified in the Historic Heritage Assessment for the Project (Appendix G of the EIS) as already listed state significant historic heritage sites within the vicinity of Area 5 and Area 6.

The Project mining layout has been designed to reduce potential subsidence impacts on the structural integrity or external fabrics of the Avon and Cordeaux dam walls through the implementation of longwall setbacks from these heritage items, including a minimum 1 km setback from any longwall extraction to the dam wall structures, and 300 m setbacks from the FSLs (which encompass a large portion of the curtilage areas of the reservoirs) (Section 6.6).

Based on the setbacks adopted, the predicted subsidence movements at these heritage items (i.e. the dam walls) are expected to be negligible, and within the range of survey tolerance.

The Historic Heritage Assessment (Appendix G of the EIS) found that, on the basis that mining would not adversely affect the dam walls, the Project would result in a negligible impact on the heritage significance of the two dams and their associated infrastructure.

The monitoring and adaptive management approach would involve the monitoring of potential subsidence as the first longwalls are extracted, and would include the development of prescribed triggers for the dam walls. These triggers would be incorporated into relevant TARPs.

The details of the monitoring program for the dam walls would be outlined in the Extraction Plans developed for the Project.

These management measures and monitoring, designed to confirm no damage to the dam walls, would also protect the heritage values of the dams.

b. Dendrobium Pit Top (Nebo Colliery) buildings.

The existing Nebo Colliery is identified as a listed heritage item in the *Wollongong Local Environmental Plan 2009*.

Existing operations at the Dendrobium Pit Top (and therefore, the historic Nebo Colliery) are approved as part of the Dendrobium Mine in accordance with Development Consent DA 60-03-2001, and would continue for the Project.

As part of the Project, South32 plans to upgrade, expand and decommission portions of the existing Dendrobium Pit Top. The proposed works associated with the Project are unlikely to adversely impact the heritage values of the Nebo Colliery heritage site, given the Project would represent continued use of the existing site facilities, wholly consistent with the nature of the heritage item, which is an operational colliery.

The proposed works at the Dendrobium Pit Top would be designed to reduce potential physical impact to the values and significance of the Nebo Colliery as well as Kembla Heights Mining Village.

Although the site has previously been subject to archival recordings as part of previous approved site upgrade works under Development Consent DA 60-03-2001, if any significant heritage relics not previously identified are discovered, works would cease in the immediate area and a suitably qualified specialist would be contacted to assess the site and confirm if any additional management measures are required.

A Conservation Management Plan (CMP) would be prepared for the Project before construction works commence at the Dendrobium Pit Top, which would provide detail for the management of the Nebo Colliery heritage values during construction and operational activities associated with the Project.

2. Potential visual amenity impacts of the Project on historic heritage.

Additional infrastructure from the Project that would have the potential to impact the visual amenity of the listed heritage items are the proposed Ventilation Shaft Sites (to the Avon and Cordeaux dam walls) and proposed upgrades at the Dendrobium Pit Top (to the Nebo Colliery, which is the currently operating Dendrobium Pit Top).

Although temporary views of the Ventilation Shaft Sites may be visible from the dam walls during construction, views of the sites from the dam walls during the operational phase of the Project are likely to be obscured by vegetation.

Therefore, the proposed Ventilation Shaft Sites are not anticipated to result in adverse impacts on the visual amenity of the Avon and Cordeaux dam walls, or its associated heritage values.

Any construction or upgrade works at the Dendrobium Pit Top would incorporate the following measures to reduce any potential impacts to heritage value of the Nebo Colliery buildings associated with its visual character:

- building form – building form would, where practicable, be consistent with the existing Dendrobium Pit Top structures (i.e. which comprise the listed heritage site); and
- fabric – building materials would be in keeping with existing Dendrobium Pit Top building materials and building fabrics (where appropriate to building function).

Responses to submissions relating to potential visual impacts of the Project from historic vantage points are provided in Section 6.21.

6.21 VISUAL

6.21.1 Submissions

Comments made in public and organisation submissions relevant potential impacts included:

- Adequacy of assessment of potential visual impacts in accordance with the requirements of the SEARs.
- Potential impacts of the construction activities to nearby private residences and Mt Kembla village.
- Proposed additional lighting management measures.

There were no agency or local government comments relevant to visual impacts.

6.21.2 Key Aspects

In consideration of the submissions described above, responses to the following key aspects are provided below:

1. Potential visual impacts of the Project construction activities on Mt Kembla village residences.
2. Night-lighting mitigation and management measures.

6.21.3 Responses

1. Potential visual impacts of the Project construction activities on Mt Kembla village residences.

The Project would involve the construction of a new carpark facility to the south of the Dendrobium Pit Top and Cordeaux Road.

Views of the Dendrobium Pit Top from local residential areas are restricted by local vegetation and the undulating topography of Kembla Heights and Mount Kembla. The existing access road, carpark and other ancillary infrastructure are already part of the existing visual landscape and can be seen from Cordeaux Road.

As a result, it is anticipated that the Dendrobium Pit Top Carpark Extension would have a low level of visual impact. Although some construction works may be visible during the construction period, these views would be minor and short-term in nature.

2. Night-lighting mitigation and management measures.

Potential incremental impacts of Project night-lighting and flaring are expected to be minimal given the distance of flaring activities from private residences, intervening topography and native vegetation at other surface facilities, and the continued implementation of the existing mitigation measures of the Dendrobium Mine.

A Lighting Management Plan is currently implemented at the Dendrobium Mine. Although night-lighting arrangements are not expected to materially change as a result of the Project, South32 would review and update the Lighting Management Plan, where appropriate, to reflect the mitigation and management measures for the Project.

South32 would also enclose flares to minimise visibility and fire risk, which would be designed in accordance with the relevant design and safety standards and guidelines.

In addition, South32 has committed to undertaking construction on the Dendrobium Pit Top Carpark Extension during daytime hours only (i.e. 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturdays), therefore, minimising potential night-lighting impacts during the construction period.

The potential impact of night-lighting at the carpark during its operation is expected to be low, with standard measures used to limit light spill (e.g. downward facing lights).

7 PROJECT EVALUATION

Submissions on the Project were received from government agencies, local councils, organisations and members of the public during the exhibition period for the EIS. Approximately 81% of submissions received from members of the public and 50% of submissions received from organisations supported the Project.

This Submissions Report provides responses to aspects raised by submissions from government agencies, local councils, organisations and members of the public during the exhibition period for the EIS and has been prepared in consideration of the *Draft Guideline 4: Guidance for State Significant Projects - Preparing a Submissions Report June 2019* (DPIE, 2019).

Since lodgement of the EIS, South32 has continued to engage with key stakeholders, including government agencies, local councils, local organisations (including businesses) and community members regarding the Project.

Potential impacts of the Project have been assessed against established thresholds of acceptability contained in relevant guidelines and policies where possible. Potential impacts have been avoided or minimised as far as is reasonable or feasible, and mitigation measures and offset strategies are proposed where residual impacts are predicted.

Through the voluntary adoption of the proposed Project design constraints (i.e. longwall setbacks from dam walls, reservoir FSLs, named watercourses and key stream features), and the Project representing a continuation of mining at the Dendrobium Mine, South32 considers the Project can continue to be compatible with existing and future surrounding land uses, including the Metropolitan Special Area.

In addition, South32 commits to offset the predicted subsidence-related surface water losses from the Metropolitan Special Area, such that the Project would result in net neutral or net beneficial effect to Sydney's drinking water supplies.

The Project would generate a significant net benefit to the State of NSW. Economic benefits potentially forgone if the Project does not proceed amount to a net benefit of $1,073.2 million to the State of NSW in NPV terms (Appendix L of the EIS).

Local councils and other stakeholders have identified the importance of the Project to the ongoing viability of the BlueScope Steelworks and, therefore, the Project would result in the continuation of local employment opportunities and support for local businesses.

In consideration of the information provided as assessed and described in the EIS and Submissions Report, South32 considers the benefits of the Project outweigh its impacts and is, on balance, considered to be in the public interest.

8 REFERENCES

Advisian (2016). *Literature Review of Underground Mining Beneath Catchments and Water Bodies.*

Australia and New Zealand Environment Council (1990). *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*.

Australia International Council on Monuments and Sites (2013). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance.*

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

Biosis (2015). *An assessment of changes in the extent and distribution of Coastal Upland Swamps in relation to Longwall mining*. Report for Wollongong Coal.

Biosis (2017). *Dendrobium Terrestrial Ecology Monitoring Program Annual Report for 2016*. Report for Illawarra Coal.

BlueScope Steel Limited (2008). *Submission to Garnaut Climate Change Review by BlueScope Steel Limited*.

BlueScope Steel Limited (2019). *Submission to Chairman of the Independent Expert Panel for Mining in the Catchment.* Letter dated 20 February 2019.

BlueScope Steel Limited (2019). *Submission to Department of Planning and Environment on the Dendrobium Mien Extension Project.*

Bureau of Meteorology (2019). *Groundwater Dependent Ecosystems Atlas.* *Website: http://www.bom.gov.au/water/groundwater/gde/*

Cadence Economics (2019). *Economic Impact Assessment of the Dendrobium Mine – Plan for the Future: Coal for Steelmaking.*

Cardno (NSW/ACT) Pty Ltd (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Aquatic Ecology Assessment.*

Commonwealth Department of Energy and Environment (2018). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomic.*

Commonwealth Department of the Environment (2014). *Conservation Advice (including listing advice) for Coastal Upland Swamps in the Sydney Basin Bioregion.*

Commonwealth Department of the Environment (2016). *National Greenhouse Accounts Factors.*

Commonwealth of Australia (2011). *Australian Drinking Water Guideline*.

Commonwealth of Australia (2015). Australia's Intended Nationally Determined Contribution to a new Climate Change Agreement – August 2015.

Commonwealth of Australia (2017). *Australia's Steel Industry: Forging Ahead.* Senate Economics References Committee.

Department of Energy and Climate Change (2008). *Managing Urban Stormwater Soils and Construction – Volume 2E – Mines and Quarries.*

Department of Energy and Conservation (2004). *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities.*

Department of Environment and Conservation (2006). *NSW Recovery Plan for the Large Forest Owls: Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae)*.

Department of Environment and Climate Change (2007). *The Vertebrate Fauna of Dharawal State Conservation Area, Dharawal Nature Reserve and Adjacent Lands.*

Department of Environment and Conservation (2004). *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities.*

Department of Environment, Climate Change and Water (2010). *Aboriginal cultural heritage consultation requirements for proponents 2010.*

Department of Planning and Environment (2018). *Technical Notes Supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals.*

Department of Planning, Industry and Environment (2019). *Draft Guideline 4: Guidance for State Significant Projects - Preparing a Submissions Report June 2019.*

Department of Sustainability, Environment, Water, Population and Communities (2012). *Environment Protection and Biodiversity Conservation Act Environmental Offsets Policy.*

Fell. C (2014). *Water Treatment and Sydney Catchment*. Discussion Paper for Office of NSW Chief Scientist and Engineer, May 2014.

Good, R., Hope, G. and Blunden, B. (2010). *Dendrobium Area 3A Swamp Impact, Monitoring, Management and Contingency Plan.* Report prepared for Illawarra Coal Holdings Pty Ltd.

GTA Consultants (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Road Transport Assessment.*

HGEO (2018). *Review of potential seepage rates adjacent to Lake Avon, Dendrobium Area 3B*. Letter to South32 Illawarra Coal dated 28 November 2018.

Hydro Engineering and Consulting (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Surface Water Assessment.*

HydroSimulations (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Groundwater Assessment.*

Independent Expert Panel for Mining in the Catchment (2018). *Initial Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines.*

Independent Expert Panel for Mining in the Catchment (2019a). *Independent Expert Panel for Mining in the Catchment Report: Part 1 – Review of specific mining activities at the Metropolitan and Dendrobium coal mines*. Prepared for the NSW Department of Planning, Industry and Environment.

Independent Expert Panel for Mining in the Catchment (2019b). *Report of the Independent Expert Panel for Mining in the Catchment: Part 2 – Coal Mining Impacts in the Special Areas of the Greater Sydney Water Catchment*. Prepared for the NSW Department of Planning, Industry and Environment.

Independent Expert Scientific Community (2019). *Final Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines.*

Independent Pricing and Regulatory Tribunal (2016). *WaterNSW Greater Sydney Price*.

Mine Subsidence Engineering Consultants (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Subsidence Impact Assessment.*

New South Wales Dams Safety Committee (2010). *Mining Near Prescribed Dams: Mining Applications.*

New South Wales Environment Protection Authority (2016). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.*

New South Wales Environment Protection Authority (2017). *Noise Policy for Industry.*

New South Wales Environmental Trust (2010). *Soft engineering solutions for swamp remediation – A "how-to" guide.*

New South Wales Government (2012). *NSW Aquifer Interference Policy.*

New South Wales Government (2015). *Guidelines for the economic assessment of mining and coal seam gas proposals.*

New South Wales Government (2019). *Media Release – NSW Government Provides Certainty for Mining Investment.*

New South Wales Planning Assessment Commission (2010). *Bulli Seam Operations PAC Report*.

Niche Environment and Heritage (2019a). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Biodiversity Assessment Report and Biodiversity Offset Strategy*.

Niche Environment and Heritage (2019b). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Aboriginal Cultural Heritage Assessment*.

Office of Environment and Heritage (2011). *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.*

Office of Environment and Heritage (2014a). *NSW Biodiversity Offset Policy for Major Projects.*

Office of Environment and Heritage (2014b). *NSW Framework for Biodiversity Assessment.*

Office of Environment and Heritage (2016). *Addendum to NSW Biodiversity Offsets Policy for Major Projects: Upland swamps impacted by longwall mining subsidence.*

Office of Environment and Heritage (2017). *NSW Biodiversity Assessment Method.*

Peabody (2013). *Metropolitan Coal Annual Monitoring Summary 2012.*

Peabody (2014). *Metropolitan Coal Annual Review 2013.*

Peabody (2015). *Metropolitan Coal Annual Review, Annual Environment Report, Rehabilitation 2014.*

PSM Consulting (2017). *Height of Cracking – Dendrobium Mine Area 3B.* Report for the Department of Planning and Environment, doc PSM3021-002R.

PSM Consulting (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Geological Structure Review.*

Ramboll (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Air Quality and Greenhouse Gas Assessment.*

Regal, R and Reeves, J. (2017). *Overview of the monitoring of sandstone overhangs for the effects of mining subsidence in the Southern Coalfields.* In Mine Subsidence Technological Society 10th Triennial Conference Proceedings Mine Subsidence: Adaptive Innovation for Managing Challenges.

Renzo Tonin (2019). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Noise and Blasting Assessment.*

SCT (2018). *Assessment of Movement on Shear Planes between Avon Reservoir and the Dendrobium Area 3B Mining Domain to be Conduits for Increased Flow*.

South32 Limited (2016). *Dendrobium Area 3B Swamp Rehabilitation Research Program*.

South32 Limited (2018). *Dendrobium Mine Water Management Plan.*

South32 Limited (2019a). *Dendrobium Mine – Plan for the Future: Coal for Steelmaking Environmental Impact Statement.*

South32 Limited (2019b). *Longwall 17 Watercourse Impact Monitoring, Management and Contingency Plan*.

South32 Limited (2019c). *Longwall 17 Swamp Impact Monitoring, Management and Contingency Plan.*

Sydney Catchment Authority (2010). *Upper Cordeaux No. 2 – Dam Wall & Ground Monitoring. The Sydney Catchment Authority, Survey No. 9a Report, dated April 2010.*

Sydney Water (2017). *Annual Report 2016-17.*

Sydney Water (2019). *Water Conservation Report 2018-2019.*

Trevor Brown and Associates (2016). *Independent Environmental Audit - Metropolitan Coal Project, May 2015*.

Turak, E., Waddell. N., Johnstone, G. (2004). *New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual.*

United Nations Framework Convention on Climate Change (2019). *What is the Paris Agreement? Website:* https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Australia%20First/Australias%20Intended%20Nationally%20Determined%20Contribution%20to%20a%20new%20Climate%20Change%20Agreement%20-%20August%202015.pdf. Date accessed: December 2019.

WaterNSW (2018a). *Draft Standardised Assessment Framework for Mining in the Special Areas – Risk Tool Manual April 2018 (Version vC.2) [Consultation Draft].*

WaterNSW (2018b). *Greater Sydney's water supply system yield May 2018.*

WaterNSW and Office of Environment and Heritage (2015). *Special Areas Strategic Plan of Management 2015.*

Watershed HydroGeo (2019a). *Geographic review of mining effects on Upland Swamps at Dendrobium Mine.*

Watershed HydroGeo (2019b). *Dendrobium Area 3B: Discussion of Surface Water Flow TARPs.*

WorkCover (2005). *Storage and Handling of Dangerous Goods – Code of Practice 2005*.

ATTACHMENT A – SUBMISSIONS SUMMARY

Table A-1A
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Division of Resources & Geoscience (Scott Anson)	563316	Maitland	Public Authority	Comment	1	1	—	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Endeavour Energy	—	Huntingwood	Public Authority	Comment	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Environment Protection Authority (Andrew Couldridge)	563306	Bathurst	Public Authority	Comment	—	—	—	—	—	—	1	—	—	—	—	—	1	—	1	—	1	—	—	—	—
Heritage Council of NSW (Steven Meredith)	571456	Parramatta	Public Authority	Comment	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Independent Expert Scientific Committee	—	—	Public Authority	Comment	—	—	1	—	1	—	1	—	1	1	—	1	1	—	—	—	—	—	—	—	—
NSW Dams Safety Committee	—	Paramatta	Public Authority	Comment	—	—	1	—	1	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—
NSW Department of Planning, Infrastructure and Environment - Biodiversity and Conservation Division Environment, Energy and Science (Southeast Branch)	564966	Parramatta	Public Authority	Comment	—	—	1	—	1	—	—	—	1	1	1	—	1	—	—	—	—	—	—	—	—
NSW Department of Planning, Infrastructure and Environment - Resources Regulator	—	Maitland	Public Authority	Comment	1	1	1	—	1	—	—	—	1	1	1	—	1	—	—	—	—	—	—	—	—
NSW Department of Planning, Infrastructure and Environment - Water	—	—	Public Authority	Comment	—	—	1	1	1	—	1	—	1	1	—	—	1	—	—	—	—	—	—	—	—
NSW Health (Glendon Lee)	564951	Warrawong	Public Authority	Comment	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NSW Roads and Maritime Services (Southern Region)	—	—	Public Authority	Comment	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—
NSW Rural Fire Service	—	Granville	Public Authority	Comment	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Subsidence Advisory NSW	—	Newcastle	Public Authority	Comment	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
WaterNSW (Juri Jung)	563311	Parramatta	Public Authority	Comment	—	—	1	1	1	1	1	—	1	1	—	1	1	—	—	—	—	—	—	—	—
Wingecarribee Shire Council (Barry Arthur)	561796	Moss Vale	Councils	Comment	—	—	1	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Wollondilly Shire Council (Michael Malone)	564961	Picton	Councils	Object	1	1	1	—	1	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—
Wollongong City Council (Ron Zwicker)	563321	Wollongong	Councils	Comment	1	1	1	—	1	—	1	—	1	1	1	—	1	1	1	—	—	—	—	1	1
360HR Recruitment (Joanne Pelham)	561291	Shellharbour	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ampcontrol (Jarrod Fair)	561701	Tomago	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Australian Youth Climate Coalition Wollongong (Dylan Green)	561911	Keiraville	Organisation	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Beyond Zero Emissions (Vanessa Petrie)	562231	Melbourne	Organisation	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
BlueScope Steel (Michael Reay)	562286	Haywards Bay	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CFMMEU Mining and Energy Division, South Western District (Amanda Brown)	561836	Kembla Heights	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Doctors for the Environment Australia Inc (Joy Oddy)	561566	College Park	Organisation	Object	1	1	1	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—
Foreshore Shipping Container Services (james ralston)	561336	Warrawong	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Georges River Environmental Alliance (Sharyn Cullis)	562446	Oatley	Organisation	Object	1	1	1	—	1	—	1	—	1	1	—	—	—	1	—	—	—	—	—	—	—
Greens Northern Beaches (Prudence Wawn)	561146	Avalon Beach	Organisation	Object	—	—	1	—	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Highland Drilling Pty Ltd (Alana Bush)	562026	Berrima	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Highland Water Solutions (Brett Allan Delamont)	562031	Medway	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Illawarra Business Chamber (James Newton)	561971	Wollongong	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Illawarra Innovative Industry Network (i3net) (Bianca Perry)	561601	Wollongong	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Illawarra Local Aboriginal Land Council (Paul Knight)	562451	Wollongong	Organisation	Object	1	1	1	—	1	—	—	—	1	1	1	1	1	—	1	—	—	—	—	—	—
Illawarra Residents Responsible Mining	562126	Corrimal	Organisation	Object	1	1	1	—	1	—	1	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Lane Cove Coal and Gas Watch (Winnie Fu)	562296	Killara	Organisation	Object	1	1	1	—	1	1	1	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Lock the Gate Alliance (Nic Clyde)	562351	Sydney	Organisation	Object	1	1	1	1	1	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—
National Parks Association - Illawarra Branch (Graham Burgess)	561821	Dapto	Organisation	Object	1	1	—	—	1	—	1	—	1	1	—	—	—	—	1	—	—	—	—	—	—
National Parks Association of NSW (Peter Turner)	562241	Pyrmont	Organisation	Comment	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
National Parks Association of NSW (Peter Turner)	562441	Pyrmont	Organisation	Comment	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
National Parks Association of NSW Southern Sydney Branch (Brian Everingham)	561816	Engadine	Organisation	Object	1	1	1	1	1	—	1	—	1	1	—	—	1	—	1	—	—	—	—	—	—
National Parks Association, Macarthur Branch (Julie Sheppard)	562206	Razorback	Organisation	Object	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nature Conservation Council of NSW (Jack Gough)	562221	Sydney	Organisation	Object	1	1	1	1	1	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Nexus Mining	571436	Wollongong	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NSW Ports (Greg Walls)	561856	Port Kembla	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Oliver Taylor (Oliver Taylor)	561346	Paddington	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pacific National (Perry Heo)	561996	North Sydney	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Burn	562151	North Sydney	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Port Kembla Chamber of Commerce (Christopher Atlee)	561901	Coniston	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Project Portfolio Management (Troy McDonald)	561521	Wollongong	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Protect Our Water Alliance (Deidre Stuart)	562261	Keiraville	Organisation	Object	1	1	1	1	—	1	1	—	1	1	1	—	—	—	1	—	—	—	—	—	—
Regional Development Australia - Illawarra (Debra Murphy)	561711	Fairy Meadow	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Singleton Shire Health Environment Group (Neville Hodkinson)	562456	Singleton	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
South Coast Equipment Pty Ltd (Philip Panozzo)	561286	Unanderra	Organisation	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sutherland Shire Environment Centre (Gregory Walker)	561681	Bundeena	Organisation	Object	1	1	1	1	1	—	1	—	1	1	—	1	—	—	1	—	—	—	—	—	—
Total Environment Centre (Jeff Angel)	561301	Surry Hills	Organisation	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
TransGrid (Michael Platt)	561171	Eastern Creek	Organisation	Comment	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
A Mills	562516	West Perth	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aaron Allman	562696	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aaron Cooper	563941	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aaron Donnelly	563736	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Adam Catania	563751	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Adam Morris	562551	Coolum Beach	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Adam Roots	562056	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Adam Sheppard	561516	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Adrian Ingleby	561721	Otford	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Ailsa Johnson	561931	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Alan Ninness	563766	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Alecia Rubbi	562016	Miranda	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Alex Pauza	561216	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Alexander Mehle	561906	Berkeley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Alison Smith	562036	Wollongong	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Amanda Blunt	562526	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Amanda Crehan	562566	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andrew Biermann	563861	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andrew Farina	561741	Cherrybrook	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andrew Relf	561311	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andrew Rosengren	563916	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andrzej Gurba	562491	Oyster Bay	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andy Davey	562796	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andy Telfer	562236	East Corrimal	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Angela Burrows	562161	North Sydney	Public	Object	—	—	1	—	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Angus Dyson	562316	Sutherland	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Anna Harvey	561631	Croydon	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Anne Marett	561706	Corrimal	Public	Object	—	—	1	—	—	1	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Annie Marlow	562346	Berkeley	Public	Object	1	1	1	—	1	1	—	—	1	1	—	1	—	—	1	—	—	—	—	—	—
Anthony Dal Santo	562216	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Anthony Davis	561376	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Anthony Leone	562636	Elderslie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arthur Kirkland	562706	Calderwood	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ashleigh Holland	561841	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Croman	563871	Conjola Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Dormer	561526	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Heemskerk	563656	Bellambi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben O'Rourke	562761	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben R.	562756	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Ransley	561386	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Sartori	563836	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ben Silarski	562536	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Benjamin Jones	563901	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Beverley Atkinson	562086	Scone	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Blake Eager	563706	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brendan Pitt	561921	Marrickville	Public	Object	1	1	1	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Brian Mason	561761	Coledale	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Brian Taylor	563866	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brodie Scott	563921	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bronwen Evans	562341	Darlinghurst	Public	Object	—	—	1	—	1	—	1	—	1	1	—	—	1	—	—	—	—	—	—	—	—
Bronwyn Vost	561951	Hurlstone Park	Public	Object	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C Bilsland	562266	Lane Cove	Public	Object	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Caleb Williamson	563676	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Calvin Richards	561636	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Casey Sargeson	563831	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Catherine Blakey	562181	Wollongong	Public	Object	1	1	1	—	1	—	—	—	1	1	1	—	1	—	1	—	—	—	—	—	—
Catherine Dyson	562321	Cronulla	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Cathy Merchant	561481	Hunters Hill	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Chris Clarke	561696	Nowra	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chris Rowles	563826	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chris Schultz	562541	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Christopher Smith	561226	Singleton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cindy Hawke	562501	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Claudia Walters	561726	Otford	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Cody Brady	562846	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Corbin Brown	563811	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Courtney Fitzsimmons	561426	Sutton Forest	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Craig Bowen	562051	Theresa Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Craig Brackenbury	561561	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Curt Aarsen	563731	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dallas Laughton	562611	Greenwell Point	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Damien Bowler	563956	Austinmer	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Damien Clark	563906	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Damon Johnson	563961	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dane Smith	563776	Bellambi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daniel Chittick	562596	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daniel Vlietstra	561421	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Danielle Sawtell	562506	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Danny Murray	562821	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Darren Hessenberger	561531	Burradoo	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Darren Quinn	563756	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
David Heffernan	561411	Bundeena	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
David Scullard	563761	Miranda	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dean Allison	563856	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dean Gray	562771	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dean Pata	562661	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Deborah Looi	562531	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Derek Finter	561961	Mudgee	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dylan Berning	562806	Mount Pleasant	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dylan Green	561916	Keiraville	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Elsa Story	561896	Woonona	Public	Object	1	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Erin Lee	561381	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fiona Bullivant	561926	Wilton	Public	Object	1	1	1	—	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
FW Giraudi	562786	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Garry Morrissy	562591	Berkeley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gavin Pollock	561486	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gemma Romuld	561936	Woonona	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
George Broadfoot	561251	Bulli	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Georgia Swinton	561331	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Geraldine Michell	561686	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Glenn Hazlewood	562746	Tapitallee	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Graham Baird	563686	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Grant Webster	561621	Hornsby	Public	Object	—	—	1	—	1	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Greg N.	562666	Muswellbrook	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Greg Rey	563786	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Helen Esmond	563161	Cherrybrook	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Hendrik Grundling	562201	Woronora	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—
Hosam Achrafi	562521	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ian Drain	562726	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ian Hill	562256	Otford	Public	Object	1	1	1	—	1	1	1	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Ian Rose	561801	Paddington	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Ikey Doosey-Shaw	561656	Bulli	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Indee Rathnayake	562671	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ingrid Strewe	562271	Bronte	Public	Object	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Irene Tognetti	562431	Keiraville	Public	Object	1	1	1	—	1	1	—	—	1	1	—	1	—	—	1	—	—	—	—	—	—
Isabelle Janicaud	561716	Gymea	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Jack Bowing	563721	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jake Westlake	563661	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
James Chalmers	563986	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jamie Attard	563801	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jamie Walker	561536	Miranda	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Janet Castle	562146	Asquith	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Jason Connor	561991	Adamstown Heights	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Jason Demmery	561571	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jason Haines	562781	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jason McCormack	562731	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jason S.	562721	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jay Townsend	563966	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jeffrey Jacobs	562331	Mount Kembla	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Jeremy Loosz	563691	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jess Whittaker	562426	Wollongong	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Jessica Young	562106	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jessie Hunt	562226	East Corrimal	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Jill Relf	562496	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jim Narbutas	562646	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
john bugg	561396	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John Clarke	562576	Glen Alpine	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John Connelly	562511	Albany Creek	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John de Lacy	563666	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John Fitzgerald	561946	Cronulla	Public	Object	—	—	1	—	—	1	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
John Nellestein	563911	Shoalhaven Heads	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
john pala	561506	Bar Beach	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John Robinson	562831	Milton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
John Spira	561776	Austinmer	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jon Reed	562416	Chatswood	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Joseph Ianni	563971	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Josh C.	562791	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Josh Taylor	562641	Tarrawanna	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Julie Ashby	562356	Gerringong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Julie Marlow	562461	Wollongong	Public	Object	1	1	1	1	1	1	1	—	1	1	—	1	1	—	1	—	—	—	—	—	—
Kane Cotton	562681	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Karen Moroney	562841	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Karina Tuveng	562571	Robertson	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kate Pryor	562676	Primbee	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Katie Grant	561771	Gwynneville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kaye Osborn	562186	Corrimal	Public	Object	—	—	1	—	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Keegan Viney	562741	Tullimbar	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Keelah Lam	562466	Fairlight	Public	Object	—	—	1	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Keith Cole	563851	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kerrie Noakes	561446	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kerry Brydon	562586	Wyong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kerry Lassila	562381	East Corrimal	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Kieran Petrovski	562751	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kiril Dimovski	562561	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kristen Mcdonald	562361	Bulli	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Krystal O'Rourke	562281	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kurtis Trindall	563816	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kyle Kruger	562686	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Kyle Northley	563881	Erskineville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kyle Zimmermann	563926	Tullimbar	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kylie Gibson	562176	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lachlan Cunningham	561201	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Laurie Marcinkowski	562711	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Liam Oakwood	561501	Panton Hill	Public	Object	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lila Gurba	562486	Oyster Bay	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Louise Kirumba	562311	Wolli Creek	Public	Object	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lucas Collins	562816	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lucy Formosa	562836	Mount Keira	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Luke Holmes	563891	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Luke Wright	563806	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lynette Pryor	561646	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
M. Johnston	563796	North Nowra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marie Flood	561746	Alexandria	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Mark Jones	563946	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mark Quodling	562766	Berry	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mark Rayment	563681	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Martin Grymel	561736	North Nowra	Public	Object	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Matthew Amos	562631	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Matthew Berry	561276	Minnamurra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Matthew Loft	561851	Thirroul	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Matthew McMahon	563936	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Matthew Mitchell	563876	Tullimbar	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Matthew Reynolds	562436	Brunswick Heads	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Matthew Rubbi	561766	Miranda	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Max Siddle	563771	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Melinda Menning	562481	Helensburgh	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Merilyn Kelly	561471	Wollongong	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Michael A.	562656	Mount Pleasant	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Michael Gaul	563621	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Michael Goodfellow	561451	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Michael Mitchell	562581	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Michael Parker	563976	Katoomba	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Michael Todd	561541	Cordeaux Heights	Public	Object	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Mick Payne	562556	Camden Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mitch Tubby	563841	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Murray White	562801	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561136	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561151	Sutton Forest	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561156	Cameron Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561161	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561176	Wattle Ponds	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561186	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561196	Mount Ousley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561206	Terrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561221	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561231	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561236	Caringbah South	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561246	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561256	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561266	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561326	Unanderra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561341	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561356	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561391	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561401	Blackbutt	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561406	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561416	Windang	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	561436	Mayfield	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561456	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561491	Coniston	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561511	Sutton Forest	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561551	Renwick	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561611	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561616	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561811	Merewether	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561166	Westmead	Public	Object	—	—	1	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561241	Cordeaux Heights	Public	Object	—	—	—	—	—	—	1	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561431	Austinmer	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	561441	Farmborough Heights	Public	Object	1	1	1	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
Name Withheld	561476	Unanderra	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561546	Valentine	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	561556	Flinders	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561626	Thirroul	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561651	Mount Kembla	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	1	—	1	—	1	—	1
Name Withheld	561671	Keiraville	Public	Object	1	1	1	—	1	—	1	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561691	Oak Flats	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561731	Bellambi	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	561966	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561751	Urila	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	561981	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561986	Hill Top	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561781	Corrimal	Public	Object	1	1	1	1	—	—	1	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561786	Annandale	Public	Object	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561831	Mount Kembla	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	1	—	1	1	1	—	1	—	1
Name Withheld	561861	Mount Kembla	Public	Comment	1	1	1	—	—	—	1	—	—	—	—	—	—	—	—	1	1	—	1	—	—
Name Withheld	561866	Bulli	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	561881	Helensburgh	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562046	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	561886	Woonona	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	561956	Newtown	Public	Object	1	1	1	—	—	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562021	Lindfield	Public	Object	1	1	1	—	—	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562061	Putty	Public	Object	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562066	Gordon	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562111	Gordon	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562091	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562096	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562101	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562116	Pascoe Vale South	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562121	Strathfield	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562131	South Turramurra	Public	Object	1	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562141	Lindfield	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562136	Berkeley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562196	Glebe	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562211	Oak Flats	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	1	—	1	—	1
Name Withheld	562246	Barrack Heights	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562251	Gwynneville	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562166	St Clair	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562276	Russell Vale	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562326	Coogee	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—
Name Withheld	562336	Randwick	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562371	Austinmer	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562386	Eraring	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562391	Wollongong	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	562411	Mount Pleasant	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Name Withheld	562476	Mount Saint Thomas	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Name Withheld	562396	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562406	Lane Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562851	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562856	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562861	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562866	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562871	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562876	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562881	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562886	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562891	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562896	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562901	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562906	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562911	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562916	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562921	Gerroa	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562926	Mount Pleasant	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562931	Bungendore	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562936	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562941	Tarrawanna	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562946	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562951	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562956	Blackbutt	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562961	Austinmer	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562966	Richmond	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562971	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562976	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562981	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562986	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562991	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	562996	Renwick	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563001	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563006	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563011	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563016	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563021	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563026	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563031	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563036	Chatsbury	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563041	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563046	Roma	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563051	Minto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563056	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563061	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563066	Pyree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563071	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563076	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563081	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563086	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563091	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563096	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	563101	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563106	Primbee	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563111	Sussex Inlet	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563116	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563121	Primbee	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563126	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563131	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563136	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563141	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563146	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563151	Austinmer	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563156	Austinmer	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563166	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563171	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563176	Berkeley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563181	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563186	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563191	Tarrawanna	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563196	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563201	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563206	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563211	Austinmer	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563216	Illawong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563221	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563226	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563231	Marrangaroo	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563236	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563241	Booral	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563246	Bellambi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563251	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563256	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563261	Helensburgh	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563266	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563271	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563276	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563281	Hamilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563286	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563291	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563296	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563301	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563326	Nowra Hill	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563331	Sussex Inlet	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563336	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563341	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563346	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563351	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563356	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563361	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563366	St Helens Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563371	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563376	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563381	Croom	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563386	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563391	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563396	Appin	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563401	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563406	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563411	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563416	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	563421	Kembla Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563426	Kembla Grange	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563431	Burrier	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563436	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563441	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563446	Lake Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563451	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563456	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563461	Windang	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563466	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563471	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563476	Scarborough	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563481	Thirlmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563486	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563491	Calderwood	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563496	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563501	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563506	Unanderra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563511	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563516	Miranda	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563521	Thirlmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563526	Quakers Hill	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563531	Mount Pleasant	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563536	Casula	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563541	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563546	Casula	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563551	Wilton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563556	Casula	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563561	Casula	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563566	Casula	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563571	Grasmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563576	Grasmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563581	Grasmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563586	Douglas Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563591	Douglas Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563596	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563601	Douglas Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563606	Barrack Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563611	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563616	Bombo	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563626	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563631	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563636	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563641	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563991	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	563996	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564001	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564006	Bomaderry	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564011	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564016	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564021	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564026	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564031	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564036	Lake Illawarra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564041	Croom	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564046	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	564051	Burradoo	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564056	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564061	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564066	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564071	Primbee	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564076	Mount Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564081	Mount Ousley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564086	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564091	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564096	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564101	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564106	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564111	Merewether	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564116	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564121	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564126	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564131	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564136	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564141	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564146	Shellharbour City Centre	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564151	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564156	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564161	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564166	Bellambi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564171	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564176	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564181	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564186	Mount Warrigal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564191	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564196	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564201	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564206	Berkeley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564211	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564216	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564221	Bellambi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564226	Gerringong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564231	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564236	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564241	Mount Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564246	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564251	Windang	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564256	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564261	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564266	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564271	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564276	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564281	South Nowra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564286	Corlette	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564291	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564296	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564301	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564306	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564311	Tullimbar	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564316	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564321	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	564326	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564331	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564336	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564341	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564346	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564351	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564356	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564361	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564366	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564371	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564376	Balmoral	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564381	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564386	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564391	Renwick	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564396	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564401	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564406	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564411	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564416	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564421	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564426	Kanahooka	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564431	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564436	Unanderra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564441	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564446	Lake Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564451	Unanderra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564456	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564461	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564466	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564471	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564476	Kianga	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564481	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564486	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564491	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564496	Appin	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564501	Wedderburn	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564506	Haywards Bay	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564511	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564516	Buxton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564521	Caringbah South	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564526	Mount Hunter	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564531	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564536	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564541	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564546	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564551	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564556	Koonawarra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564561	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564566	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564571	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564576	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564581	Koonawarra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564586	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564591	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564596	Keiraville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	564601	Wallerawang	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564606	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564611	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564616	Kiama	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564621	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564626	Thirlmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564631	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564636	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564641	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564646	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564651	Nowra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564656	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564661	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564666	Camden South	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564671	Appin	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564676	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564681	Baulkham Hills	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564686	Mount Ousley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564691	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564696	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564701	Woonona	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564706	Engadine	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564711	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564716	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564721	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564726	Thirroul	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564731	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564736	Mount Ousley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564741	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564746	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564751	Gwynneville	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564756	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564761	Russell Vale	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564766	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564771	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564776	Mangerton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564781	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564786	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564791	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564796	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564801	Warrawong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564806	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564811	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564816	Clarence Town	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564821	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564826	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564831	Gerringong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564836	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564841	West Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564846	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564851	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564856	Gymea	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564861	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564866	Towradgi	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564871	Thirlmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564876	Katoomba	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564881	Appin	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Name Withheld	564886	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564891	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564896	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564901	Kiama Downs	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564906	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564911	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564916	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564921	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564926	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564931	Oak Flats	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564936	Albion Park Rail	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Name Withheld	564941	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Neil Cairns	562191	Mount Ousley	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Nicola Curtis	561591	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nikki Grayson	561846	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Olivia Isherwood	562471	Kangaloon	Public	Object	—	—	1	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Olivia Valentine	562006	Kings Beach	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Patricia Kahler	561941	Basin View	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Paul Hawker	561316	North Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Paul Lynch	562401	Port Kembla	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Paul Ryrie	563886	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peggy Fisher	562301	East Killara	Public	Object	—	—	1	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Peter Bishop	563746	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Dowson	562171	Centennial Park	Public	Object	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter F.	562691	Dapto	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Lamb	561891	Fairy Meadow	Public	Object	—	—	1	—	1	—	—	—	1	1	—	1	—	—	1	—	—	—	—	—	—
Peter Maitz	562601	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Maitz	562621	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Noonan	562701	Bulli	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Roberts	561281	Smeaton Grange	Public	Comment	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peter Wilson	561806	Wombarra	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Phil Panozzo	561296	Basin View	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Phillip Enderby	561191	Speers Point	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rachel Bolton	561826	Port Kembla	Public	Object	1	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rada Germanos	561466	Woonona	Public	Object	1	1	1	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Rebecca Page	561581	Engadine	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Rena Friswell	561576	Hornsby	Public	Object	—	—	1	—	—	1	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Rhonda Hunt	561791	Fairy Meadow	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Richard Johnson	561366	Port Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Richard Langford	563896	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rob Charlesworth	562826	Tahmoor	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Robyn Parkinson	562366	Kurnell	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rodney James Latham	562651	Cordeaux Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rohan Shaw	563781	Shell Cove	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rosie Simmons	562041	Woonona	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Ryan Crasta	561211	Balgownie	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ryan Young	561181	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ryan Young	563711	Farmborough Heights	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. AH	562546	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sarah Caruana	561596	Pennant Hills	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Sava Nesic	563646	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Scott Ellerton	562626	Swansea	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Scott Murchison	561641	Ryde	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Scott Rowland	561756	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table A-1A (Continued)
Summary of Submissions

Name	Reference Number	Location	Group	View	Positive Socio-economic	Adverse Socio-economic	Surface Water Losses from the Catchment	Surface Water Licencing	Physical Impacts and Cracking of Streams	Impacts to WaterNSW Assets	Surface Water Quality	EPL Discharges to Allans Creek	Biodiversity	Biodiversity Offset Strategy	Aboriginal Heritage	Geology	Groundwater	Impacts to Built Infrastructure	Greenhouse Gas Emissions	Air Quality	Noise	Blasting	Traffic	Non-aboriginal Heritage	Visual
Scott Sawtell	562776	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Scott Spicer	563981	Thirlmere	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sean Poulton	563791	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sean Watson	561321	Scarborough	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shane Hay	562811	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sharon Pusell	561871	Fairy Meadow	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Shauna Aarsen	563701	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shirley Gladding	562291	Fairy Meadow	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
Simon Green	561676	Keiraville	Public	Object	1	1	1	—	1	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Simon King	563931	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Simon Thomas	561361	Warilla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Simon Twigg	563716	Shellharbour	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Siobhan Irving	562001	Woy Woy	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Stephen Spencer	561306	Wollongong	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Stephen Young	561351	Thirroul	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Steven Whitehead	561661	Fernhill	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stuart Martin	562011	Albion Park	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sue Abbott	562081	Moobi	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Susan Benham	561666	Woonona	Public	Object	—	—	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Susan Gay	562376	Appin	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sybille Frank	562156	Bronte	Public	Object	—	—	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
T. Arthur	563846	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
T. Davidson	563671	Mount Kembla	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
T. Tiananga	562716	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Taj Aarsen	563696	Horsley	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tara Hunt	562306	Fairy Meadow	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Ted Booth	561141	Wollongong	Public	Object	1	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
Terry Lee	561261	Figtree	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thomas lauder	561461	Bargo	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tim Gaudry	561371	Picton	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Timothy Cummins	562606	Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Todd Nederkoorn	562736	Fairy Meadow	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tom Kristensen	561876	Maianbar	Public	Object	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tony Leslie	563951	—	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Troy Kowalczyk	563821	Wandandian	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tyson Calvo	561586	Cremorne	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vanessa Dodd	561271	Calderwood	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vojislav Nesic	563651	Unanderra	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. Bakker	563741	Flinders	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wendy Wales	561976	Kayuga	Public	Object	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
William D'Arcy	561606	Oakdale	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
William Holliday	562076	Lilyfield	Public	Object	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Winnie Fu	562071	Kensington	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Yuawhoi Wang	562616	Wollongong	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Yul Scarf	562421	Woonona	Public	Object	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Zac Muscat	563726	East Corrimal	Public	Support	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zoe King	561496	Abbotsford	Public	Object	1	1	1	—	1	1	—	—	1	1	—	—	1	—	1	—	—	—	—	—	—
Total					**696**	**94**	**157**	**10**	**109**	**66**	**29**	**1**	**111**	**111**	**7**	**10**	**68**	**6**	**106**	**2**	**5**	**1**	**6**	**2**	**5**
Public Authority (agencies)					3	3	6	2	7	2	4	1	7	7	2	3	7	3	1	—	1	1	1	1	1
Public Authority (councils)					2	2	3	—	3	—	2	—	2	2	1	1	2	1	1	—	—	—	—	1	1
Organisations					33	14	17	6	12	2	9	—	12	12	2	2	5	2	11	—	—	—	1	—	—
Public					658	75	131	2	87	62	14	—	90	90	2	4	54	—	93	2	4	—	4	—	3

ATTACHMENT B – REGISTER OF SUBMITTERS

Table B-1A
Register of Submitters

Group	Reference Number	Name	Where issues are addressed (section)*
Public Authority	563316	Division of Resources & Geoscience (Scott Anson)	6.1,6.2,6.5,6.9,6.10
Public Authority	—	Endeavour Energy	6.14
Public Authority	563306	Environment Protection Authority (Andrew Couldridge)	6.7,6.13,6.15,6.17
Public Authority	571456	Heritage Council of NSW (Steven Meredith)	6.20,6.21
Public Authority	—	Independent Expert Scientific Committee	6.3,6.5,6.7,6.9,6.10,6.12,6.13
Public Authority	—	NSW Dams Safety Committee	6.3,6.5,6.6,6.8,6.12,6.13,6.18
Public Authority	564966	NSW Department of Planning, Infrastructure and Environment - Biodiversity and Conservation Division Environment, Energy and Science (Southeast Branch)	6.3,6.5,6.9,6.10,6.11,6.13
Public Authority	—	NSW Department of Planning, Infrastructure and Environment - Resources Regulator	6.1,6.2,6.3,6.5,6.9,6.10,6.11,6.13
Public Authority	—	NSW Department of Planning, Infrastructure and Environment - Water	6.3,6.4,6.5,6.7,6.9,6.10,6.13
Public Authority	564951	NSW Health (Glendon Lee)	6.1,6.2
Public Authority	—	NSW Roads and Maritime Services (Southern Region)	6.14,6.19
Public Authority	—	NSW Rural Fire Service	6.9,6.10
Public Authority	—	Subsidence Advisory NSW	6.14
Public Authority	563311	WaterNSW (Juri Jung)	6.3,6.4,6.5,6.6,6.9,6.10,6.7,6.9,6.10,6.12,6.13
Councils	561796	Wingecarribee Shire Council (Barry Arthur)	6.3,6.5,6.13
Councils	564961	Wollondilly Shire Council (Michael Malone)	6.1,6.2,6.3,6.5,6.7,6.9,6.10,6.12
Councils	563321	Wollongong City Council (Ron Zwicker)	6.1,6.2,6.3,6.5,6.7,6.9,6.10,6.11,6.13,6.14,6.15,6.20,6.21
Organisation	561911	Australian Youth Climate Coalition Wollongong (Dylan Green)	6.3,6.5,6.9,6.10,6.15
Organisation	562231	Beyond Zero Emissions (Vanessa Petrie)	6.1,6.2,6.3,6.15
Organisation	561566	Doctors for the Environment Australia Inc (Joy Oddy)	6.1,6.2,6.3,6.13,6.15
Organisation	562446	Georges River Environmental Alliance (Sharyn Cullis)	6.1,6.2,6.3,6.5,6.7,6.9,6.10,6.14
Organisation	561146	Greens Northern Beaches (Prudence Wawn)	6.3,6.5,6.7,6.9,6.10
Organisation	562451	Illawarra Local Aboriginal Land Council (Paul Knight)	6.1,6.2,6.3,6.5,6.9,6.10,6.11,6.12,6.13,6.15
Organisation	562126	Illawarra Residents Responsible Mining	6.1,6.2,6.3,6.5,6.7,6.9,6.10,6.13,6.15
Organisation	562296	Lane Cove Coal and Gas Watch (Winnie Fu)	6.1,6.2,6.3,6.5,6.6,6.7,6.9,6.10,6.15
Organisation	562351	Lock the Gate Alliance (Nic Clyde)	6.1,6.2,6.3,6.4,6.5,6.9,6.10,6.13
Organisation	561821	National Parks Association - Illawarra Branch (Graham Burgess)	6.1,6.2,6.5,6.7,6.9,6.10,6.15
Organisation	562241	National Parks Association of NSW (Peter Turner)	6.3
Organisation	562441	National Parks Association of NSW (Peter Turner)	6.3
Organisation	561816	National Parks Association of NSW Southern Sydney Branch (Brian Everingham)	6.1,6.2,6.3,6.4,6.5,6.7,6.9,6.10,6.13,6.15
Organisation	562206	National Parks Association, Macarthur Branch (Julie Sheppard)	6.1,6.2,6.3,6.4
Organisation	562221	Nature Conservation Council of NSW (Jack Gough)	6.1,6.2,6.3,6.4,6.5,6.7,6.15
Organisation	562261	Protect Our Water Alliance (Deidre Stuart)	6.1,6.2,6.3,6.4,6.6,6.7,6.9,6.10,6.11,6.15
Organisation	561681	Sutherland Shire Environment Centre (Gregory Walker)	6.1,6.2,6.3,6.4,6.5,6.7,6.9,6.10,6.12,6.15
Organisation	561301	Total Environment Centre (Jeff Angel)	6.1,6.2,6.3,6.5,6.9,6.10
Organisation	561171	TransGrid (Michael Platt)	6.14

Table B-1A (Continued)
Register of Submitters

Group	Reference Number	Name	Where issues are addressed (section)*
Public	561721	Adrian Ingleby	6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562036	Alison Smith	6.3,6.5,6.9,6.10,6.15
Public	562236	Andy Telfer	6.3
Public	562161	Angela Burrows	6.3,6.5,6.7,6.9,6.10
Public	562316	Angus Dyson	6.3,6.5,6.9,6.10
Public	561631	Anna Harvey	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561706	Anne Marett	6.3,6.6,6.9,6.10,6.15
Public	562346	Annie Marlow	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.12,6.15
Public	562086	Beverley Atkinson	6.1,6.2,6.3,6.3,6.15
Public	561921	Brendan Pitt	6.1,6.2,6.3,9,6.9,6.10
Public	561761	Brian Mason	6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562341	Bronwen Evans	6.3,6.5,6.7,6.9,6.10,6.13
Public	561951	Bronwyn Vost	6.3,6.5
Public	562266	C Bilsland	6.3,6.6
Public	562181	Catherine Blakey	6.1,6.2,6.3,6.5,6.9,6.10,6.11,6.13,6.15
Public	562321	Catherine Dyson	6.3
Public	561481	Cathy Merchant	6.3,6.5,6.9,6.10,6.15
Public	561696	chris clarke	6.3
Public	561726	Claudia Walters	6.3,6.5,6.6,6.9,6.10
Public	561411	David Heffernan	6.1,6.2,6.3.6.5,6.6,6.9,6.10,6.13,6.15
Public	561961	Derek Finter	6.3
Public	561916	Dylan Green	6.3,6.15
Public	561896	Elsa Story	6.1,6.2,6.3,6.6
Public	561926	Fiona Bullivant	6.1,6.2,6.3,6.5,6.7,6.9,6.10
Public	561936	Gemma Romuld	6.3,6.5,6.9,6.10,6.15
Public	561251	George Broadfoot	6.1,6.2,6.3,6.5,6.9,6.10
Public	561621	Grant Webster	6.3,6.5,6.7,6.15
Public	563161	Helen Esmond	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562201	Hendrik Grundling	6.3,6.5,6.6,6.9,6.10,6.13
Public	562256	Ian Hill	6.1,6.2,6.3,6.5,6.6,6.7,6.9,6.10,6.13,6.15
Public	561801	Ian Rose	6.3,6.15
Public	561656	Ikey Doosey-Shaw	6.1,6.2,6.3
Public	562271	Ingrid Strewe	6.3,6.6
Public	562431	Irene Tognetti	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.12,6.15
Public	561716	Isabelle Janicaud	6.3,6.15
Public	561536	Jamie Walker	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562146	Janet Castle	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15

Table B-1A (Continued)
Register of Submitters

Group	Reference Number	Name	Where issues are addressed (section)*
Public	561991	Jason Connor	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562331	Jeffrey Jacobs	6.3,6.5,6.9,6.10
Public	562426	Jess Whittaker	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562226	Jessie Hunt	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561946	John Fitzgerald	6.3,6.6,6.9,6.10,6.15
Public	561776	John Spira	6.3
Public	562416	Jon Reed	6.1,6.2,6.3,6.3,6.15
Public	562461	Julie Marlow	6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.9,6.10,6.12,6.13,6.15
Public	562186	Kaye Osborn	6.3,6.5,6.7,6.9,6.10
Public	562466	Keelah Lam	6.3,6.9,6.10,6.15
Public	562381	Kerry Lassila	6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562361	Kristen Mcdonald	6.1,6.2,6.3,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561501	Liam Oakwood	6.3,6.5,6.6
Public	562311	Louise Kirumba	6.3,6.5
Public	561746	Marie Flood	6.1,6.2,6.3,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561736	Martin Grymel	6.3,6.5
Public	561851	Matthew Loft	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562436	Matthew Reynolds	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562481	Melinda Menning	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561471	Merilyn Kelly	6.1,6.2,6.3,6.5,6.9,6.10
Public	561541	Michael Todd	6.15
Public	561166	Name Withheld	6.3,6.9,6.10
Public	561241	Name Withheld	6.7,6.9,6.10,6.15
Public	561431	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561441	Name Withheld	6.1,6.2,6.3,6.5,6.11
Public	561476	Name Withheld	6.1,6.2,6.3
Public	561546	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561556	Name Withheld	6.1,6.2,6.3,6.15
Public	561626	Name Withheld	6.3,6.5,6.9,6.10,6.15
Public	561651	Name Withheld	6.1,6.2,6.3,6.5,6.9,6.10,6.15,6.17,6.19,6.21
Public	561671	Name Withheld	6.1,6.2,6.3,6.5,6.7,6.9,6.10,6.15
Public	561691	Name Withheld	6.3
Public	561731	Name Withheld	6.3,6.5,6.9,6.10,6.13,6.15
Public	561751	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561781	Name Withheld	6.1,6.2,6.3,6.4,6.7,6.9,6.10,6.15
Public	561786	Name Withheld	6.15
Public	561831	Name Withheld	6.1,6.2,6.3,6.5,6.9,6.10,6.13,6.15,6.16,6.17,6.19,6.21

Table B-1A (Continued)
Register of Submitters

Group	Reference Number	Name	Where issues are addressed (section)*
Public	561861	Name Withheld	6.1,6.2,6.3,6.7,6.16,6.17,6.19
Public	561866	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561881	Name Withheld	6.1,6.2,6.36.5,6.6,6.9,6.10,6.13,6.15
Public	561886	Name Withheld	6.1,6.2,6.3,6.15
Public	561956	Name Withheld	6.1,6.2,6.3,6.6,6.9,6.10,6.13,6.15
Public	562021	Name Withheld	6.1,6.2,6.3,6.6,6.9,6.10,6.13,6.15
Public	562061	Name Withheld	6.1,6.2,6.15
Public	562066	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.15
Public	562111	Name Withheld	6.3,6.15
Public	562116	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562121	Name Withheld	6.3
Public	562131	Name Withheld	6.1,6.2,6.15
Public	562141	Name Withheld	6.3,6.15
Public	562196	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562211	Name Withheld	6.3,6.5,6.9,6.10,6.15,6.17,6.19,6.21
Public	562246	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562251	Name Withheld	6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562276	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562326	Name Withheld	6.3,6.5,6.6,6.9,6.10,6.13
Public	562336	Name Withheld	6.3,6.15
Public	562371	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562386	Name Withheld	6.3,6.5,6.9,6.10,6.15
Public	562391	Name Withheld	6.1,6.2,6.3
Public	562411	Name Withheld	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562476	Name Withheld	6.3,6.5,6.9,6.10,6.15
Public	562191	Neil Cairns	6.3,6.15
Public	562471	Olivia Isherwood	6.3,6.9,6.10,6.15
Public	562006	Olivia Valentine	6.3,6.15
Public	561941	Patricia Kahler	6.3
Public	562401	Paul Lynch	6.1,6.2,6.3,6.5,6.9,6.10,6.13,6.15
Public	562301	Peggy Fisher	6.3,6.9,6.10,6.15
Public	562171	Peter Dowson	6.3,6.5,6.7
Public	561891	Peter Lamb	6.3,6.5,6.9,6.10,6.12,6.15
Public	561281	Peter Roberts	6.1,6.2
Public	561806	Peter Wilson	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561826	Rachel Bolton	6.1,6.2,6.3,6.6
Public	561466	Rada Germanos	6.1,6.2,6.3,6.6,6.15

Table B-1A (Continued)
Register of Submitters

Group	Reference Number	Name	Where issues are addressed (section)*
Public	561581	Rebecca Page	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561576	Rena Friswell	6.3,6.6,6.9,6.10,6.15
Public	561791	Rhonda Hunt	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562366	Robyn Parkinson	6.3
Public	562041	Rosie Simmons	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561596	Sarah Caruana	6.1,6.2,6.3,6.5,6.6,.6.9,6.10,6.13,6.15
Public	561641	Scott Murchison	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561871	Sharon Pusell	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562291	Shirley Gladding	6.1,6.2,6.3,6.3,6.5,6.9,6.10,6.15
Public	561676	Simon Green	6.1,6.2,6.3,6.5,6.7,6.9,6.10
Public	562001	Siobhan Irving	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561306	Stephen Spencer	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561351	Stephen Young	6.1,6.2,6.3,6.5,6.9,6.10
Public	562081	Sue Abbott	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561666	Susan Benham	6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562376	Susan Gay	6.3
Public	562156	Sybille Frank	6.3,6.5,6.9,6.10
Public	562306	Tara Hunt	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	561141	Ted Booth	6.1,6.2,6.3,6.5,6.9,6.10
Public	561876	Tom Kristensen	6.3,6.5,6.7
Public	561976	Wendy Wales	6.3,6.15
Public	561606	William D'Arcy	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562071	Winnie Fu	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15
Public	562076	William Holliday	6.3,6.5
Public	562421	Yul Scarf	6.1,6.2,6.3,6.15
Public	561496	Zoe King	6.1,6.2,6.3,6.5,6.6,6.9,6.10,6.13,6.15

* only objecting or commenting individual submissions are presented.

ATTACHMENT C – RESPONSES TO IEP RECOMMENDATIONS IN RELATION TO THE PROJECT

Table A3-1
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
IEP Part 1 Report					
1	*Subsidence Management Plans for future longwall panels in Area 3B at Dendrobium Mine must:* *i. give very careful consideration to the risk to water quantity in the catchment presented by basal shear planes, lineaments, faults and mining-induced changes in permeability around the flanks of Avon Reservoir* *ii. give very careful consideration to the potential for further mining in the southern end of Area 3B to reduce confinement of fault planes and the implication of this for enhanced conductivity between Lake Avon and both the Elouera and Dendrobium mine workings* *iii. be supported by robust independent peer review, risk assessment and risk mitigation controls.*	Ground Subsidence Effects	• This recommendation is specific to SMPs for the Dendrobium Mine. • In addition to the EIS assessments, Extraction Plans for the Project would further consider risks to water quantity in consideration of geological features (including the incorporation of contemporary knowledge as mapping of geological features continues to be refined), with supporting risk assessment and review (including peer review).	N/A	✓
2	*The conditions of approval for LW 301 and LW 302 at Metropolitan Mine in relation to additional groundwater monitoring (Section 7.1) and further investigations into potential impacts on Woronora Reservoir (Section 7.2) should be carried forward into future approvals and have explicit regard to the potential for mining-induced impacts on the hydraulic conductivity of lineaments, the possible development of basal shear planes and the risk that these impacts could present to water quantity in the catchment.*	Ground Subsidence Effects	• This recommendation is not relevant to the Project.	N/A	N/A

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
3	*The concept of restricting predicted valley closure to a maximum of 200 mm to avoid significant environmental consequences should be reviewed for watercourses.*	Groundwater Impacts	• The SMP and Environmental Management Plan processes at the Dendrobium Mine have successfully used the closure impact model to date as a longwall setback design tool from named watercourses. The adoption of a target value of 200 mm predicted closure has resulted in a low-likelihood of impact (consistent with the model predictions) at the Dendrobium Mine. • Consistent with the existing application of the closure model, the Project would also adopt this design tool, and when applied on a case-by-case basis, the closure impact model can be refined and continued to be used to achieve a specified level of impact likelihood (refer to Section 6.5 of the Submissions Report).	Project EIS	South32 supports the ongoing review of data to refine the closure impact model, which would be undertaken for the Project. Notwithstanding, a reduction in the long-accepted target of 200 mm predicted closure for designing setbacks for named streams at Dendrobium Mine and the Project would have material implications for South32, is not considered to be justified, and would not be supported.
4	*In future, mines operating in the Special Areas need to develop, in consultation and with the agreement of regulators and key stakeholders, a standard for field investigations, data collection, analysis and reporting that provides for and integrates the interests of all stakeholders and facilitates the sharing of the information by being presented on a common platform.*	Groundwater Impacts	• This recommendation is consistent with the SMP and Environmental Management Plan processes at the Dendrobium Mine, where details of monitoring programs (e.g. location, frequency, purpose, method [including with reference to Australian Standards where relevant]) are described and provided to relevant stakeholders for consultation.	Extraction Plans / Management Plans	✓
5	*This monitoring standard should include provision for:* *i. installation of multi-level piezometers on the centreline of panels at Dendrobium and Metropolitan mines in order to monitor pore pressure changes associated with subsidence. These should include at least five transducers per borehole with installation being completed at least two years in advance of being undermined.*	Groundwater Impacts	i. Consistent with existing operations, South32 would continue to implement multi-level piezometers on the centre line of panels for the Project, with at least 5 transducers per borehole. More than two years of data would sought to be obtained prior to undermining where possible (for example it may not be practical to drill piezometers at every longwall in the Metropolitan Special Area due to surface constraints).	Extraction Plans	✓
	ii. daily monitoring of local rainfall and of mine water ingress from overlying and surrounding strata; and separation of rainfall-correlated inflows for base flow volumetric analyses.		ii. Rain gauges have been installed in Area 5 and 6 that log daily rainfall data. South32 currently undertakes daily monitoring of local rainfall and mine water ingress to enable analysis of rainfall-correlated inflows (refer to Table 4-8 of the EIS Groundwater Assessment for this analysis). This monitoring would continue for the Project. The monitoring above would be described in Extraction Plans and Environmental Management Plans for the Project.	Extraction Plans	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
	iii. Dendrobium Mine and Metropolitan Mine to develop site-specific databases in relation to the height of complete drainage in lieu of relying on height of drainage equations.		iii. Data from piezometers and weather stations would be used to develop site-specific information about the height of pressure heads reducing to zero in a short period after undermining (referred to by Tammetta as complete groundwater drainage) above longwall panels mined at the Dendrobium Mine and for the Project.	Extraction Plans / End of Panel Reports / Annual Reporting	✓
6	*Notwithstanding that uncertainty is associated with both the Tammetta and the Ditton height of complete drainage equations, it is recommended to err on the side of caution and defer to the Tammetta equation until:* *i. field investigations quantify the height of complete drainage at the Dendrobium Mine and Metropolitan Mine, and/or* *ii. geomechanical modelling of rock fracturing and fluid flow is utilised to inform the calibration of groundwater models*	Groundwater Impacts	• As described in 5(iii), data from piezometers and weather stations would be used to develop site-specific information about the height of depressurisation above longwall panels mined. • The Project groundwater assessment has used geotechnical FLAC2D modelling to estimate the height of connective fracturing (for the Project longwall panels with void width of 305 m). This modelling is relatively new and not calibrated to an extensive dataset, however, analysis shows that the height of depressurisation adopted in the Project groundwater model using geotechnical modelling is higher than (i.e. more conservative than) what would be calculated using the Tammetta equation. • Extraction Plans for the Project would continue to adopt best-practice and conservative groundwater modelling methods, incorporating the latest monitoring data.	Project EIS / Extraction Plans	✓
7	*Research be progressed into the use of tritium for calculating 'modern' water contributions at Dendrobium Mine, including the potential for results to be affected (skewed) by adsorption.*	Groundwater Impacts	• In addition to the use of tritium, South32 has undertaken trials to assess other methods to 'date' the age of mine water at the Dendrobium Mine. • Consistent with existing operations, South32 would undertake water quality sampling for the Project, targeting tritium and other parameters (as an indicator of the presence of modern water), which would be described in Extraction Plans and Environmental Management Plans for the Project. • It is anticipated that a combination of techniques would be used to confirm water pathways and complement the existing chemistry and tritium database for the Project.	Extraction Plans / Management Plans	✓
8	*Groundwater models should:* *i. continue to be updated*	Groundwater Impacts	i. The groundwater model developed for the Project is an extension of previous groundwater models developed for the Dendrobium Mine, and builds on previous groundwater modelling efforts over the last decade in the development of best practice modelling methods (as acknowledged by the IEP Part 1 Report).	Project EIS / Extraction Plans	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
	ii. be migrated from Modflow-Surfact to Modflow-USG only if significant benefits can be demonstrated		ii. The groundwater model for the Project has been developed using MODFLOW-USG software. Additional model techniques, such as localised 2D models, may be used to inform Extraction Plans for the Project where the benefits of these alternatives can be demonstrated.	Project EIS / Extraction Plans	✓
	iii. be underpinned by unified material properties (for common stratigraphic layers) unless differences can be demonstrated to exist through measurements.		iii. Material properties in the EIS model are based on an extensive database of measured material properties that is comprised of site-specific data (i.e. Dendrobium Mine), as well as data from other mining operations in the Southern Coalfield (e.g. Bulli Seam Operations and Tahmoor Mines) (particularly horizontal and vertical hydraulic conductivity [Kh and Kv]). This includes measurements for changes to hydraulic conductivity due to mine subsidence, of which the best available data is from the Dendrobium Mine. A description of data used in the groundwater model is provided in Section 6.13 of the Submissions Report.	Project EIS / Extraction Plans	✓
9	*Government should verify that sufficient entitlements are retained by Dendrobium and Metropolitan mines to cover surface water losses resulting from mining-induced effects.*	Groundwater Impacts	• This recommendation is addressed to the Government.	N/A	N/A
10	*Mine owners be required to produce robust, independent peer reviews and/or a demonstrated history of the reliability of mine design procedures and methodologies that underpin important aspects of mining approvals.*	Groundwater Impacts	• For the Project, the Groundwater Assessment and Surface Water Assessment have been peer reviewed by Dr Frans Kalf and Emeritus Professor Thomas McMahon, respectively (refer to Attachment 5 of the EIS). • During the Project assessment phase, the mine design and associated assessments would be reviewed by Government specialists and independent experts. • Secondary approval applications (i.e. Extraction Plans) would be supported by specialist studies to demonstrate mine design achieves approved performance measures.	Project EIS / Extraction Plans	✓
11	*Mine owners wishing to extract coal within the Special Areas be required to support applications with robust, independently facilitated risk assessments that conform to ISO 31000 (2009b), the international standard for risk management to which Australia subscribes.*	Groundwater Impacts	• The Project has considered the risks associated with the potential environmental issues identified in accordance with the frameworks detailed in Australian/New Zealand Standard (AS/NZ) *International Standards Principles and Guidelines (ISO) 31000:2009 Risk Management – Guideline* as described in the Environmental Risk Assessment for the Project EIS (Appendix M of the EIS). • Secondary approval processes (e.g. Extraction Plans) would also include risk assessment conducted in accordance with ISO 31000.	Project EIS / Extraction Plans	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
12	*The Department should continue to exercise its powers to attach conditions of approval to Subsidence Management Plans for Dendrobium Mine and Extraction Plans for Metropolitan Mine to cause appropriate, timely and ongoing monitoring and responses to monitoring outcomes, consistent with the recommendations of the PSM study.*	Groundwater Impacts	• This recommendation is addressed to the Government.	N/A	N/A
13	*In the longer-term, arrangements should be made to ensure that government has access to appropriate and independent expert advice when assessing mining proposals and performance outcomes.*	Groundwater Impacts	• This recommendation is not addressed to South32.	N/A	N/A
14	*In future, surface water monitoring requirements should include:* *i. a distinction between primary watercourse monitoring sites, which are the sites at which performance measures are specified; and secondary watercourse monitoring sites, which will provide additional information identified as necessary as the mine plan evolves*	Surface Water Impacts	i. This recommendation is consistent with existing SMP and Environmental Management Plan processes at the Dendrobium Mine, with surface water monitoring sites with performance measures and TARPs included in the existing *Dendrobium Area 3B Watercourse Impact Monitoring, Management and Contingency Plan* (WIMMCP). This detail for the Project (i.e. primary and secondary watercourse monitoring sites) would be identified in Extraction Plans.	Extraction Plans / Management Plans / Conditions of Consent	✓
	ii. a specification of the minimum flow measurement accuracy required at the primary and secondary sites		ii. The Project Surface Water Assessment (Appendix C of the EIS) included specification of recommended flow resolution and accuracy for flow monitoring sites to be adopted for the Project. This detail would be identified in Extraction Plans for the Project.	Extraction Plans / Management Plans	✓
	iii. the identification of the primary sites in proposed future mining areas and the installation of flow monitoring at these sites at least four years in advance of mining activities		iii. This detail for the Project (i.e. identification of primary watercourse monitoring sites) would be reported in Extraction Plans for the Project. All currently installed Area 5 and Area 6 surface flow monitoring sites would have at least 4 years of baseline data prior to any proposed mining (refer to Figure 6-3C of this Submissions Report).	Extraction Plans / Management Plans	✓
	iv. the identification of the secondary sites as the mine plan evolves and the installation of flow monitoring at these sites at least two years in advance of mining activities or a shorter time if approved as part of the mine plan approval		iv. This detail for the Project (i.e. identification of secondary watercourse monitoring sites) would be identified in Extraction Plans for the Project.	Extraction Plans / Management Plans	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
	v. paired piezometers in swamp sediments and nearby bedrock, and flow gauges at the swamp exit stream, at minimum for representative large valley infill swamps, and complemented by soil moisture sensors at selected sites		v. This monitoring is in place for key swamps within the current mining area and all swamps in Area 5 and Area 6 and is specified in the Project Surface Water Assessment (refer to Table 20 of Appendix C of the EIS).	Extraction Plans / Management Plans	✓
	vi. consistent use of inter-site comparisons using suitable control sites to complement rainfall-runoff modelling.		vi. Area 5 and Area 6, and current mining Area 3B have inter-site comparisons available and use monitoring data from existing control sites.	Extraction Plans / Management Plans	✓
15	*Surface flow monitoring associated with mining should be required to be continued until the consequences of mining (including any rehabilitation) have stabilised and/or the mine is considered by the relevant regulatory authorities to have been rehabilitated. This requires clear metrics of stabilisation.*	Surface Water Impacts	• This recommendation is consistent with existing processes at the Dendrobium Mine and there are no current plans to discontinue monitoring at primary surface water flow sites. • Metrics for stabilisation of surface flow (i.e. baseline conditions) would be specified in the Extraction Plans for the Project.	Extraction Plans / Management Plans	✓
16	*To ensure confidence in the accuracy and validation of surface water models and conclusions and to support transparency in decision-making:* *i. a statement is provided on all relevant modelling assumptions and which good practice guides have been followed and how they have been followed, with justification of any departures from good practice* *ii. updated peer reviews of rainfall-runoff modelling and reporting be undertaken by suitable independent experts and published*	Surface Water Impacts	• Modelling methodology and guidelines adopted are described in the Surface Water Assessment for the Project (Appendix C of the EIS), which was independently peer reviewed for the Project.	Project EIS	✓
17	*Monitoring requirements at the Dendrobium Mine should include:* *i. an assessment of flow monitoring procedures, their accuracy and implications for confidence in compliance is undertaken by a suitable independent expert and published*	Surface Water Impacts	These recommendations relate to monitoring for the Dendrobium Mine, with the intent of the recommendation applicable to monitoring for the Project, the details for which would be described in Extraction Plans for the Project. i. As described in 14(ii), the Project Surface Water Assessment (Appendix C of the EIS) included specification of recommended flow resolution and accuracy for flow monitoring sites. This detail would also be reported in Extraction Plans for the Project and would be supported by independent peer review.	Extraction Plans / Management Plans	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
	ii. installation of weirs and/or flumes at selected sites agreed by WaterNSW and the Dendrobium Mine, having regard to the observations made in this report. The selection of sites should consider the benefits in terms of assessing compliance within the remainder of the Area 3B operations and include at least one site representing the catchments draining to Lake Avon potentially affected by LW 16 to LW 18. The mine is currently in process of installing new weirs and/or flumes		ii. As described in the IEP report, South32 is currently in the process of installing new weirs/flumes. Similar methods would also be adopted for the Project and described in Extraction Plans and Environmental Management Plans accordingly.	Extraction Plans / Management Plans	✓
	iii. publishing of rating curve data (including the manually gauged reference data) and photographs of flow gauges, so that accuracy can be judged when interpreting performance reports		iii. South32 would provide this data upon request to the Department.	Extraction Plans / Management Plans	✓
	iv. additional basal shear monitoring, implemented as a priority between the Avon Dam and LW 14 to 18 before mining commences. The sites should be designed to complement the construction and monitoring strategy (geotechnical and groundwater) used at sites S2313 and S2314.		iv. Basal shear monitoring is in place between the Avon Dam and Longwalls 14 to 18. Although this specific recommendation is not relevant to the Project, similar monitoring would be installed for the Project.	N/A	N/A
18	*Metropolitan Mine should be required to provide a detailed report about how conclusions of 'no consequences' have been reached using the observed and modelled flow data*	Surface Water Impacts	• This recommendation is not relevant to the Project, however, South32 supports the conditioning of clear levels of acceptability via achievable performance measures that reflect predicted effects of mining.	N/A	N/A
19	*In the future:* *i. In setting performance measures, government should have regard for those measures relevant to strategic resources (such as flow to storage) and sanctions which rapidly prevent escalation of impacts and consequences if there are exceedances, clearly linked to monitoring results. Consent conditions should clearly specify the acceptable levels of impacts and consequences on catchment resources, and that assessment of these should continue at strategic locations beyond the life of mine*	Surface Water Impacts	i. This recommendation is addressed to the Government.	N/A	N/A

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
	ii. TARP triggers should be based on meaningful surface water loss indicators developed in consultation with relevant agencies with oversight and regulatory responsibilities for mining *iii. TARPs should be related to the desired outcomes (such as maintenance of water flows) and be consistent both within and between mine domains. TARP triggers for surface and groundwater should be based on meaningful flow loss indicators developed in consultation with relevant agencies and authorities with oversight and regulatory responsibilities for mining* *iv. In situations where performance measures of negligible or minor environmental consequences are set by government, mine planning should incorporate appropriate factors of safety to avoid marginal situations associated with gaps in the current knowledge base*		ii-iv. TARPs for the Project would be developed as part of the Extraction Plan process, in consideration of approved performance measures. Surface water flow TARPs for the Dendrobium Mine have been recently reviewed in light of improvements to stream gauging and past experience of implementing TARPs. These outcomes would be incorporated into TARPs developed for the Project, where relevant, in consultation with relevant stakeholders.	Extraction Plans / Management Plans / Conditions of Consent	✓
	v. Consideration should be given to whether a performance measure of 'minimal iron staining' over a specified length of a watercourse is practically achievable if mining that results in iron staining is approved upstream of that designated area.		v. South32 agrees that performance measures should reflect achievable outcomes based on predicted and approved effects associated with the Project.	Conditions of Consent	✓
20	*Reservoir water balance models need to be developed that should include drought periods and results for these periods should be highlighted.*	Catchment, Groundwater and Reservoir Water Balances	It is understood this recommendation is directed at WaterNSW.	N/A	N/A
IEP Part 2 Report					
21	*The concept of subsidence effects, subsidence impacts and subsidence consequences should continue to be embedded in mining assessment processes*	Subsidence effects, impacts and consequences on water supply	• This recommendation is consistent with the assessment presented in the Project EIS.	Project EIS	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
22	*There is a need for a higher focus on the assessment of regional impacts and consequences associated with groundwater depressurisation, including if and how far these impacts and consequences might extend beyond the mining footprint.*	Subsidence effects, impacts and consequences on water supply	• The Groundwater Assessment for the Project (Appendix B of the EIS) has considered the potential impacts for sensitive receivers located outside of the underground mining areas (e.g. at groundwater bores and reservoirs), with the groundwater model domain for the Project extending beyond the footprint of the Project underground mining areas, some 10 to 15 km from the edge of these areas. • The model extent was also refined to incorporate sensitive receivers within this domain, such as reservoirs, along watercourses, upland swamps and registered groundwater bores, as well as historic stresses to the groundwater system from other mines proximal to the Project (refer to Section 6.3 of the Submissions Report).	Project EIS	✓
23	*Research is required into:* • *quantifying the height of complete drainage above mine workings* • *the reliability of geomechanical modelling of rock fracturing and fluid flow for informing the calibration of groundwater models and, thus, also replacing the use of the Tammetta and/or Ditton equations* • *establishing the potential for regional movement on bedding planes and the potential consequences that this may have, especially in the vicinity of water storages.*	Subsidence effects, impacts and consequences on water supply	• Data from piezometers would continue be used to develop site-specific information about the height of free drainage above longwall panels mined. • South32 has undertaken geomechanical investigations and modelling to complement groundwater pressure data, the outcomes of which are considered in the Project groundwater model. • Similarly, basal shear monitoring is in place between the Avon Dam and Longwalls 14 to 18. Post-mining horizontal hydraulic conductivities for strata between Longwalls 14 and 15 have been considered in the Project groundwater model (i.e. to reflect any change that may have occurred as result of basal plane movement). • The details of ongoing investigations (including any changes in hydraulic properties associated with bedding plane movements, in particular between Area 5 and Avon Dam) would be detailed in Extraction Plans and other Environmental Management Plans for the Project.	Project EIS / Extraction Plans / Management Plans / End of Panel Reports	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
24	*Management plans need to make provision for the early detection and control of the elevated risk that variance between predicted and measured subsidence effects, both conventional and non-conventional, when mining in areas sensitive to subsidence impacts, such as the Greater Sydney Water Catchment. This is especially the case when utilising longwall mining since the method is inflexible to immediate changes in mine layout to address of deviations from predictions.*	Subsidence effects, impacts and consequences on water supply	• As described in the Project EIS, the IPM model has shown that subsidence movements observed at Dendrobium Mine are typically less than the subsidence predictions, and the model provides reasonable, if not, conservative predictions of the conventional and non-conventional subsidence effects. The subsidence predictions for the Project are less than the maximum predicted at Area 3A and Area 3B at the Dendrobium Mine (refer to Section 6.5 of the Submissions Report). • This recommendation is consistent with the existing SMP and Environmental Management Plan processes at the Dendrobium Mine, where TARPs are used to provide for the early detection and control of impacts if they are approaching performance measures, and this would be incorporated into Extraction Plans for the Project.	Extraction Plans	✓
25	*Impact assessments for watercourses should consider not only rockbars and the pools behind them, but all features along the full lengths of watercourses.*	Subsidence effects, impacts and consequences on water supply	• This recommendation is consistent with South32's current approach at the Dendrobium Mine, as well as for the Project. • As described in the EIS, South32 has conducted stream mapping along watercourses to identify significant stream features, which include not only rockbars and pools but also waterfalls/steps along named watercourses and tributaries. Key features identified in the Project underground mining areas have been setback from the longwalls to reduce potential subsidence impacts (refer to Section 6.5 of the Submissions Report).	Project EIS / Extraction Plans	✓
26	*The Department should review the practicality of specifying water quality and iron staining as components of performance measure for only a proportion (or percentage) of the length of a watercourse.*	Subsidence effects, impacts and consequences on water supply	• As per South32 response to 19(v), however, note this recommendation is addressed to the Government.	N/A	N/A
27	*All future mine approvals should include performance measures that are objective and can more precisely determine the cumulative impacts and consequences of a mine project progression. Performance measures should include changes in pressure and/or pressure gradients where these have the potential to impact on surface water losses.*	Groundwater and surface water	• As per 24, South32 agrees that achievable performance measures should be specified, and that could be used as part of TARPs to provide for the early detection and control of impacts if they are approaching performance measures. • The Project would use groundwater pressure/level and surface water flow TARPs to confirm performance measures relating to surface water. These would be outlined in the Extraction Plans and Environmental Management Plans for the Project. • TARPs and relevant performance measures/indicators would build on previous experience at the Dendrobium Mine as well as incorporate the considerations of the IEP.	Extraction Plans / Management Plans / Conditions of Consent	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
28	*When consent conditions make provision for meeting the requirements of performance measures by avoidance, mitigation or remediation, they need to be quite specific about the scope of attributes that have to be avoided, mitigated or remediated and the verification standards that avoidance, mitigation and remediation measures have to satisfy.*	Groundwater and surface water	• This recommendation is addressed to the Government.	N/A	N/A
29	*TARP triggers for surface and groundwater should be based on meaningful indicators developed in consultation with relevant agencies and authorities with oversight and regulatory responsibilities for mining*	Groundwater and surface water	• This is consistent with the Extraction Plan process, where TARPs for the Project would be developed in consultation with relevant stakeholders.	Extraction Plans / Management Plans	✓
30	*Uncertainty analysis of groundwater and surface water models should follow the uncertainty analysis workflow recommended by the IESC.*	Groundwater and surface water	• The Project Groundwater Assessment (Appendix B of the EIS) considered the *Update to IESC Information Guidelines* (IESC, 2018) and *Draft Explanatory Note on Uncertainty* (Middlemis and Peeters, 2018) in the development of the uncertainty analysis.	Project EIS	✓
31	*Independent expert peer review should become a more regular part of the groundwater and surface water model assessment process*	Groundwater and surface water	• This recommendation is consistent with South32's current approach, with the Groundwater Assessment and Surface Water Assessment for the Project EIS independently peer reviewed (Attachment 5 of the EIS).	Project EIS	✓
32	*WaterNSW should continue its program of work towards determining the significance for the Greater Sydney water supply of different thresholds of surface water loss due to mining.*	Groundwater and surface water	• This recommendation is addressed to WaterNSW.	N/A	N/A
33	*An inter-agency working group should be set up with the task of identifying acceptable levels of surface water loss due to mining.*	Groundwater and surface water	• While there would be overlap with the EIS assessment process, South32 would support the implementation of such a working group, subject to the terms of reference of any such group and requiring consideration of the objects of the NSW *Environmental Planning and Assessment Act, 1979* (i.e. the consideration of both socio-economic benefits and potential impacts).	N/A	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
34	*A precautionary approach to mine design in the Special Areas should be taken that does not assume groundwater model outputs are accurate. Predictions of water losses should be conservatively high to allow for prediction uncertainty and where practicable the associated non-exceedance probability should be stated.*	Groundwater and surface water	• This approach is consistent with the approach adopted in the Project Groundwater Assessment (Appendix C of the EIS), which adopts conservative modelling assumptions. The conservative nature of these assumptions is supported by observed effects (e.g. the overprediction of historic mine inflows to Area 3 by approximately 20% by the Project groundwater model). Details of the conservative assumptions adopted in the groundwater model are described in Section 6.3 of the Submissions Report. • On the basis of the conservative assumptions adopted, the risk of actual impacts to surface water losses being significantly greater than those predicted from the groundwater model can be considered low.	Project EIS	✓
35	*Additional flow gauges and improvements to existing flow gauges should continue to be undertaken selectively by mining companies in consultation with WaterNSW, or by WaterNSW (with potential financing from the companies) including aiming for at least 4 years of baseline flow data at sites that are important for quantifying water supplies including future performance measure sites and control sites.*	Groundwater and surface water	• South32 maintains an extensive surface water monitoring network, including stream flow monitoring of a number of ephemeral drainage lines proximal to Area 5 and Area 6 (refer to Figure 6-3C of the Submissions Report). Consistent with the recommendations of the Surface Water Assessment for the Project (Appendix C of the EIS), the existing Area 5 and Area 6 surface water monitoring networks would be expanded and augmented for the Project, the details of which would be provided in Extraction Plans for the Project. • South32 would continue to engage with WaterNSW regarding flow gauge upgrades and (if as a result it is determined) would implement actions that are identified as being required during the Extraction Plan stage of the Project. • All currently installed Area 5 and Area 6 surface flow monitoring sites would have at least 4 years of baseline data prior to any proposed mining.	Extraction Plans	✓
36	*Monitoring of contaminant concentrations should be integrated with flow monitoring at operational mines to support calculation of contaminant loads at the main inputs to reservoirs and other key locations and to improve understanding of future contaminant loading risks. Relevant contaminants should be agreed between primary stakeholders.*	Groundwater and surface water	• The existing water quality monitoring network for Area 5 and Area 6 in the Metropolitan Special Area would be continued and expanded for the Project, and would be outlined in Extraction Plans and Environmental Management Plans. This would include monitoring of key contaminants and stream flow monitoring, developed in consultation with relevant stakeholders and consistent with the recommendations of the Surface Water Assessment (Appendix C of the EIS).	Extraction Plans / Management Plans	✓
37	*Government should ensure that sufficient water entitlements are retained by mines operating in the Special Areas to cover surface water losses resulting from mining-induced effects.*	Groundwater and surface water	• This recommendation is addressed to the Government, as per 9.	N/A	N/A

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
38	*Future swamp monitoring and modelling programs should be designed to:* • *provide a hydrological balance for representative swamps, sufficient to identify any mining-induced changes in soil moisture and in baseflow down the exit stream; and to provide vertical leakage rates as inputs to groundwater models, in order to quantify how much of the leakage is diverted back into the catchment or elsewhere.* • *link any changes in swamp vegetation to changes in water table position, soil moisture content and soil organic carbon content.* • *identify the presence of and any changes in obligate swamp fauna such as the giant dragonfly (Petalura gigantea).*	Swamps	• The Surface Water Assessment for the Project (Appendix C of the EIS) based swamp modelling on measured data for swamp water levels, soil moisture data, anticipated changes in vertical leakage due to fracturing of the base of the swamp and potential changes in slope due to subsidence-related tilts. • Monitoring of swamp water levels, soil moisture and vegetation composition would be conducted for the Project, as is conducted for the Dendrobium Mine. • The EIS included the results of swamp fauna monitoring and this would continue for the Project (i.e. noting access restrictions to the Metropolitan Special Area, particularly following rainfall, which may be opportune survey timing for key species). • Additional swamp monitoring developed for the Project would be detailed in Extraction Plans and Environmental Management Plans.	Project EIS (modelling) / Extraction Plans (monitoring) / Management Plans	✓
39	*Government organisations, especially WaterNSW, should support and/or carry out independent research (possibly on a cost recovery basis from the mining sector) to provide regional information on swamp hydrology and ecology. In particular, continuation of monitoring at sites where there is a substantial basis of data should be a priority.*	Swamps	• This recommendation is addressed to the Government/agencies.	N/A	N/A
40	*Annual performance reports, end-of-panel reports and reports on studies required by development consent conditions, should:* a. *integrate hydrological and ecological impact and consequence assessments* b. *include discussion of the inter-related changes in hydrological and ecological consequences for swamps, rather than having only discrete chapters on each* c. *include results for the entire period of monitoring, rather than just the previous year, that should be assessed, not only for the current mining area but for previous mining domains.*	Swamps	• This recommendation to integrate various data and assessment approaches is consistent with the approach undertaken to assess potential impacts for swamps in Area 5 and Area 6 for the Project, which integrated hydrological, hydrogeologic and ecological data (including from previously undermined swamps) with groundwater and surface water modelling. • Similarly, predicted hydrological changes in swamps and ecological consequences are combined in a single, integrated section of the EIS (refer to Section 6.8 of the EIS Main Text). • Annual / End of Panel Reports for the Project would continue to integrate these findings when considering impacts to swamps.	Project EIS / Conditions of Consent / End of Panel Reports	✓
41	*The concept of Reverse Onus of Proof should be discarded.*	Additional matters (reverse onus of proof)	• South32 agrees with this recommendation.	N/A	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
42	*Environmental data from mine companies should be housed in a centralised data portal, such as the SEED portal, prioritised according to its value in assessing cumulative impacts of concern.*	Additional matters (cumulative impacts)	• South32 makes environmental data from its operations available to agencies on request and is reported as required. • It is considered this recommendation is directed at the NSW Government (practicality of database, servers, privacy etc).	N/A	N/A
43	*Remediation should not be relied upon for features, including watercourses and swamps, that are highly significant or of special significance (as per the guidance provided by the Planning Assessment Commission Panels for the Metropolitan Coal Project and the Bulli Seam Operations Project).*	Additional matters (remediation)	• South32 has adopted setbacks in the mine design to reduce the potential for subsidence impacts to significant features (e.g. setbacks from the dam walls, named watercourses and key stream features) rather than rely on remediation to protect these features (refer to Section 6.5 of the Submissions Report). • Similarly, South32 has provided offsets for potential residual impacts to swamps for the Project, as is government policy, rather than rely on remediation/rehabilitation. • Remediation would be undertaken for named streams and key stream features only if physical damage were to occur due to the Project as a result of subsidence impacts. Remediation techniques would then be implemented where possible to repair the damage where monitoring indicates that subsidence-related impacts have occurred as a result of the Project. • These measures, and triggers for their implementation, would be outlined in the Extraction Plans and Environmental Management Plans developed for the Project.	Extraction Plans / Management Plans	✓
44	*There is a need to update provisions for offsetting water loss from the catchment resulting from all mining operations.*	Additional matters (offsets)	• This recommendation is consistent with the condition of the Longwall 17 SMP Approval which specifies requirements for South32 to provide suitable offsets for predicted surface water loss from the catchment for that longwall. • Consistent with this existing condition, the Project would also provide offsets for the predicted surface water take, including beneficial use of mine water and payment to WaterNSW for the predicted take for the Project. The aim of this is that the Project would result in a net neutral or net beneficial effect to Sydney's drinking water supplies from subsidence-related surface water losses from the Metropolitan Special Area.	Project EIS / Extraction Plans / Conditions of Consent	✓
45	*Provisions for offsetting impacts on water quantity and water quality associated with mining operations in the catchment need to give careful consideration to long term impacts, post-mine closure.*	Additional matters (offsets)	• South32's preferred methods for offsetting predicted surface water losses (e.g. mine water treatment and use) could continue to provide water supply post-mining. • The implementation of ongoing offsets following the end of the Project mine life would be subject to future discussion with relevant stakeholders closer to mine closure.	Management Plans / Mine Closure Plan	✓

Table A3-1 (Continued)
Responses to IEP Recommendations in Relation to the Project

No.	Recommendation	Category	Response/Comment in Relation to the Project	Relevant Phase of Project	South32 Agreement with Intent of Recommendation
46	*Mine planning today needs to take into account impacts that may arise in the long term, post-mine closure*	Additional matters (offsets)	• Potential long-term impacts of the Project have been considered, including groundwater impacts (i.e. the Groundwater Assessment for the Project EIS has predicted potential water loss from proposed and known mine workings, including in the long-term). • The SEARs for the Project included the requirements to consider "*the measures which would be put in place for the long term protection and management of the site and any biodiversity offset areas following the cessation of mining.*' In the long-term, all sites would be rehabilitated to a safe, stable and sustainable landform of a similar character to surrounding areas. • Potential mitigation, management and rehabilitation measures post-closure for the Project would be undertaken in accordance with the Mine Closure Plan developed for the Project. This would be developed in accordance with any development consent issued for the Project and in consultation with relevant stakeholders.	Project EIS / Management Plans / Mine Closure Plan	✓
47	*A study be undertaken to better understand and quantify the potential impacts of historic and current mining for long-term cumulative impacts on water quantity and quality in the Greater Sydney Water Catchment, for the purpose of properly informing mine design, mine rehabilitation and closure planning, planning assessments, offsets and rehabilitation bonds.*	Additional matters (rehabilitation and mine closure planning)			
48	*SEARs and any conditions of consent should include a focus on the long term implications of mining proposals for rehabilitation and mine closure planning.*				
49	*Impact assessments associated with proposals for mining in the Special Areas need to include detailed consideration of rehabilitation and mine closure planning that extends beyond management of the landscape.*				
50	*Government needs to establish a sustainable mechanism for accessing objective and timely expert advice when assessing mining applications and performance outcomes and this mechanism needs to be supported by probity guidelines that have regard to experts having worked in the mining industry in order to gain their expertise.*	Additional matters (Government access to expertise)	• This recommendation is addressed to the Government.	N/A	N/A